SB
74
DOCUMENTS
FOR
(FILE 2)

B

MARIJUANA AND STATE PRISONERS

I. Alaska Prison Inmates Have High Rates Of Marijuana Use And Abuse.

- 23% of Alaskan prisoners in a recent survey had a marijuana disorder they needed treatment for during the past year when they were not incarcerated. *See, State of Alaska, Department of Health and Social Services, Division of Alcoholism and Drug Abuse, Substance Abuse Treatment Needs of Alaska's Newly Incarcerated Prisoner Population Prior to Incarceration, Executive Summary, p.viii.*
- These prisoners are committing crimes other than drug offenses. (Only 6.1% of inmates surveyed in 1999 had a controlled substance charge as the primary charge) *Alaska Justice Forum, Vol. 17, No. 1.*
- Marijuana was the most commonly used drug of the Alaskan prisoners. (93%) This figure is 16% higher than found in a 1997 national survey of state inmates. *State Survey cited above, at p. 37, Table 9.*
- 49% of Alaskan prisoners surveyed had used marijuana in the month prior to incarceration and 20% reported using marijuana on a daily basis during the year prior to incarceration. *State Survey cited above, at p. 39, Table 10.*
- 22% of the prisoners self-reported having been dependent on, or having a problem with marijuana. *Id. at p. 41.* 38% have had a marijuana disorder

within their lifetime. *State Survey cited above, at p.42, Table 11.*

MARIJUANA AND STATE PRISONERS

I. <u>Alaska Prison Inmates Have High Rates Of Marijuana Use And Abuse.</u>

- 23% of Alaskan prisoners in a recent survey had a marijuana disorder they needed treatment for during the past year when they were not incarcerated. *See, State of Alaska, Department of Health and Social Services, Division of Alcoholism and Drug Abuse, Substance Abuse Treatment Needs of Alaska's Newly Incarcerated Prisoner Population Prior to Incarceration, Executive Summary, p.viii.*
- These prisoners are committing crimes other than drug offenses. (Only 6.1% of inmates surveyed in 1999 had a controlled substance charge as the primary charge) *Alaska Justice Forum, Vol. 17, No. 1,*
- Marijuana was the most commonly used drug of the Alaskan prisoners. (93%) This figure is 16% higher than found in a 1997 national survey of state inmates. *State Survey cited above, at p.37, Table 9.*
- 49% of Alaskan prisoners surveyed had used marijuana in the month prior to incarceration and 20% reported using marijuana on a daily basis during the year prior to incarceration. *State Survey cited above, at p. 39, Table 10.*
- 22% of the prisoners self-reported having been dependent on, or having a problem with marijuana. *Id. at p. 41.* 38% have had a marijuana disorder

within their lifetime. *State Survey cited above, at p.42, Table 11.*

State of Alaska
Department of Health and Social Services
Division of Alcoholism and Drug Abuse

Substance Abuse Treatment Needs of Alaska's Newly Incarcerated Prisoner Population Prior to Incarceration:

Final Report

William E. McAuliffe
Richard LaBrie
Eric Sevigny
Ryan Woodworth
Jaime Mellitt
Timothy Stablein

North Charles Research and Planning Group
North Charles, Inc.
875 Massachusetts Avenue
Cambridge, MA 02139
December 26, 2001

Substance Abuse Treatment Needs of Alaska's Newly Incarcerated Prisoner Population Prior to Incarceration:

Final Report

CSAT CONTRACT # 270-98-7058

Table of Contents

ACKNOWLEDGMENTS

North Charles Research and Planning Group extends our thanks to the individuals and institutions whose support has assisted our work: Alaska Department of Corrections, Sarah Williams, Gary Webster, Ken Braz, Dr. P.A. Crandell; Hiland Mountain Correctional Center, Bruce Ronchetti, Samuel Edwards, Sergeant Mark Oakley; Palmer Correctional Center, Sergeant Noel Gast, Terry McCarron, John Atwell, Janet Afcan, Dianne Wilson, Darcy King; Wildwood Correctional Center, Dale Long, George Miller, Sergeant Richard Sitbon, Gary Kanuk, Joseph Tuckfield, Alfred Allen, and Ryan Clapsaddle. We wish to thank Clay McDowall for his continuing support, understanding, patience, and encouragement during the study. This study was supported by a contract from the State Treatment Needs Assessment Program of the Center for Substance Abuse Treatment (CSAT) to the State of Alaska.

The authors wish to acknowledge the contributions of the following former North Charles staff members: Stephen Haddad, Kimberly Dahl, and Jocelyn Leary.

EXECUTIVE SUMMARY

This report describes the results of an interview survey of Alaska's newly incarcerated prison inmates to determine their substance use disorder treatment service needs in the last year prior to incarceration. North Charles Research and Planning Group (NCRPG) conducted the study under contract with the Division of Alcoholism and Drug Abuse of the Alaska Department of Health and Social Services. The study is one of a family of studies that the State is conducting as part of the Center for Substance Abuse Treatment's State Treatment Needs Assessment Project. Designed to yield a comprehensive estimate of the need for treatment services in the state during the past year, the family of studies includes a social indicator study, a telephone survey of the general household population, and interview surveys of high-risk populations that would be missed by the household survey, including a face-to-face survey of arrestees and the present telephone survey of newly incarcerated people. The primary object of the present study is to estimate the amount of unmet need for Block Grant and state-funded treatment services during the past year represented by these subjects prior to their entering prison. This estimate is needed as a supplement to the telephone survey estimate of need. The study also provides the prison system with an objective measure of the number of entering inmates in need of prison-based substance abuse treatment services.

Methods

With the assistance of officials and staff of the Alaska Department of Corrections, NCRPG's research team surveyed a sample of prisoners by telephone using a specially-designed needs assessment questionnaire. The computerized instrument measured clinical criteria for assessing abuse and dependence on alcohol and controlled drugs. It also obtained a history of substance use and treatment utilization prior to incarceration. All subjects volunteered, gave informed written consent, and received $10 for participation. The study oversampled females in order to have enough cases for analysis, and the analysis reweighted the sample totals in order to obtain results representative of the number of female prisoners in the State.

Results

Between July 11 and October 13, 2000, the study team completed 208 interviews with Alaskan adult residents who entered state correctional facilities during the past year. At a minimum, the inmates had at least one month during the last year when they were not incarcerated. The female respondents (n=40) came from the Hiland Mountain Correctional Center, while the 168 male respondents came from the Palmer Correctional Center's Minimum Security unit (n=85) and the Wildwood Correctional Center (n=83). The study interviewed all eligible inmates at the prisons who were willing to participate. The study achieved a 77% response rate, with a range from 74% to 84% at the three facilities. Respondents understood and responded fully to the study's questions. The interviews averaged one hour in length. Measures built into the study design indicated that the data were high in quality.

The interviewed prison inmates were primarily males (81% actual, 91% weighted), aged 35 years, and employed (72%) when not incarcerated. They had completed a median of 11 years of education. Thirty-nine percent of the subjects were Alaska Natives, 31% were white, and 16% were African Americans. The age and race/ethnicity statistics closely matched statistics for all inmates in the state's prison facilities, except that the female inmates at Hiland Mountain were less likely to be Alaska Natives and less likely to be employed just prior to incarceration. One in five inmates were homeless during the year before imprisonment. The prisoners in all three prisons had been incarcerated a median of four times. On average, the respondents had been on the outside for 5.6 months during the last year.

The Alaskan prisoners had extensive histories of alcohol use and nonmedical use of controlled drugs. All of the prisoners reported using alcohol, and 95% reported some experience using controlled drugs for nonmedical purposes. The comparable rate of lifetime controlled drug use in a 1977 national sample of state prisoners was 83%. The most commonly used drugs by the Alaskan inmates were marijuana (93%) and cocaine (76%). Nearly three of four (74%) Alaskan inmates admitted illegal drug use in the full year before they were incarcerated, and more than half (61%) of the respondents used an illegal drug in the month before entering prison. Forty percent used cocaine in the past 12 months, and over a quarter (27%) reported cocaine use in the 30 days prior to incarceration.

Nine out of ten prisoners (91%) had a substance use disorder at some time in their lives. Although the order of magnitude is consistent with previous studies, this rate is as high or higher than any rates previously reported in the scientific literature since standardized diagnostic studies of prisoners commenced two decades ago. Four out of five recently incarcerated Alaskan inmates have had an alcohol use disorder, and two out of five have had a cocaine use disorder. The males at Palmer Minimum and Wildwood were more likely to have had alcohol use disorders, while the females at Hiland Mt. were more likely to have had a cocaine use disorder. Males were also more likely than females to have abused hallucinogens. With the exception of hallucinogens and sedative use disorders, most of the subjects with a substance use disorder met criteria for dependence rather than abuse.

Seventy-nine percent (79%) of the Alaskan prisoners had a substance use disorder during the past year when they are not incarcerated and therefore needed treatment on the outside during the past 12 months. This rate of past year substance use disorders was among the highest rates found in other prisoner studies to date, and these results are consistent with Alaska's ranking as third highest in the country with regard to its substance abuse treatment needs in the general population. Sixty-seven percent (67%) of the Alaskan prisoners had an alcohol use disorder in the last year when not in prison during the past year, and 43% had a drug use disorder in the last year when on the outside. Cocaine and marijuana use disorders were the most common causes of the drug use disorders (28% and 23% respectively). The remaining drugs accounted for a much smaller part of the drug use disorders.

There was no difference between Alaskan male and female prisoners in the rate with which they needed treatment during the last year, but Alaska Natives were more likely to have needed treatment (88%) than were Whites or African Americans (76% and 74% respectively). Virtually every Native Alaskan prisoner (97%) had a history of having a substance use disorder.

Most of the prisoners had received treatment for substance use disorders in the past when not incarcerated. Seventy-nine percent (79%) had received some form of substance abuse treatment (specialty, self help, or nonspecialty) during their lives. While the largest percentage (42%) of these prisoners had received treatment once or twice in the past, 25% of the total sample had received treatment three or more times. In most cases (63% of the total sample), the prisoners had received specialty treatment as well as self help or nonspecialty treatment for their alcohol or controlled drug problems. During the past year, 53% of the prisoners received treatment for substance use disorder before they entered prison. There was no difference between the prison samples in this regard.

A proportion of these subjects had unmet need for treatment services prior to incarceration. Of the Alaskan prisoners who had a lifetime substance use disorder, 18% never received treatment of any kind. Of the subjects who had a substance use disorder in the last year, slightly more than half (57% or 45% of the sample of 208) received substance abuse treatment of some type in the last year when they were on the outside. One third of the total sample of 208 needed treatment but did not receive it in the last year.

Some of the group that received treatment may have been underserved. Only half of the prisoners who needed and received some form of treatment (29% of those in need) received specialty treatment in the last year; the rest (28% of those in need) received services from nonspecialists or self help groups. Thus, about two out of three who were incarcerated in the past year and needed treatment when they were on the outside either had not obtained specialty treatment or any treatment at all, despite severe substance abuse problems. Outreach and increased availability of specialty services for persons with criminal histories is an attractive intervention strategy.

If the sample's percentage of unmet need generalized to the total population of Alaska's prisoners, 481 prisoners incarcerated at the time of the study needed, and 205 did not receive some form of treatment in the last year. Those figures should be added to the household survey estimate of the number who needed and who did not receive treatment.

There was also evidence of unmet demand for treatment in the prisoner sample that needed it. Of the subjects who received treatment in the last year, nearly half (49%) said that they would have wanted longer, more intensive, or additional services than they received if the services had been available. The interviewers asked the 69 subjects who needed treatment in the last year but had not obtained treatment if they would have sought treatment when on the outside if it had been available. Thirty-seven percent (37%) of the subjects responded affirmatively. Half of them said that they had taken concrete steps in an effort to obtain care, but were unsuccessful. In most cases, they called a program, asked knowledgeable people about the availability of care, or obtained a referral. Some were on waiting lists for treatment. Thus, greater availability of services might have reduced the consequences of the respondents' substance use disorders and in some cases perhaps might have prevented the crimes that brought these inmates into custody. If that percentage of prisoners in the state who needed and wanted treatment but did not receive it were generalized to the state prison system, there would be 293 prisoners in prison at the time of the survey who represented unmet demand for treatment in the past year and should be added to the similar figure obtained in the telephone survey.

The interview asked subjects what explained their failure to seek or obtain desired treatment. The most common reason was the absence of insurance or a way to pay for treatment. The prisoners were also concerned about red tape and hassles during the admissions process. A number of prisoners mentioned that the treatment programs were full, that the respondents lacked transportation, or that the programs were too far away.

Implications

The results showed that the prisoners had extensive histories of substance abuse and high levels of treatment need. Nine out of ten inmates had a history of clinical problems with alcohol or drugs. Eight of ten prisoners needed treatment in the past year. While the sample focused on only recently incarcerated prisoners, it is likely that these figures are also relevant for prisoners who have been in jail longer. Most of the prisoners who had a disorder have sought treatment in the past and wanted treatment when it was not available. These statistics suggest that treatment and relapse prevention services should be available for the vast majority of prisoners.

While many who are currently in need had received needed treatment on the outside, about a third of the prisoners were seriously ill substance abusers but were apparently falling through the cracks in the system. Of those who did receive treatment in the past year, half said that they would have sought more treatment if it had been available. Thus, the treatment needs of Alaska's prisoner population are great, and a substantial number of those who needed treatment in the past year would have sought more if it had been available.

The study showed that failing to estimate the treatment needs of state residents who were in custody would result in underestimation of the overall state need for treatment services, although the actual number was small when compared to the total state population. While the rate of need among prisoners is probably greater than any group besides clients in treatment, the number of recently incarcerated prisoners at any point in time is not very large. In Alaska, the estimated number was 610. Part of the explanation is that on any day many of persons who were incarcerated during a year have been discharged. As a result, their treatment needs are part of the estimate obtained from the household survey of the general population or in estimates of the needs of homeless people, people in households without telephones, and persons who have died of diseases related to their substance use disorders. Despite their relatively small size, this population is at extremely high risk of substance abuse, its medical complications, and committing crimes as a result of their continued dependence on alcohol and drugs. For the prison system, the proportion of prisoners in the course of a year who need treatment when they entered the prison is large. The failure of prisoners-to-be to obtain effective treatment is a significant concern for society at large.

INTRODUCTION

This report describes the results of an assessment of the substance-use-disorder treatment needs of recently incarcerated prison inmates to determine their treatment needs during the last year when they were on the outside. North Charles Research and Planning Group (NCRPG) conducted the study under contract with the Division of Alcoholism and Drug Abuse of the Alaska Department of Health and Social Services. The study is part of a family of studies that the State is conducting under contract with the Center for Substance Abuse Treatment (CSAT) as part of its State Treatment Needs Assessment Project. Alaska's family of studies includes a social indicator study, a telephone survey of the general household population, and interview surveys of high-risk populations that would be missed by the household survey (Johnson & Alaska Department of Health and Social Services, Division of Alcoholism and Drug Abuse 1998; The Gallup Organization 1998; Bhardwaj, Moore, et al. 1998). One of the high-risk studies, the present investigation was a telephone survey of newly incarcerated people.

Study Goals

The study's primary objective was to supplement Alaska's statewide estimate of treatment service needs outside of prison during the past year by assessing the needs of a high-risk population that Alaska's telephone survey of the general household population had missed Using the National Technical Center's (NTC) needs assessment questionnaire, Alaska previously obtained a statewide estimate of the number of people who needed substance abuse treatment by interviewing the population living in households with telephones. The present study will add to that statewide estimate of treatment need by estimating the number of persons who were on the outside and needed treatment during the past year but whom the household survey would have missed because they would have been incarcerated when the household survey was underway. Prisoners represent the largest and most high-risk institutionalized population who were missed by the household survey (McAuliffe et al. 1998).

The unmet treatment needs on the outside of people who are incarcerated may represent a useful gauge of the overall performance of the State's substance abuse treatment system. An especially troubling recent case illustrates this point. After a week-long binge, a mentally-ill young man with a severe alcohol dependence sought detoxification for three days running, but each day he was refused admission because the local detoxification unit had no beds available. Sent home from a hospital emergency room with inadequate medication to see him through the night, he began drinking heavily in the early morning. An argument over this relapse ended with his girlfriend's death by a kitchen knife. He is now serving 20 years for second-degree murder. Recently incarcerated persons who have substance use disorders, especially those who sought but were unable to obtain treatment and who committed substance-related property or violent crimes, may be valuable indicators of system failure. Information on this population can be used to justify requests to the legislature for more funds for the state's treatment system and can act as a baseline for evaluating the effects of improved system planning on the performance of the treatment system in the coming years.

Finally, although the study's focus was not on estimating the in-prison treatment needs of these prisoners, the statistics on lifetime and current need for treatment should be useful for prison officials evaluating the adequacy of their services for incoming inmates.

The Family-of-Studies Research Strategy

The rationale for the present study design is that it is part of a multimode approach to estimating the treatment needs of the State's population during the previous year, as recommended by the National Technical Center for Substance Abuse Needs Assessment (NTC) in its model family of studies (McAuliffe et al. 1995). The NTC recommended conducting a family of studies in which most of the population would be surveyed by telephone in their households about their treatment needs in the past year, while the remainder (approximately 5%) would ideally be assessed using the same instrument in surveys of specific high-risk, non-household populations. The remainder included people living in households without telephones, the homeless, and people who were institutionalized at the time of the telephone survey but who needed publicly-funded treatment during the past year. Because prisoners constitute the largest high-risk institutionalized population, Alaska conducted the present study.

Previous Studies of Substance Use Disorders Among Arrestees and Prisoners

The published scientific literature shows clearly that people who were incarcerated during the past year are likely to have been at high risk of needing substance abuse treatment prior to incarceration. There is a strong correlation between criminal behavior and substance use disorders (Green 1981; Chaiken and Chaiken 1982; Gropper 1985; Inciardi 1986; Rolph and Chaiken 1987; Chaiken and Johnson 1988; Visher 1990). Over the past 15 years, inmates with primary drug abuse offenses in Alaskan prison facilities have increased 2.4 times from 4.9% in 1985 to 6.1% of all prisoners in 1999 (Alaska Justice Statistical Analysis Unit and Justice Center 2000a, Table 2). In federal prisons, the percentage has increased even more dramatically, from 25% in 1980 to over 60% in 1997 (Alaska Justice Statistical Analysis Unit and Justice Center 2000a, Table 1; Mumola 1999, p. 1).

The National Institute of Justice's Drug Use Forecasting (DUF) program has found that most arrestees recently used one or more drugs (National Institute of Justice 1995). In a 1999 Arrestee Drug Abuse Monitoring (ADAM) study of Anchorage arrestees, 54% of males and 56% of females had a positive urine test indicating use of one or more drugs (Alaska Justice Statistical Analysis Unit and Justice Center 2000b).

CSAT has funded research which established that arrestees have high rates of substance use disorders and treatment need. The studies found that between one-third and two-thirds of all arrestees met clinical criteria for abuse or dependence on one or more substances (Blane et al. 1995; Cochran et al. 1996; Kroliczak et al. 1996; University of Alabama at Birmingham, Department of Psychiatry, Substance Abuse Programs 1996; Institute of Public Affairs, University of South Carolina 1997; Hudik et al. 1996; Baumer et al. 1995).

Johnson, Bassin & Shaw, Inc. (Johnson & Alaska Department of Health and Social Services, Division of Alcoholism and Drug Abuse 1998) conducted Alaska's own study of treatment need among arrestees at three sites: Anchorage (two facilities, Sixth Avenue and Cook Inlet), Fairbanks, and Bethel. A total of 658 arrestees completed interviews that included diagnostic criteria based the revised third edition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R) (1987), and 503 of the subjects also provided urine samples. The biological specimens were assayed for traces of illicit drugs. The results showed that 60% had a substance use disorder diagnosis during the past year. These findings clearly establish that there is a high level of treatment need among Alaska's criminal justice population. However, because arrestees are a part of the general population, the results cannot be easily combined with the telephone survey results to estimate the precise level of treatment service needs in Alaska.

Studies of prisoners have found many indications of high rates of substance use. A national survey of state prisoners in 1991 found that 78% had ever used an illicit drug, 50% regularly used an illicit drug, and 31% had been using a drug at the time of their offense (Beck et al. 1993). More than a quarter of the inmates sentenced for robbery, burglary, or larceny self-reported that they committed these crimes to pay for their drug habits. Research has also shown that heavy alcohol use is prevalent among prisoners. Twenty-nine percent of male inmates and 19% of female inmates were daily drinkers before they were imprisoned, and more than half of the drinkers had received treatment for an alcohol use disorder (Beck et al. 1993).

Prisoners' Need for Treatment. Diagnostic studies of prisoners have shown that they have some of the highest rates of substance use disorders of any population other than treatment clients (Table 1). The pioneering Epidemiological Catchment Area (ECA) Study used the Diagnostic Interview Schedule (DIS-III) to assess the prevalence of substance use disorders of a combined sample of 715 prisoners from five sites in 1980-1984 (Regier et al. 1990; Robins & Regier, 1991). The DIS permitted lay survey interviewers to determine whether respondents met criteria for alcohol and drug use disorders according to the Diagnostic and Statistical Manual, third edition (DSM-III) of the American Psychiatric Association (1980). Seventy-two percent of the inmates had a history of substance abuse or dependence (Regier et al. 1990). This rate was the highest of any of the major population groups surveyed in the classic study. In a 1983-84 study, Teplin (1994) evaluated a sample of 728 male Jail detainees in Cook County using the DIS-III. She found that 29% had a current substance use disorder (19% alcohol and 15% drugs), and 61% had a lifetime substance use disorder. Similar results were obtained ten years later in another study of Illinois inmates using the revised version of the NIMH instrument, the DIS-III-R (Illinois Department of Corrections 1995). It found that 56.6% of 526 male prisoners and 62.5% of 104 female prisoners (57% in the overall weighted sample) had a diagnosis of abuse or dependence on one or more drugs during their lives. The Illinois study used the same DSM-III-R instrument as Alaska used in its household survey to measure the revised criteria of the

American Psychiatric Association (1987).

Studies conducted elsewhere have found even higher rates of substance use disorders among prisoners. Bland et al. (1990) found that nearly nine out of ten male inmates (87%), 18 to 44 years of age, in Canada had a lifetime substance use disorder. In Iowa, experienced substance abuse counselors conducted clinical assessments of newly incarcerated prisoners and found that 81% of the males and 71% of the females had symptoms indicating a current diagnosis of substance abuse or dependence (Hudik et al. 1994). A Texas study conducted in 1993 and another one in 1994 found that 63% of both males and females had a current substance use disorder diagnosis (Farabee 1994, 1995). A survey of males entering prison in Kentucky by the same author found that 59% had a lifetime diagnosis of a substance use disorder according to the American Psychiatric Association's DSM-IV criteria (Farabee 1997). Peters et al. (1998) found that 56% of a sample of Texas inmates had a current substance use disorder, and Kerber (2000) found that 64% of another Texas prisoner sample had a current substance use disorder.

Table 1. Studies of Substance Use Disorders among Prisoners

Reference	Data Collection Location / Date	Study Population	Diagnostic Measurement	% Alcohol or Drug Use Disorder: Current – Time Frame	% Alcohol or Drug Use Disorder: Current – Estimate	% Alcohol or Drug Use Disorder: Lifetime
Regier et al. 1990	five-site ECA areas 1980-84	715 combined ECA prisoner sample	DIS-III			72
Teplin 1994	Chicago, IL 1983-84	728 males at Cook County Department of Corrections	DIS-III	Past 2 weeks	29	61
Bland et al. 1990	Edmonton, Canada 1986-87	222 males, 18-44 years of age in two correctional centers	DIS-III	Past six months	62	87
Teplin et	Chicago	1,272 females	DIS-III-R	At Least	60	70

Table 1. Studies of Substance Use Disorders among Prisoners

Reference	Data Collection Location / Date	Study Population	Diagnostic Measurement	% Alcohol or Drug Use Disorder: Current Time Frame	Current Estimate	Lifetime
al. 1996	, IL 1991-93	awaiting trial at Cook County Dept of Corrections		One Symptom in the Last Six Months		
Hudik et al. 1994	Iowa 1993	242 males and 132 females newly admitted to Iowa's prisons.	Substance abuse counselors using local assessment scale	Time of interview	80	85
Farabee 1994, 1995	Texas 1993, 1994	1,030 entering adult males (except gang members and known homosexuals); 500 females	DIS-III-R items. Asked if had 10+ drinks or used illicit drugs in past year. Dependence=3 + Sx, abuse=1 or 2 Sx.	Past year	63	
Illinois Dept of Corrections 1995	Illinois 1994	630 new inmates in four intake sites	DIS-III-R	Past year	35	57
Peters et al. 1998	Huntsville, TX 1996	400 inmates in Holliday Transfer Facility	DSM-IV (SCID-IV)	Past month	56	74
Farabee et al.	Kentucky 1997	600 inmates (567 male/ 33 female)	Items based on DSM-IV.			59

Table 1. Studies of Substance Use Disorders among Prisoners

Reference	Data Collection Location / Date	Study Population	Diagnostic Measurement	% Alcohol or Drug Use Disorder: Current Time Frame	Current Estimate	Lifetime
1997		from 15 prisons	Qualify for items if ever used alcohol or ever felt addicted to drugs.			
Kerber 2000	Texas 1998	792 males newly admitted to 4 intake facilities	DIS-III-R	Time of interview	64	
McAuliffe et al. 2000	Rhode Island 1999	198 adult inmates recently incarcerated in Adult Correctional Institution or Intake Service Center.	DIS-IV	During Past Year When on Outside	82	84

In a study recently completed in Rhode Island using the same instrument and research design employed in the present study, McAuliffe et al. (2000a) found that 82% of recently incarcerated prisoners had a substance use disorder in the past year during the time when they were on the outside. As in the ECA study, McAuliffe et al. (2000b) found that prisoners had the highest rate of substance use disorders besides clients in treatment.

Taken together, the studies in Table 1 suggest that approximately three out of four (74%) prisoners had a history of a substance use disorder, and about three out of five (63%) had a substance use disorder during the past year. However, developing a precise estimate for Alaska from these studies is difficult because they occurred at different times, used different versions of the diagnostic instruments and screening criteria, and defined "current" differently (time of interview, last month, last year). Changes in mandatory sentencing laws have also led to a steady increase in the number of persons in prison for drug-related crimes (Schiraldi et al. 2000). Consequently, studies conducted 20 years ago may have limited relevance to estimating inmate substance abuse prevalence currently. Because the most comparable results are the recent Rhode Island study that used the same instrument and procedures, the present report will use the results of that out-of-state study when appropriate to provide some of the context needed to interpret Alaska's results.

Because Alaska's Department of Corrections (DOC) does not conduct diagnostic assessments of the substance use disorder treatment needs of prisoners when they enter prison, the State has no hard statistics of its own on the size of the substance use disorder problem among its prisoners (Alaska Justice Statistical Analysis Unit and Justice Center 2000c).

Unmet Demand for Treatment among Prisoners

Although measuring the need for treatment among Alaska's recently incarcerated prisoners is important, it is also essential to measure the demand for and adequacy of access to treatment services. The growing prevalence of substance use disorders and related problems among prisoners, combined with a recognition that appropriate substance use disorder treatment can reduce recidivism in this population, has led to the widely held belief that an effective way to attack the nexus between substance abuse and criminality is by providing ample substance abuse treatment services in prisons and jails (Early 1996; Feeley 1992; Gendreau 1993; Gerstein and Harwood 1990; Inciardi 1994; Lipton 1995; Nurco et al. 1995; Stewart 1997; Wexler 1994). As a result, there have been a variety of recent initiatives to expand and revamp correctional substance abuse treatment services (Corrections Program Office 1997; Hayes and Schimmel 1993; Peterson and Johnstone 1995; Taylor 1997). However, an assessment of institutional requirements for substance abuse treatment found that many inmates with histories of extensive substance use did not seek or obtain treatment prior to incarceration or while in prison, apparently because they were insufficiently motivated or were deterred from seeking it by various barriers to treatment (Petersilia 1990). It is important therefore to assess the level of treatment demand and barriers among inmates who were in need of treatment as they entered prison.

Qualitative evidence indicates that the current services in Alaska have not kept up with prisoner demand, but it is unclear by how much. According to a report by the Alaska Justice Statistical Analysis Unit and Justice Center (2000c), the available treatment services in Alaska's prison system are limited, the programs are reportedly always full, and more inmates request treatment than receive it. Despite the more than two-fold increase in prisoners with drug offenses, the Alaska DOC's budget for substance abuse services has not increased in eight years (Alaska Justice Statistical Analysis Unit and Justice Center 2000c).

There is also reason to believe that the supply of state-funded treatment services on the outside are not fully adequate to meet the needs of Alaska's populace. Recent national studies have found that treatment services are inadequate to meet treatment needs (Woodward et al. 1997), and McAuliffe et al. (1999b, 1999c, 2000c) found that Alaska's treatment needs in 1991-1993 (as measured by alcohol- and drug-related death and arrest rates) were 12th greatest in the country, but its treatment client rate in 1993 ranked 23rd highest according to the federal UFDS survey. The present authors' update of those studies for 1994-1996 found that Alaska's combined alcohol and drug treatment needs were third greatest in the country. The State's treatment clients per capita for those years ranked 7th in the country. Consequently, in a nation where services are generally inadequate, Alaska's services have been below its high level of need.

To supply Alaska with precise information on unmet demand for treatment among people heading to prison, the present study has obtained treatment histories and assessed the motivation for treatment and perceived obstacles to obtaining it among recently incarcerated inmates.

Specific Questions and Issues that the Study Addressed

In sum, the study 1) estimated the number of inmates who needed treatment during the past year when they were on the outside, 2) estimated the number of inmates with an active substance use disorder who obtained treatment or would have sought treatment if it had been available in the last year, and 3) conducted an analysis of the barriers that prevented some of them from obtaining treatment.

The study used this information to test the following hypotheses:

- Recently incarcerated prisoners have substance abuse and dependence rates that greatly exceed rates in the general population. Failing to include these subjects in a statewide needs assessment would result in underestimating overall treatment need and overlooking one of the groups most in need of services.
- Many of the prisoners with a history of substance use disorders have not received treatment, and many would have sought it if it had been readily available.
- Many prisoners-to-be encountered obstacles when trying to obtain treatment.

METHODS

Study Design Overview

The study design was a cross-sectional interview survey of 208 people recently admitted to Alaska's prisoner populations. The study surveyed inmates serving sentences who were not incarcerated for a month or more during the last year. Participation in the study was voluntary, and the study paid $10 to each participant.

Data collection employed an updated version of the NTC's needs assessment questionnaire (McAuliffe et al. 1995) adapted for use with prisoners. The instrument measured the need for treatment services when the subjects were on the "outside" during the last year. The research staff programmed the questionnaire for computer-assisted telephone interviewing (CATI). A coordinator at the prisons recruited respondents, while trained interviewers in Cambridge, MA, conducted the interviews by cellular telephone.

Institutional Review Board (IRB) Approval of Study Methods. The IRB of the North

Charles Foundation reviewed and approved of the study's design and methods on April 7, 2000. The study team prepared an application for studying prisoners according to the guidelines for the Harvard Medical School and Harvard School of Dental Medicine Human Subjects Application, and submitted it to the North Charles Institutional Review Board. North Charles, Inc. is affiliated with the Harvard Medical School's Department of Psychiatry at Cambridge Hospital.

Site Selection

The study team selected three Alaska correctional centers in the Anchorage area to interview prisoners: the Wildwood Correctional Center (Wildwood for short), the Palmer Correctional Center (Palmer), and the Hiland Mountain Correctional Center (Hiland Mt.). To develop the sampling plan, the study team reviewed an inmate daily census for June 15, 2000, obtained from the Alaska Department of Corrections (DOC). On that day, the DOC listed 2,655 people incarcerated in Alaska's prisons. One thousand thirty-nine (1,039) of those prisoners were awaiting trial or sentencing. Of the remaining 1,616 sentenced inmates, 796 had begun serving their sentences more than 11 months previously and were therefore ineligible. These prisoners were not in the general population for sufficient time in the past year (less than one month) to receive services. Thus, there were 820 inmates in 15 prison facilities who were potentially eligible for the study (Table 2). The study's interviewers would have to obtain more information from these individuals to determine how many would meet all of the study's eligibility criteria and whether they would volunteer to participate.

Table 2. Census of Inmates Sentenced in the Last 11 Months, By Correction Center (6/15/00)

Correction Center	Location	Number of Potentially Eligible Inmates Sentenced in Last 11 Months
Wildwood	Kenai	165
Palmer	Sutton	126
Spring Creek	Seward	115
Point McKenzie Rehabilitation Project	Wasilla	66
Hiland Mountain	Eagle River	63
Lemon Creek	Juneau	62
Eight remaining facilities		less than 50

Total	820

Budget constraints and study logistics were important considerations in the selection of the interview sites. Travel costs ruled out selection of remote prisons. Because establishing the logistics for conducting interviews at each facility consumed a substantial amount of time staff time, the study selected the two largest facilities, Wildwood and Palmer. At Palmer, the study sample included only inmates at the minimum security facility. The medium security facility had many inmates who had not yet been sentenced and many who were transfers from other facilities. Lacking statistical information on when those inmates were last on the outside, the investigators were less able to project how many of them would be eligible in this facility than in other facilities. The study coordinator experienced difficulty implementing the study's respondent selection procedures at the medium security unit and began encountering inmates who were apparently underreporting substance use to make the interview go more quickly. The senior staff decided to drop the medium facility as a study site and to interview the remainder of the sample at another facility. Because the Alaska DOC sequesters most women prisoners (81%) at the Hiland Mt. prison, it was an obvious additional choice to insure an adequate representation of females in the sample. Another large correctional facility nearby was the Point McKenzie Rehabilitation Project, but it had to be dropped when the cellular phones would not work adequately there. The three selected sites housed a substantial portion (43%) of the system's 820 potentially eligible prisoners.

In order to obtain a reasonably reliable estimate of their treatment needs, the study interviewed all willing participants among the recently incarcerated female inmates at the Hiland Mt. facility. Women comprise 9% of the people in DOC custody. If the study had employed a proportional sampling by gender, it would have interviewed only 18 inmates. By oversampling females, the study obtained enough cases to support separate analyses of female inmates. In the present report, the authors reweighted the estimates for the total sample in order to adjust for the oversampling of females.

Subject Selection

Eligibility Criteria. The study employed a series of eligibility criteria. A prisoner was eligible if he or she was currently at least 18 years old and was a resident of Alaska on the day before he or she was incarcerated.[1] As a practical matter, prisoners incarcerated outside of Alaska were not be eligible for the study. Only sentenced prisoners or convicted prisoners awaiting sentencing were eligible for the study. People awaiting trial were not yet convicted and might return to the general population before the field staff could interview them. Also, they might not be incarcerated long enough to participate in treatment programming.

[1] To be considered a resident according to the Medicaid requirements, the person had to be living in Alaska voluntarily with the intention of making Alaska his or her permanent home, not staying in the state temporarily.

The study further defined eligible inmates as those who were in the general population (not institutionalized in prison, residential treatment facility, halfway house, etc.) for a minimum of 30 days during the last year. The study's primary goal was to estimate the need and utilization of Block-Grant funded treatment services on the outside (nonprison services) during the past year. Obviously, inmates who have been in prison for the entire year or longer could not have needed or utilized those services. The study team concluded that the questions regarding use of services in the last year would not be meaningful if the prisoner had less than 30 days on the outside.

The potential respondents also had to meet minimum practical requirements for completing the interview. Inmates were ineligible if they lacked sufficient fluency in English, were severely mentally ill, had significant cognitive impairment, were agitated (could not sit still), or were otherwise unable to respond (e.g., due to physical impairments).The coordinator or interviewer administered the Short Blessed Cognitive Impairment Scale to inmates who appeared to have cognitive difficulties. More than ten errors on the Blessed Scale is indicative of cognitive impairment (Katzman et al. 1983).

Selection Process. The study team assumed that it would have to approach all eligible inmates at each study site in order to meet the target for at least 200 completed interviews. Experience conducting a similar study in Rhode Island suggested that some of the potentially eligible inmates would be unwilling to participate or would turn out to be ineligible when the study coordinator obtained more information about them.

The study team prepared a randomized list of all potentially eligible inmates (incarcerated in the past 11 months) at each study site, and the study coordinator contacted inmates in order according to their position on the list. Before beginning the formal interview process, the study coordinator verified the eligibility of the prospective participant. The coordinator screened out inmates without sufficient time in the general population, who were not Alaska residents, or who could not competently complete the interview. The coordinator also excluded inmates who were not available to be interviewed because they were in medical treatment, solitary confinement, or away from the facility on work-release during interview hours.[2]

Interviewing and Questionnaire

[2]The study interviewed prisoners on work release when they were available.

Interviewing Methods. The study team used cellular telephones in the Alaska sites to allow interviewers in Cambridge to conduct the interviews (a methodology pioneered by Appel 1995). Cellular telephoning assured high interview quality. The study team used on-staff interviewers who had experience interviewing prisoners with the same instrument in Rhode Island, and the project staff obtained the data immediately and could apply quality control measures to correct any interviewing errors. Since Alaska's household study was a telephone survey, the present study shared the same telephone survey mode. Although one potential site had to be dropped because it had inadequate cellular telephone coverage, at the other sites the on-site study coordinator easily remedied the minor transmission and telephone equipment problems which sometimes arose at the beginning of the interviewing period.

Questionnaire Content and Revisions. For this study, NCRPG employed a revised version of its core needs assessment instrument, the "Substance Abuse Epidemiology and Services Research Questionnaire," (McAuliffe et al. 1999a). The core instrument collected information on all essential aspects of measuring the need for substance abuse treatment. Modular in construction, the core questionnaire had modules on demographics, substance use, DSM-IV diagnoses of substance use disorders, history of treatment, demand for treatment, and barriers to obtaining treatment. The diagnostic module incorporated the widely accepted diagnostic criteria presented in the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) (American Psychiatric Association 1994) as they have been operationalized in the Diagnostic Interview Schedule (DIS-IV) (Robins et al. 1998). The DIS-IV is one of the most validated substance abuse diagnostic instruments currently available (see McAuliffe et al. 1995 for a review of relevant research).

<u>Questionnaire Revisions Needed for Prisoners</u>. The study team adapted the core instrument to make it suitable for an incarcerated population and the study's goal of measuring treatment needs prior to incarceration during the past 12 months. Only pre-institutional substance use and symptoms were relevant to Block Grant treatment planning, since the Block Grant does not fund substance use and treatment within correctional institutions. The study team revised the questions about treatment to distinguish between prison-based and non-prison-based services. The study team also revised the demographic questions concerning living arrangements, telephone access, and similar questions that did not apply to institutionalized persons. See Appendix B for a detailed discussion of the questionnaire modifications.

Data Collection

Pretesting. NCRPG had thoroughly pretested the questionnaire before commencement of the study. The study team had previously used the telephone version of the questionnaire in several studies and the face-to-face version of the questionnaire in Rhode Island to interview samples of homeless subjects, people receiving treatment, and prisoners. In the course of these prior studies, the study team had corrected CATI programming errors, modified individual questions that were difficult to administer, added response codes that were discovered by review of open-end responses, expanded context-directed CATI help displays, and developed comprehensive administration instructions for interviewers.

Field Activity Procedures. The Study Procedures Manual provided detailed guidance to field staff during the interviewing period. The document explained the study's purpose, described how the field coordinator should recruit subjects and obtain informed consent, how the interviews should be conducted, and it also stipulated how field staff should report any problems encountered each day with the equipment (particularly the cell phones), interviewees, site facilities, site managers, transportation, or study protocol to senior staff immediately. Staff addressed field problems not covered by the Manual by bringing them to the project director. In general, the staff corrected the problem by reinterviewing the subject, modifying the instrument, or occasionally establishing new or revising old procedures to rectify the problem.

The field staff recorded all problems, decisions, and procedural modifications in the Prisoner Field Activities Database. The database included individual records for recording information regarding the study sites, individual respondents, interviewers, and so on. The research team designed the field-activities database to help schedule and contact the prospective respondents, to keep track of the outcomes of every contact with all selected potential respondents, and to remind interviewers about what needed to be done next. As a result, the Prisoner Field Activities Database contained all of the information tracking the progress of each respondent from initial selection through payment for participation.

Initial Contact and Obtaining Informed Consent. The on-site study coordinator attempted to speak to all eligible subjects in the correction center. As an incentive to participate and reimbursement for the time and energy required for the interview, the study offered a small gratuity of $10 to be paid in a manner approved by the administration of the Alaska Department of Corrections and the Institutional Review Board. A few inmates told the person designated to escort the inmate to the study interview rooms that they refused to participate. These inmates did not meet with the study coordinator to determine final eligibility. If a prospective respondent refused to participate, the coordinator tried to address any concerns and answer any questions. If the person still refused, the coordinator went on to enroll the next potential subject. Before starting each interview, the on-site study coordinator introduced him- or herself to a prospective subject and explained the purpose and nature of the study. The coordinator described what was expected of the respondent during an interview, including the types of questions asked and the approximate length of the interview. In this preliminary discussion, the coordinator sought to establish rapport and make the respondent comfortable with the procedures. The introduction stressed confidentiality and informed the respondent about potential risks and the small stipend that he or she would receive upon completion of the interview. The respondent then read the IRB-approved consent form. The coordinator confirmed the subject's understanding of the information before asking him or her to sign the form. The on-site study coordinator returned the signed consent forms to NCRPG.

Interviewers. Five trained, college-educated research assistants (three females and two males) conducted these interviews. Two staff members (a male and a female) acted as site coordinators. Because there were only two interview rooms at the sites, the study team conducted no more than two interviews at the same time.

Computer Assisted Telephone Interviewing Methods. The interviewers completed all of the prisoner interviews with the assistance of networked computers and the CASES (Computer-Assisted Survey Methods Program 1998) programmed questionnaires. After obtaining written consent, the coordinator placed the call to an staff interviewer in Cambridge. The interviewer assigned a unique case identification number to the respondent. The interviewer then entered the date, his or her identification number, and a code for the correctional center. Once the interview began, the interviewer asked questions directly from the computer screen. The interviewer would read the questions exactly as written in the questionnaire. If the respondent did not understand a question, the interviewer repeated it more slowly and clearly. If the comprehension problem persisted, the interviewer would attempt to explain the question as best as he or she could with as little elaboration as possible to minimize variability in questioning.

Data Processing

Quality Control. Staff cleaned the interview data as rapidly as possible. When the interviewers completed each day's interviews (usually late in the evening given the four-hour difference in time between Alaska and the interview site in Massachusetts), they transferred the completed interviews from the hard drives of their desktop comput rs to the central workstation. The statistical programmer monitored the information to assure accurate transfer. He transformed the raw interview data into SPSS-formatted analytic records. At this step, he made any corrections, additions, or changes to the data that interviewers indicated were necessary because of events that had occurred during the interview. For example, if the respondent's answers revealed an inconsistency with an e. 'ier response, the interviewer would ask the respondent to explain his responses. Sometimes, this explanation would suggest that the interviewer should modify the earlier response (either change or amplify it). If the original question occurred very early in the interview, the interviewer would make a note and ask the programmer to modify the data before he entered it into the data base.

The research staff examined several forms of information to determine whether they should exclude any of the previous day's interviews from further analysis because the data were of poor quality. The information included interviewer ratings of interview quality, respondent comprehension, self reports regarding truthfulness, excessive numbers of "don't know" or refused responses, missing or inaccurate data that prevented obtaining a substance use diagnosis, and interview length (e.g., excessively short interviews).

Open-End Coding. The research team prepared a detailed coding guide for the highly structured core questionnaire and for the modifications made for the Alaska prisoner study. The interviewers used these codes to record the respondents' answers. Because many of the questions also had open-end response options that permitted respondents to give answers that the developers had not anticipated when designing the questions, the research staff had to code those responses. In most cases, these open-end responses were recorded for a response-alternative described as "Other (please specify)." The coding guide already contained codes for most open-end responses to these items because respondents gave the responses in the previous studies in which the questionnaire was used. However, the study team occasionally had to devise a new code when a response clearly did not fit any of the existing codes. To develop the new codes, the study team reviewed the open-end responses in light of the theoretical or substantive purpose of the questions. Sometimes, the open-end "other" responses turn out to be misunderstandings by the respondent, repetition of one of the closed-end response categories already part of the question, or answers that were not truly responsive to the questions. In such cases, the study team coded the open-end response as irrelevant or invalid.

Case Weights Used in the Analyses

Depending on the goal of the analysis, the analysts used one of two sets of case weights in these analyses. One set of weights adjusted for oversampling females, and the second set adjusted for demographic differences between the sample and the total population of prisoners in Alaska.

Sampled Interview Weights. The first set of weights corrects the sample totals for the disproportionate sampling of females. As noted earlier, the study oversampled females in order to have enough cases to make comparisons with the males. The weights in this instance insure that the totals obtained when combining all 208 interviews reflect the percentage of males and females in the total prison population. Strictly speaking, the results of analyses that used the sampled population case weights apply only to the 208 recently incarcerated prisoners at the three correctional facilities from which the study obtained subjects. However, a simple sum of the responses would reflect a much higher proportion of females than found in the prisons. The authors therefore reweighted the sample totals to generate results that would have resulted if the study had proportionately sampled men and women. In the tables presented in this report, the statistics that describe the total sample have been reweighted in order to avoid the effect of overweighting females. Statistics that apply to individual prisons, of course, have not been reweighted because at each prison the inmates were either all males or all females.

Statewide Inmate Population Case Weights. The statewide population case weights sought to produce estimates for all eligible inmates in the total prison system. Results of analyses that used the statewide inmate population case weights may be interpreted as heuristic estimates of the treatment needs of all of Alaska's recently sentenced prisoners who eligibility criteria at a given time (610)[3].

---

[3]The DOC provided the study with an analysis indicating that the number of inmates serving sentences in Alaska on the last day of the year who were incarcerated during the past 12 months was 678. This figure had to be adjusted in two ways. First, some prisoners who entered DOC custody in the first month of the year and who were still in prison at the end of the year would not meet the study's eligibility criterion that the inmates were in the general population for a month or more in the year. To eliminate these people who lacked even one month on the outside, the study assumed a flat rate of intake during the year, and estimated that 11/12ths of the 678 prisoners who entered custody (622 prisoners) would satisfy the criterion for a minimum length of one month not incarcerated. Second, the DOC information also did not identify the

residence of the prisoners. The Alaska Prisoner Study asked 315 recently sentenced inmates if they were Alaska residents. Six of the 315 inmates (1.9%) reported that they were not residents. The study assumed that this rate applied to the DOC count, which reduced the estimated population of study-eligible prisoners to 610. Thus, the population size (610) was the number of persons the total number of recently incarcerated prisoners.

Using the interview results to develop an idea of the likely treatment needs of the total eligible population was justified on logical rather than statistical grounds. The study's sampling design did not provide statistical justification for generalizing the sample results to all of Alaska's prisoners. Rather, the projection of the results is made on the basis of assumption that the inmates of the sampled prisons were the best available approximation of the treatment needs as prisoners throughout the system and that adjustments for demographic differences (sex, age, and race) would eliminate some of the known differences between the sample and the total population. Analysis showed that the demographics of the sampled respondents (208) did not differ markedly from the demographics of the total prisoner population. In addition, the sample of 208 inmates constituted a reasonably large percentage of the total eligible population (610), 55% for women and 31% for men. In effect, the estimates produced by applying the population-weight are what one would get if the interviews were generalizable to the total population after the sample interviews had been adjusted to match the demographics of the total population. These weights have been used in only key analyses, and the text specifically identifies those instances.

Statistical Methods

The study employs standard descriptive statistics: means, proportions, ranges, and so on. Because the samples were 100% samples of the eligible prisoners in the facilities at the time, statistical inference from sample to population was not necessary. It would be reasonable to expect that the study's results might have varied if it had been conducted in the same facilities at a different time, but there is no statistical basis or model for statistically generalizing the current results to all possible times. Some variability in the results may also occur due to random measurement errors. The selected prisons were not selected randomly from the population of facilities. As just noted above, the few generalizations from the interviewed prisoners to the total prisoner population were made on the basis of logical inference rather than statistical inference. Accordingly, the text does not include the results of statistical tests or confidence intervals. Nevertheless, readers should bear in mind the modest size of the prison samples as well as the magnitude and consistency of any differences in the statistical results.

RESULTS

Research Design Implementation

Completed Interviews and Exclusions. The study of recently incarcerated prisoners interviewed 208 eligible inmates at three correctional facilities from July 11, 2000, through October 13, 2000. The interviewers conducted a total of 211 interviews, but three of them had to be excluded from the sample. Two interviewed respondents turned out to be ineligible because upon further questioning the interviewer learned that the subjects did not meet the requirement of living in the general population (not institutionalized) for a month or more during the last year. Information obtained during the interviews indicated that when they were not incarcerated in the past year they were in halfway houses (operated by the DOC in at least one of the cases). The interviewers completed the interviews because the disqualifying information became apparent only after the interviews were well underway. The Procedures Manual did not contain explicit instructions regarding people living in halfway houses when not incarcerated. The study procedures directed interviewers to complete questionable interviews and pay the respondents. The senior staff reviewed the cases and decided to exclude the interviews. Review of National Household Survey on Drug Abuse (NHSDA) data on residents of halfway houses indicated that the residents used drugs at much lower rates when in the halfway houses than when not (National Institute on Drug Abuse 1994). Another respondent failed to meet the residency eligibility criterion because she had been arrested on an outstanding Alaskan warrant and extradited to Alaska from Washington where she was living. The interviewer decided to conduct the interview because of the unusual circumstance. After senior staff reviewed this case, they decided that her *yes* to the qualifying question, "Were you living in Alaska when you were incarcerated?" was not accurate. When arrested in Washington State, she was residing there after having moved from Alaska.

Recruitment Efforts and Outcomes. The study began recruiting participants at the Hiland Mt. CC first. The study team used the June 15, 2000 census (P. A. Crandell, personal communication, 2000a[4]) to generate the randomized roster of potentially eligible inmates at Hiland Mt. The roster included inmates who were not sentenced in order to include inmates sentenced between June 15 and July 11. The study coordinator updated the initial roster to remove the names of inmates who were no longer at the facility and inmates who were still not sentenced. There were 67 potentially eligible female inmates at Hiland Mt. (Table 3). Ten of them were not in the general population for at least 30 days before incarceration. One inmate, describe above, was living out of state when she was returned to Alaska because of an outstanding warrant. Two inmates were away from the facility receiving medical treatment. Forty eligible inmates completed interviews, and 14 refused to do so. The resulting completion

[4]NCRPG wishes to thank Dr. P. A. Crandell for making these rosters available.

rate was 74%.

Some of the potentially eligible women who refused to participate might have been ineligible. They had learned from other subjects about the survey and had refused to attend the screening interview with the study coordinator. Consequently, the study could not assess the subjects' actual eligibility. The computation of the completion rate uses the conservative approach of assuming that all inmates who refused to participate were actually eligible.

Table 3. Outcomes of Sample Recruitment Efforts, by Interview Site

	Correction Center			
Disposition	Hiland Mt.	Palmer Min.	Wildwood	Total
Potentially Eligible Inmates	67	118	130	315
Not Eligible or Not Available	13	17	15	45
Less than 30 Days Free	*10*	*9*	*9*	*28*
Not Alaska Resident	*1*	*4*	*1*	*6*
Medically Unavailable	*2*	*1*	*1*	*4*
In Work Release Program	*0*	*3*	*0*	*3*
In Solitary Confinement	*0*	*0*	*2*	*2*
Not Competent	*0*	*0*	*2*	*2*
Number of Eligible Inmates	54	101	115	270
Refused	14	16	32	62
Completed Interview	40	85	83	208
Completion Rate	74%	84%	72%	77%

A few days before beginning interviewing inmates at the next site, the Minimum Security facility at Palmer CC, the study team obtained an inmate census that included information on whether the inmates were sentenced or not (only six were not sentenced) and when they were admitted to Palmer. The study team generated a randomized roster from the census after eliminating inmates who were not sentenced and inmates who were admitted more than 11 months before recruitment began. The roster initially identified 149 potentially eligible inmates but 31 were transferred or released before they could be contacted for an interview, leaving 118 potentially eligible inmates. Proportionately fewer inmates at Palmer (9 of 118, or 8%) were not eligible because of the length of their incarceration compared to the women inmates at Hiland Mt.(10 of 67, or 15%). Four inmates at Palmer Min. were not Alaskan residents when they were arrested. These inmates were working in Alaska temporarily. Seven were on work-release at a nearby meat processing plant The study coordinator arranged for the inmates to be excused from work and interviewed at the meat processing plant. Three other inmates were on work-release at other sites where they could not be interviewed. The completion rate at Palmer Min. was 84% (Table 3).

The study team followed a similar recruitment procedure at the final study site, Wildwood. A few days before the interviewing began at Wildwood CC, the study team obtained an inmate census and eliminated inmates not yet sentenced or admitted to Wildwood more than 11 months before. The DOC examined its records about the remaining potential participants and identified the inmates whose total current incarceration was longer than 11 months (Crandell, personal communication, 2000b). NCRPG's coordinator verified the accuracy of DOC's identification of ineligible subjects. The study team was in the field for two days before the DOC prepared the list. In those two days, the study coordinator checked the roster for accuracy by directly questioning 20 inmates whom the roster as having too little time outside of prison. The addition of information on time at risk increased the efficiency of recruitment at Wildwood.

When the study team had exhausted the original randomized list of potential participants, it had completed interviews with 78% of the eligible inmates. The study team decided to take advantage of the remaining planned recruitment time (approximately two days) to enroll additional inmates. NCRPG generated a supplementary randomized list of 29 potentially eligible inmates admitted to Wildwood during the recruitment period. DOC had not screened this list for time-at-risk.

Of the 130 potentially eligible inmates at Wildwood, 15 proved to be ineligible or unavailable. The study coordinator screened out nine inmates from the supplementary list because they had too little time outside in the last year. Ten inmates on the supplementary list refused to participate. One inmate was at the prison but too sick to be interviewed. The study coordinator screened out two inmates because they could not competently complete an interview. One inmate could not adequately converse in English, and the other failed the study's mental competency test. Two prisoners in solitary confinement could not be interviewed. The final completion rate for Wildwood was 73% (Table 3). The completion rate for the three sites combined was 77%.

Table 4. Reasons for Refusal to Participate in the Study, by Recruitment Site

Reasons	Hiland Mt. (n=14)	Palmer Min. (n= 16)	Wildwood (n=32)	Total (n=62)
Non-specific ("not interested," "do not	71% (10)	50% (8)	69% (22)	65% (40)

Table 4. Reasons for Refusal to Participate in the Study, by Recruitment Site

Reasons	Hiland Mt. (n=14)	Palmer Min. (n= 16)	Wildwood (n=32)	Total (n=62)
want to," "don't want to answer questions for anybody," and would not speak to field coordinator)				
Dislike/distrust of subject matter (paranoia over subject matter, apprehension over subject matter, not wanting to talk about drugs or treatment, dislike of treatment)	0	13% (2)	16% (5)	11% (7)
Time (being "busy" or that the interview would "take too long")	14% (2)	19% (3)	0	8% (5)
Dislike/distrust of research (not wanting "to do research")	14% (2)	6% (1)	0	5% (3)
Wanting more money (feeling story is worth more money, not willing to do it for "less than twenty dollars")	0	13% (2)	0	3% (2)
Concern over confidentiality (would participate but concerned that NCRPG would have the signed consent forms as documentation of their participation)	0	0	6% (2)	3% (2)
Impending release from prison (not wanting to discuss subject because being released soon)	0	0	6% (2)	3% (2)
Dislike of cellular phones	0	0	3% (1)	2% (1)
Total	100%	100%	100%	100%

Reasons for Refusals to Participate. Sixty-two inmates (23%) refused to participate at the three interview sites: 14 at Hiland Mt., 16 at Palmer Min., and 32 at Wildwood. To check for unknown obstacles to participation, the study coordinators routinely asked subjects who refused why they were unwilling to participate. The coordinators recorded the reasons, and NCRPG's study team coded them (Table 4).

There were three basic reasons for refusal to participate at Hiland Mt. Two respondents belong in the "time" category: one stated that she was too busy to do the interview, while the other stated that the interview would take too long. Two respondents refused because they were suspicious or disliked the research project. The field coordinator invited the suspicious subject to speak with a Cambridge interviewer who could tell her more about the project, but the inmate refused the invitation. The other woman told the field coordinator that she did not want "to do research," and told the coordinator to not ask her to participate again. The other women did not give specific reasons for refusing to participate. They merely told the field coordinator that they did not want to do the interview (three) or they had no interest (seven). When the coordinator probed for a more specific reason, they reiterated that they just did not want to do the interview.

At the Palmer Min. facility, the field coordinator reported 16 refusals. NCRPG's research assistant categorized these responses into four categories: time, dislike/distrust of research, dislike/distrust of the subject matter, wanting more money, and non-specific. Three respondents refused because of time reasons: two respondents were "busy" (they also did not want to reschedule at a more convenient time), and another respondent stated that the interview would take too long. One respondent disliked the idea of participating in a research project, and he defiantly told the field coordinator that he would not be participating.

Two respondents refused because they did not like the subject of the interview. One of these respondents did not want to talk about treatment issues, while the other respondent did not believe that what he would say would help anybody since "change comes from within [a person] and not some treatment center." Two respondents wanted more money for doing the interview: one respondent said that he felt his story was worth more than ten dollars, and the other respondent would not do the study for less than twenty dollars. The field coordinator thanked them for their time and did not re-contact them.

Eight Palmer Min. respondents refused to participate for non-specific reasons, but with varying levels of assertiveness. One person would not come down and speak with the field coordinator. Two respondents had "no interest in doing the interview," while another respondent "did not want to do the interview." Two other respondents defiantly told the interview that they were "not doing the interview." The other two non-specific refusals included an individual who was invited for interview three times but refused after the third time when he had thought it over. The other individual may have refused because he was hard of hearing and felt that he would not be able to participate fully in a study using cellular phones.

There were thirty-two refusals to participate at Wildwood. The individuals at Wildwood often refused to come down and even talk with the field coordinator, which may account for the relatively large number of refusals at this correctional center. The study team coded the thirty-two reasons for refusal into five categories: 1) concerns over confidentiality, 2) impending release from prison, 3) dislike of cellular telephones, 4) dislike distrust of subject matter, and 5) non-specific reasons. Two Wildwood men agreed to do the interview until they learned that they would have to sign a consent form. They both stated that they would do the interview only if they could be anonymous. Two individuals refused to participate because they were being released soon. When assured of confidentiality, both respondents again refused–one of the two respondents added that he was "was just not ready for anything like this yet."

One prospective Wildwood respondent refused because he did not want to use a cell phone. Five respondents refused because they did not want to talk about drugs or treatment. One of these respondents felt that the interview sought information that was too personal. Another was recently given a maximum sentence for a drug offense. He felt bitter toward "the system" and politely declined to be interviewed. Two of the five respondents became apprehensive and declined when they learned of the subject matter. The final respondent included in this category declined and seemed slightly paranoid to the study coordinator regarding the subject matter.

NCRPG categorized the remaining twenty-two refusals as non-specific. As previously mentioned, 11 individuals refused to come down. Two of these inmates expressed anger about being awoken for the study. The first Wildwood refusal fit into this category: He angrily stated that he was not interested and not convinced that participation would help him. Four other individuals also reported that they were not interested. One respondent stated that he did not want to answer any questions for anyone. Another individual refused to enter the interview room–he refused participation at the doorway and persisted in his refusal even after listening to a brief explanation of the study. One respondent wanted to be left alone. One respondent was hesitant and said that he might come back, but he never did. Another respondent stated that he did not want to do the interview. The final respondent refused but would not give a reason. The field coordinator reported that the potential participant appeared offended when probed for a reason.

Data Quality

Interviewer Ratings of Quality of Interview Data. At the end of each interview, the interviewer rated the quality of the interview data by responding to the question: "How would you rate the quality of the information obtained in this interview?" (Table 5). NCRPG's policy is to review any cases rated as "poor" or "inadequate." If the review of the case confirmed that its data quality was "poor" or "inadequate," the project director excluded the case from the study's sample.

The study team did not exclude any interviews because the information received "poor" or "inadequate" ratings. Initially, an interviewer rated one interview as "poor" because of the respondent's slow comprehension. After discussing the case with the project director, the interviewer changed the rating to "fair" because she acknowledged that the respondent eventually understood the questions and gave reasonable responses. The information obtained in the 208 interviews received ratings of excellent (61%), good (30%), or fair (9%). The distributions of the ratings were similar across the sites, although the interviewers rated more interviews as excellent at Hiland Mt. and Wildwood than at Palmer Min. (Table 5).

Table 5. Interviewer Ratings of the Quality of the Interview Data (percent)

"How would you (the interviewer) rate the quality of the information obtained	Wildwood (n=83)	Hiland Mt.	Palmer Min.	Total

in this interview?		(n=40)	(n= 85)	(n=208)
Excellent (no problems at all)	69	62	53	61
Good (a few problems but overall quality good)	23	28	38	30
Fair (a number of problems but overall acceptable)	8	10	9	9
Poor (many problems, overall quality open to question)	0	0	0	0
Inadequate (interview was terminated by interviewer, or quality judged too poor to include in the data set)	0	0	0	0
Total	100	100	100	100

N = Number interviewed.

For the 81 cases that received good or fair quality ratings, the interviewers explained why the data were not excellent by responding *yes* or *no* to the 11 possible reasons listed in Table 6. One response option was for the interviewer to enter an open-end "other" reason for why the interview quality was not excellent. The principal reasons for the interview information being less than excellent were the respondents did not understand the meaning of some of the drug or treatment questions (52%), had trouble due to interruptions or distractions (48%), had trouble hearing due to phone problems, background noise, or hearing loss (47%); had difficulty due to the mental or physical competency to respond to the questions (11%), had problems because English was not their first language (10%), did not take the interview as seriously as most respondents did (5%), seemed to be rushing to get through the interview (5%), and appeared to be put off by the content of the interview (2%). Eleven percent of the interviews were rated as good or fair for "other" reasons, such as the interview being interrupted for periods of a day or longer, cellular battery problems, extreme responses, respondent being tired, respondent fearing that his answers would incriminate him, respondent rambling, and respondent feeling that the interview was not applicable to him.

There were more phone problems at Hiland Mt and Palmer Min. than at Wildwood. At Wildwood, the field coordinator always plugged the cellular phones into their adapters and the phones had a headset adaptor that the respondents could choose to use. As a result, the phone problems due to static and low batteries declined dramatically (Table 6). At Wildwood interviews were more likely to be less than excellent because of respondents had language problems and difficulty understanding the questions.

Table 6. Reasons for Less than "Excellent" Rating of Quality of Interview Data (percent)

"What were the reasons that the quality of information was less than excellent?"	Hiland Mt. (n=15)	Palmer Min. (n=40)	Wildwood (n=26)	Total (n=81)
Respondent did not understand the meaning of some of the drug or treatment questions	47	38	77	52
Interruptions or distractions	60	65	15	48
Hearing and phone problems (static, hearing difficulties)	73	65	4	47
Lack of mental or physical competency to respond	0	10	19	11
Other (tired, rambling, etc.)	27	5	12	11
Interview not in respondent's native language	7	3	23	10
Respondent did not take interview seriously	7	3	8	5
Respondent rushed interview	20	0	4	5
Respondent put off by content of interview	0	0	8	2

N= the number of cases with less than excellent rating. Percentages sum to more than 100% because there may be more than one reason per case.

Respondent Comprehension. NCRPG staff examined interviewer ratings of the respondents' comprehension. If the interviewers rated the respondent's comprehension as "poor" or "inadequate," the project director considered the case for exclusion. The interviewers rated one respondent's comprehension as "inadequate." The study team examined the interviewer's notes and discussed the case with the interviewer. She reported that the rating was a typographical error and, instead, rated the respondent's comprehension as "good." There were no other cases with "poor" or "inadequate" comprehension ratings.

Respondent Truthfulness. At the end of the interview, the interviewer asked the respondent if he or she had answered truthfully when asked three key alcohol and drug use questions. The questions focused on whether the subject had a problem with alcohol in the past and whether the subject had used cocaine and used heroin in the past year. The study team chose these items because they were among the questions that qualified the subjects for the diagnostic questions. The senior staff advised the interviewers to ask these questions carefully and directed them to probe respondents whose tone suggested that they might have been dishonest. In previous studies, interviewers noticed that respondents often misunderstand this question. In this study, one interviewer reported that approximately four respondents misunderstood the first honesty question but when probed indicated that they had answered truthfully. It is noteworthy that these questions led to exclusions in other studies that have used the present instrument. Ninety-four respondents answered the truthfulness question on having a problem with alcohol, 125 answered the question on use of cocaine in the last year, and 196 answered the question on use of heroin or other opiates in the last year. All of the Alaskan inmates whom the interviewers asked these questions reported that their responses denying having an alcohol problem or using cocaine or heroin in the last year had been truthful.

Don't Knows and Refusals to Answer Specific Items. Another criterion for determining the quality of an interview was the number of don't know responses or refused responses. In particular, NCRPG considered whether the respondent failed to provide information critical to determining need for treatment. Sixty-one percent of the interviewees had no *don't know* responses. Only eight participants (4%) had eight or more *don't know* responses. One subject had 14 *don't knows*. No respondent refused to answer any question.

NCRPG staff examined the pattern of missing responses for participants who did not know the answer to eight or more questions. The study team found that none of these missing responses affected the diagnostic scoring. The respondents most often said that they did not know the complete answer to questions that asked for the month and year of symptoms and other events that happened more than two years ago. It is of course reasonable for a respondent to not remember the month when a symptom last occurred when many years have passed since the event. Moreover, for the purposes of assessing need for treatment in the last year, the study did not have to know the month of distant events. In fact, the instrument included a follow-up question when respondents did not know one of these dates. The follow-up question simply asked whether or not the event occurred in the last two years.

Missing or Inconsistent Data Preventing a Substance Use Diagnosis Course Specification. As part of the study's quality control procedures, the study team periodically (usually daily) scored the diagnostic data from the newly completed interviews. The primary purposes of this study was to assess Alaskan prisoner's need for treatment prior to incarceration. A key element in measuring treatment need was the presence of a substance use disorder diagnosis and having a course specification of active, partial remission, or early full remission. Persons who never had a diagnosis or who were in sustained full remission during the entire past year were not in need of treatment. Therefore, the study team examined any cases that received a diagnostic score signaling that the interview contained missing or inaccurate data that prevented its scoring program from obtaining a specific diagnostic course, which in turn may have affected assessment of the need for treatment. If the interview contained missing/inaccurate data or there was a problem in the questionnaire program or scoring program, a respondent could obtain an "indeterminate diagnostic" score for the specific substance.

The study team detected cases with potentially problematic diagnostic scores. The most common problems were due to 1) the respondents' misinterpretation of one ambiguously worded course-specification question dealing with the date of events relevant to determining the precise form or remission, 2) programming errors in the skip directions in the questionnaire program that led to missing data, and 3) the respondents changed an answer so late in the interview that questions that depended on that answer could not be asked. An inconsistent date could result in an indeterminate course specification. Whenever possible, the study team reinterviewed respondents to obtain consistent responses or obtain responses to items that had been skipped in error. If reinterviewing the subject was impossible, NCRPG examined the case to determine whether treatment need could be determined even if the diagnostic course specification was ambiguous. For example, a person in partial remission (still has one or two dependence or abuse symptoms after meeting dependence criteria in the past) presumably still needed some form of treatment or aftercare during the past year, even if the interview data did not allow the analysts to determine whether the exact form of partial remission was early or sustained.

There were 17 instances of an indeterminate course specification: 11 cases for alcohol; 3 cases for cocaine, 1 case for marijuana, 1 case for stimulant drugs and 1 case for heroin or other opiate drugs. In all of these cases the subject may have needed treatment as a result of a diagnosis associated with another substance. Fifteen of the 17 indeterminate course specifications stemmed from the respondents giving inconsistent dates in the DSM diagnosis section for one or more substances. The interviewers asked respondents if they had three or more symptoms around the same time during the last two years. A *yes* answer indicated a clustering of dependence symptoms in the last two years. If respondents answered affirmatively, interviewers asked if they had experienced a symptom-free period of a month or longer since that *last* time that they had the clustering. Respondents who indicated *yes* to both of these questions were then asked for the date when the symptom-free period began. An indeterminate course specification resulted if respondents gave a date that was more than two years ago. That data contradicts their assertion that the last time they had three or more symptoms around the same time during the last two years. Apparently, some respondents thought that the interviewer was asking about the very first time the respondents had a symptom free period following clustering, not the most recent time. The study team discovered these inconsistent responses at a time when it could still reinterview two of the 15 respondents and obtain their correct course specifications. The other thirteen cases could not be interviewed. Fortunately, there was enough other information in these interviews to allow the study team to code these cases with regard to need for treatment, even though the precise course specification was somewhat ambiguous. While there was some loss of information regarding the detailed course specification, except for its use in determining need for treatment that level of detail is largely of academic interest.

The other two indeterminate scores were caused by an error in the CASES programming of the instrument that could be fixed after the fact. In the DSM diagnosis section discussed above, respondents were asked for a date of the symptom free period. If they had three or more substance use disorder symptoms in the last two years, the date should be in the last two years. When respondents gave a date of exactly 24 months ago, the diagnostic scoring program would erroneously categorize their response as being more than 24 months ago–giving them an indeterminate score. The study's programmers revised the questionnaire program to categorize dates of exactly two years ago as falling within the two-year guideline. After the staff made this change in the program, the diagnosis scoring program produced correct course specifications for these two cases.

While examining the scoring program, the study team found an additional error in the scoring program. This error affected four instances (two cases with two instances each). The scoring program indicated that these two individuals were not asked the DSM substance disorder questions even though they did answer these questions. The error was due to an error in the scoring program's syntax. The programmers repaired this error and successfully rescored the cases to obtain their correct diagnostic scores.

The study team encountered a case at Wildwood with missing diagnostic scores for sedatives. The questionnaire failed to ask this respondent the DSM diagnostic questions for sedatives even though the respondent qualified for them. The staff immediately discovered the omission and reinterviewed the respondent and fixed the questionnaire program. The programmers traced the problem to a typographical error in the CASES programming. This problem affected diagnostic questions for cocaine, sedatives, stimulants, and heroin or other opiate drugs.

After finding this error, the study team found three additional cases where the respondent should have been asked the questions for sedatives but were not. Unfortunately, it was too late to reinterview these three respondents. The project director concluded that the final diagnostic score for sedatives would be "missing" for these three cases. However, there are several reasons to believe that these subjects did not have a current diagnosis for sedative abuse or dependence. None of them reported extensive use of sedatives; two used them only one to five times in the past year, and one used the drug once or twice a week. None used the drug every day for four weeks or more in the last month. Moreover, few nonmedical substance abusers use only sedatives. All three subjects qualified for the diagnostic questions concerning their use of alcohol and marijuana, and two qualified of other substances (cocaine, hallucinogens and stimulants) as well. If they had a substance use disorder, it is more likely that they would have needed treatment for one for those drugs rather than for sedatives. In fact, the subject who reported the largest amount of sedative use was actively dependent on both alcohol and cocaine in the past year. Therefore that subject clearly needed treatment and would not be missed due to these missing data regarding sedatives. Neither of the other two subjects needed treatment in the past year as a result of any other substance. One never had substance use disorder diagnosis although he qualified for the diagnostic questions for other substances, and the other was a past abuser of alcohol only. Thus, while some of the diagnostic data on three subjects was missing, it is unlikely that it had an impact on our overall estimates of need for substance abuse treatment in this prisoner sample.

In the analyses described below, these two cases were treated differently depending on the context. They were coded and analyzed as missing (i.e., removed from both the denominator and the numerator) when reporting the percentage of cases with sedative use disorders specifically. However, in the measures of lifetime and past year rates of substance use disorders that combined all substances these cases were treated as if the respondent did not have diagnosis. As just explained, it appeared to be highly unlikely that they had a sedative use disorder, and data on the other substances was not missing. If the sedative responses were treated as missing, then the cases would automatically be missing for the combined measures even though data was available for all of the other drugs and the likely outcome for sedatives was clear.

This programming error also caused seven individuals to be asked DSM diagnosis questions for substances (cocaine, sedatives, stimulants, or heroin or other opiate drugs) that they should not have been asked about because they did not qualify for the diagnostic or treatment items. Our programmers examined these cases and verified that their diagnostic scoring was accurate, and the additional data was treated as irrelevant. The scoring program does not calculate a diagnosis if the subject did not qualify for the items.

There were six respondents who changed their answers too late to allow the interviewer to go back and correct their response. If a respondent reported that he or she had not used a specific substance, the questionnaire program skipped the respondent past follow-up questions regarding symptoms due to use of that substance and treatment for abuse of the substance. If the respondent changed the answer shortly thereafter, the interviewer could go back to the original question, record the changed response, and continue on from that point. However, if respondent admitted using the substance much latter in the interview, the interviewer simply recorded the change in a note and did not go back. To go back would not have been practical, since the respondent would grow weary and the overall validity of the interview could have been undermined. Another version of this problem occurred because several respondents were confused by the questionnaire wording (e.g., assumed that "stimulant" included cocaine even though the interview distinguished cocaine from other stimulants, or the respondent confused prescribed medical use of sedatives with nonmedical use). As the interview proceeded, these respondents eventually realized the confusion and informed the interviewer. In all but one instance of underreporting, the interviewers reinterviewed the subject on a subsequent data with regard to only the substance in question. With regard to the four cases of over-reporting due to confusion, the study team corrected the data to indicate that the person had not used the substance.

The study team took corrective action to eliminate additional occurrences of these problems. The project director revised the confusing symptom-free period questions in the diagnosis section. These revised questions and additional interviewer training prevented additional problems. The study team found several programming errors in the questionnaire program and the scoring program. The corrections made to these programs resolved many of the inaccurate diagnoses and prevented future problems. Although the number of these problems was surprising, their impact on the study's findings was small.

Interview Length. The length of interviews can be used as an indicator of quality. Interviews can be very short if respondents deny all substance use. Consequently, the study team examined short interviews to determine whether there was any indication of obvious underreporting. Interviews can be excessively long if subjects ramble in their responses. Interruptions due to poor telephone connections and other disturbances can also lengthen an interview. Long interviews can also result from the interviewer failing to close the program correctly or from conducting an interview on two days.

The median length of the interviews was 59 minutes (n=201). Seven interviews that appeared to be very long represented interrupted interviews, mechanical problems, or programming errors, and the length of interview data were therefore invalid and not analyzed. The shortest interview was 16 minutes long. Only two interviews were less than 25 minutes, and both respondents had no alcohol use in the last two years, no marijuana use in the last two years, and never used any other controlled drugs. Consequently these subjects did not qualify for the diagnostic or treatment questions. Such cases are common in general population surveys, and NCRPG designed the instrument to make their interviews short. Ten (5%) of the interviews were less than a half hour long. The longest interview lasted two hours (123 minutes). The subject had language and comprehension difficulties, and he had used many drugs. Thus, a large number of items regarding drug use and related symptoms had to be repeated several times for each substance in this interview.

Interview length varied somewhat from institution to institution. Interviews at Hiland Mt., Palmer Min., and Wildwood lasted a median of 67, 62, and 54 minutes, respectively. Cellular telephone transmission quality partly explained this variance in interview length. When the interviewing began at Hiland Mt., the interviewers reported that the sound quality caused delays in the interviewing. Static would force a temporary suspension of the interview or would cause the interviewer to hang up and call back to restore the clarity to the transmission. By the end of the field period, the interviewers had developed solutions to most of the telephone problems, and by luck transmission at Wildwood was good.

Summary of Data Quality. The study's evaluation of data quality found it to be very good. Interviews conducted at Palmer Medium had to be dropped because of staff errors when recruiting respondents and the senior staff's suspicion that some respondents were intentionally underreporting to reduce the length of the interview. At the other three prisons, the study did not have to exclude any interviews because of poor or inadequate data quality. NCRPG eliminated three respondents because they were ineligible by the study's criteria. The interviewers rated all 208 interviews as excellent, good, or fair. The majority (64%) of the interviews received excellent ratings, a figure that is only slightly lower than the ratings found in our study of Rhode Island's prison, where 72% of the interviews received an excellent rating. Only eight respondents (4% of the sample) had eight or more "don't know" responses. In every instance, the relatively large number of *don't know* responses appeared to be justified. No subjects refused to answer a question. Most of the problems caused by missing or inaccurate data that affected the course specifications could be corrected by reinterviewing subjects, recoding the data, or by modifying the scoring and questionnaire programs. Three respondents had missing sedative diagnostic data.

Demographic Characteristics

The Alaskan inmate sample had a preponderance of unmarried males, Alaska Natives and whites, and people in their mid-thirties who were employed full time prior to incarceration (Table 7). Males made up eighty-one percent of the inmate sample, a figure determined by the study's decision to oversample female inmates in order to have enough cases for analysis of gender. In order to adjust for this research decision in descriptive analysis, the study team reweighted the sample to reflect the percentage of females in the total prison population (9%). Accordingly, the percent female of the weighted total in Table 7 was 9%. Alaska Natives were the largest racial group, comprising 39% of the weighted sample. The rest of the sample was 31% white, 16% African American, 2% Asian/Pacific Islander, 1% other race (mostly people who described their race as Hispanic alone), and 11% more than one race. When specifically asked whether they were Hispanic, six percent of the sample responded affirmatively. The interviewees averaged 35 years of age, with a range from 19 to 66. They had completed a median of 11 years in school. However, sixty-five of the 105 inmates who did not finish high school reported that they had a high school equivalency certificate. Consequently, 81% of the prisoner sample had a high school degree or its equivalent. Seventy-two percent were employed prior to incarceration. Four percent were in school. One in five of the prisoners was homeless for a month or more in the last year. Fourteen percent of the sample were married, and another 37% were living with someone in a marriage-like relationship prior to incarceration.

Table 7. Demographic Characteristics of Prisoner Sample

Characteristic	Hiland Mt. (n=40)	Palmer Min. (n=85)	Wildwood (n=83)	Total (n=208)
Gender (% female)	100	0	0	9
Mean Age (minimum-maximum)	35 (20-66)	35 (19-59)	34 (19-61)	35 (19-66)
Race:				
% Alaska Native/American Indian	30	41	40	39
% White	37	27	35	31
% African American	18	19	12	16
% Asian or Pacific Islander	0	2	1	2
% Other Race (e.g., Hispanic, etc.)	5	0	0	1
More than One Race	10	11	12	11
Ethnicity: % Hispanic	8	9	2	6
Median grade or years of education completed (range)	11 (5-15)	11 (7-18)	11 (2-14)	11 (2-18)
% Employed prior to incarceration	58	82	64	72
% In School Just Before Being Incarcerated	0	4	6	4
% Homeless Just Before Being Incarcerated	25	15	23	20
% Married	15	15	13	14

Besides gender, there were only minor variations in most demographic characteristics of the inmate groups at the three prisons. The mean ages, years of education, and percent married were virtually identical at all sites. The female prisoners at Hiland Mountain were more likely than the male prisoners at the other two prisons to be divorced (43% versus 13%), while the males were more likely than the females to have never married (35% versus 67%).

Native Alaskans and whites were the most common racial groups in all prisons, although the percentage of Native Alaskan females at Hiland Mt. was smaller than the percentage of Native Alaskan males at the other two prisons. There were fewer Hispanics at Wildwood, and a higher percentage of the inmates at Palmer Minimum than at the other two prisons were employed before becoming incarcerated.

Criminal Justice Characteristics

An important descriptive question is how many of the prisoners had criminal-justice-related risk-factors for substance use disorders prior to incarceration (Table 8). Many of the prisoners were repeat offenders. The median number of times ever incarcerated was 4 for all three prisons. A few prisoners reported many incarcerations (as many as 48 in one case), so the mean (6.9) was much higher than the median.

Another key characteristic for the study was the amount of time the respondents were on the outside in the last year, because many of the questions refer to this time period. The unweighted mean for the entire sample was 5.6 months (median and mode of 5.0 months), with a range between one month and 12 months (a value of 12 months could include any subject who entered prison within the two weeks prior to the interview). The three samples varied slightly on this measure: 5.3 months for Hiland Mountain inmates, 6.1 months for Palmer Minimum inmates, and 5.0 for Wildwood.

One in ten (10%) of the prisoners had been arrested for a drug violation in the last year, with the rate among the female prisoners (23%) being more than twice as high as the rate among the male prisoners (9%). According to the Alaska Department of Corrections' (1999) statistics, 13% of the female prisoners and 5% of the male prisoners in state correctional institutions on December 31, 1999, were sentenced for a controlled drug offense. Most of the 24 prisoners who were arrested for a drug violation had only one such arrest in the last year, but six had between two and five drug violation arrests. The females who were arrested for drug violations were arrested more often (1.8 times on average) than the male prisoners who had been arrested for drug abuse violation (1.2 times on average). The males were more than twice as likely to have been arrested for disorderly conduct or drunkenness, while females were more likely than the males to have been arrested for a DUI in the last year. Thirty-seven percent of the 208 prisoners had been arrested for a drug- or alcohol-defined offense (DUI, disorderly conduct, or drunkenness) in the past year. Department of Corrections' (1999) statistics indicated that 25% of the females and 10% of the males in the State's correctional institutions were classified as having committed either an alcohol or drug violation. The results show that more of the prisoners were arrested for a drug or alcohol violation in the last year than were incarcerated for one of the two types of offenses.

Table 8. Criminal Justice Characteristics of Prisoner Sample

Characteristic	Hiland Mt. (n=40)	Palmer Min. (n= 85)	Wildwood (n=83)	Total Sample (n=208)
Mean (median) Number of Times in Prison Lifetime	7.8 (3.5)	6.0 (4)	7.5 (4)	6.9 (4)
% Arrested for Drug Abuse Violation in Last Year	23	9	8	10
Of Those Arrested, Mean Number of Times Arrested for Drugs	1.8	1.3	1.1	1.3
% Arrested for Drunkenness or Disorderly Conduct in Last Year*	7.5	14.5	18.3	15.6
Of Those Arrested, Mean Number of Times Arrested for Drunkenness or Disorderly Conduct in Last Year	2.7	3.1	1.7	2.2
% Arrested for Driving Under the Influence (DUI) in Last Year	20.0	15.3	15.7	15.9
Number of Times Arrested for Driving Under the Influence in Last Year	2.0	1.2	1.1	1.2
% Arrested for a Drug- or Alcohol-Defined Offense in the Last Year	45.0	34.1	37.3	36.6

*n= 205 for drunk or disorderly conduct arrests due to missing data in three cases: two from Palmer Minimum and one from Wildwood. Total weighted for gender.

Health

When asked about their emotional or psychological health in the past year, half of the Alaskan prisoners said that their health was only "poor" or "fair," rather than "good," "very good," or "excellent." The interviewers asked the 148 subjects who rated their psychological health no better than "good" whether they had been in counseling or treatment for a psychological or emotional problem other than substance abuse in the last year. Twenty-three (11% of the total sample) said that they had received psychological counseling in the last year.

Ten of them (5% of the total sample) had received a prescribed medication for a psychological or emotional problem in the last year. Forty-eight subjects (23% of the sample) reported that they had been "limited, disabled, or impaired in any way in [their] daily activities because of physical, mental, or emotional problems."

Substance Use

Nearly every member of the Alaskan prisoner sample had an extensive history of substance use. Although the diagnostic scales incorporated in the study's questionnaire focus on symptoms caused by substance use rather than substance use per se, establishing lifetime and recent substance use is an essential prerequisite for asking about the problems caused by chronic excessive use. Moreover, learning about substance use is important for describing the sample and comparing it to other populations described in the literature.

Lifetime Substance Use. The Alaskan prisoners reported extensive lifetime (ever) use of every one of the major categories of substances of abuse (Table 9). Alcohol use was universal, and use controlled drugs was nearly so (95%). Ninety-three percent of the sample admitted using marijuana, but only 13% reported that marijuana was the only illicit drug that they used. Four subjects had not used marijuana, but had used cocaine. All of the other respondents reported using more than one controlled drug. Three of four (76%) inmates had tried cocaine at least once. The Alaskan prisoners were least likely to have tried opiates (25%) and inhalants (25%). While some underreporting may be present in these data, the amount of illegal drug use freely admitted by the prisoners during the interviews was substantial even for this population. Having nearly every respondent willing to report a history of illegal drug use is an essential prerequisite for a valid assessment of the substance abuse treatment needs of the inmates.

Table 9. Lifetime Substance Use: Percent Ever Used by Alaskan and Rhode Island Prisoners

Substance	1997 National Survey of Inmates		Rhode Island Prisoners (n=198) Ages 18+	Alaska Prisoners			
	Federal	State		Hiland Mt. (n=40)	Palmer Min. (n= 85)	Wildwood (n=83)	Total (N=208)
Alcohol	NA	NA	100	100	100	100	100
Alcohol, No Controlled Drug Use	NA	NA	5	0	8	4	5
Any Controlled Drug Use	73	83	95	100	92	96	95

Table 9. Lifetime Substance Use: Percent Ever Used by Alaskan and Rhode Island Prisoners

Substance	1997 National Survey of Inmates		Rhode Island Prisoners (n=198) Ages 18+	Alaska Prisoners			
	Federal	State		Hiland Mt. (n=40)	Palmer Min. (n= 85)	Wildwood (n=83)	Total (N=208)
Marijuana	65	77	92	95	92	94	93
Marijuana Only Controlled Drug Used	NA	NA	13	10	14	12	13
Cocaine	45	49	67	83	69	81	76
Hallucinogens	19	29	59	50	57	63	59
Stimulants	21	28	27	45	42	46	44
Sedatives	17	24	34	35	35	35	35
Opiates	16	25	48	30	21	28	25
Inhalants	8	14	18	15	20	31	25

Note: Source for the national survey was Mumola (1999). The Alaska prisoner total is reweighted for gender, while the Rhode Island sample was reweighted for gender and oversampling of persons incarcerated in the last month.
NA= not available.

To provide a perspective for evaluating the substance use levels in the sample of Alaskan prisoners, the authors compared the Alaskan prisoner survey's findings with a 1997 national survey on inmates in state and federal prisons (Mumola 1999) and with a Rhode Island prisoner sample that McAuliffe et al. (2000a) interviewed recently using the same questionnaire (Table 9). Both the Alaskan and Rhode Island samples reported higher rates of use of controlled drugs than the national samples of inmates in federal and state prisons in 1997. For example, whereas 95% of the Alaskan and Rhode Island prisoners had ever used an illicit drug, 83% of the 1997 national sample of state prisoners reported having ever used an illicit drug. It is noteworthy that a national sample of inmates of state correctional facilities in 1974 found that 61% admitted ever using a controlled drug for nonmedical purposes (Barton 1980). A national survey of local jail inmates in 1996 found that 82% reported ever having used illicit drugs (Wilson 2000).

The correspondence between the Alaska prisoner sample and the Rhode Island prisoner sample was remarkable, although there were some differences in the substance preferences. For the Alaskan and Rhode Island prisoner samples the percentages reporting lifetime use of alcohol, marijuana, hallucinogens, and sedatives were identical or nearly so. It is noteworthy that both of these prisoner samples were more likely to have ever smoked marijuana as to have ever smoked tobacco cigarettes 100 times or more (86% of Alaska's prisoners and 88% of Rhode Island's prisoners ever smoked 100 or more cigarettes). Alaskan prisoners reported more cocaine (76% versus 67%), stimulant (44% versus 27%), and inhalant use (25% versus 18%) than the Rhode Island Prisoners reported, but Alaskan prisoners reported less heroin and other opiate use (25% versus [illegible]%) than the Rhode Island prisoners reported.

Statistics from other sources (Synectics for Management Decisions, Inc. & SAMHSA, OAS 1999; McAuliffe et al.1999, 2000c) suggest that these differences between the two prisoner samples are reflections of general differences between the drug abuse scenes in the two states. For example, according to TEDS admissions statistics Alaska and Rhode Island had about the same number of admissions in 1997 (8,455 for Alaska and 9,146 for Rhode Island), but more of Alaska's than Rhode Island's admissions were for stimulants (55 versus 7), slightly fewer for cocaine (715 versus 828), but far fewer for opiates (124 versus 3,930) (Synectics for Management Decisions, Inc. & SAMHSA, OAS 1999, pp.88-89).

Recent Alcohol Use. Most of the Alaskan inmates drank alcohol in the full year prior to being imprisoned, and they generally drank heavily. Eighty-three percent of the Alaskan prisoners reported alcohol use during the year, and 76% drank during the month prior to incarceration (Table 10). Of those who abstained in the last year, half drank during the year before last. Nearly a quarter (24%) of those who drank during the 12 months prior to incarceration did so every day or nearly every day. Most (62%) of the others drank at least once a week during the year. A commonly used definition for "binge drinking" (e.g., the definition used in the BRFSS surveys and in many college studies) is having five drinks in one day. Seventy-two percent of the prisoners who drank alcohol during the 12 months prior to incarceration reported that they had five drinks or more on average every day that they drank. The median for drinkers was eight drinks per drinking day on average. The interviewers also asked directly, "In your lifetime, have you ever gone on binges where you kept drinking for a couple of days or more without sobering up?" Sixty-two percent of the prisoners said that they had. This more stringent definition of binge drinking came from the Diagnostic Interview Schedule (Robins et al. 1998).

Table 10. Recent Use of Substances: Last Year and Last Month Prior to Incarceration

	1997 National Survey of Inmates: % Month Prior to Offense	Rhode Island Prisoners (n=198)	Alaska Prisoners (n=208)

	Federal	State	% Any Use in Last year	% Last Month	% Any Use in Last year	% Last Month
Alcohol	NA	NA	81	70	83	75
Marijuana	30	39	66	57	63	49
Cocaine	20	25	48	38	40	27
Sedatives	3	5	23	14	13	6
Hallucinogens	2	4	23	10	10	4
Heroin and other opiates	5	9	35	27	6	3
Stimulants	8	9	5	1	8	3
Inhalants	1	1	3	1	2	1
Any controlled drug use	45	57	85	81	74	61

NA= Not Available; Source for the 1997 national survey of federal and state prisoners was (Mumola 1999).The Alaska prisoner total is reweighted for gender, while the Rhode Island sample was reweighted for gender and oversampling of persons incarcerated in the last month.

In the BRFSS survey, "chronic drinking" is defined as having sixty drinks or more a month. In this sample, all of the 40 subjects (19% of the total sample) who reported daily drinking during the past year averaged at least three drinks a day and would therefore qualify as a chronic drinkers. When asked how many drinks they had on the day that they drank the most in the last year, the median prisoner who drank reported that he or she had 18 drinks that day.

Recent Controlled Drug Use. Three out of four (74%) Alaskan inmates admitted illegal drug use during the full year before they were incarcerated, and more than half (61%) of the respondents used an illegal drug in the month before entering jail (Table 10). Half (49%) of the Alaskan inmates admitted marijuana use in the month before incarceration, and 20% of the total sample reported using the drug on a daily basis during the year prior to incarceration. More than a quarter (27%) of the sample reported cocaine use in the 30 days prior to incarceration, and seven percent of the total sample used cocaine on a daily basis in the year prior to incarceration.

Just as in their lifetime use, the inmates were most likely to have used marijuana and cocaine during the periods just prior to becoming incarcerated this time. Few of them reported recent use of heroin and stimulants.

The Alaskan prisoners' use of controlled drugs in the month before incarceration closely paralleled the levels of use reported by the national sample of state prisoners. Although the Alaskan prisoners reported a higher level of marijuana use (49%) than the national sample of state prisoners reported (39%), the Alaskan prisoners reported lower levels of use of opiates and stimulants than the national state inmate sample reported (9% for the national sample versus 3% for the Alaskan sample). Otherwise the two samples were quite similar with regard to past-month use of other controlled drugs (cocaine, sedatives, hallucinogens, and inhalants).

With the exception of stimulants, more of the Rhode Island sample than the Alaskan prisoner sample reported use of controlled drugs prior to incarceration. Eighty-one percent of the Rhode Island prisoners reported use of a controlled drug during the month before their being incarcerated, a rate that was 20% higher than the percent reported by the Alaskan prisoners. The largest percentage difference between the two samples was with regard to opiate use. The eight-fold difference between the Alaskan and Rhode Island prisoner samples regarding recent use of opiates was even larger than the difference observed for lifetime use. Relatively few of the Alaskan prisoners used opiates in the last year (6%) and in the last month (3%), while large proportions of the Rhode Island sample had done so (35% in the last year and 27% in the last month).

Self-Reported Substance Problems and Self-Diagnoses

The interview included a series of questions to assess the extent to which the subject's drinking or drug use led to common substance-related problems. As part of the qualifying criteria for being asked the DSM diagnostic questions, these items occurred prior to questions about the clinical symptoms of abuse and dependence. Twenty-seven percent of the Alaskan inmates reported that they had ever been admitted to hospital or emergency room for an alcohol-related injury or illness. More of the prisoners at Palmer Minimum (30%) had been in a hospital due to alcohol use than the prisoners at Palmer Minimum (25%) or at Hiland Mountain (20%). Thirty-seven percent of the total weighted Alaskan sample said that a doctor or health professional told them that they should cut down on drinking before it caused serious damage to their health.

The interviewers asked subjects about alcohol problems and dependence directly, "Have you ever had a drinking problem or felt dependent on alcohol?" Fifty-seven percent (118 of 208 inmates) of the sample responded yes. When asked when was the last time that they had a problem or were dependent on alcohol, nearly half (48% of 118) gave a date in the current calendar year (2000). Seventy-seven percent of the 118 persons who admitted having an alcohol problem gave a date in the past three years (1998 to 2000).

Several questions assessed the presence of severe problems due to use of one or more controlled drugs. Fourteen percent of the Alaskan prisoners said that they had gone to an emergency room for a drug overdose, bad reaction, or drug-related illness or injury at least once in their lives. Forty-four percent said that they had ever had a drug problem or been dependent on a drug. A larger percentage of the Highland Mountain inmates (63%) than the Wildwood (43%) or Palmer Minimum inmates (41%) admitted to having had a drug problem or having been dependent on a drug. Conklin et al. (2000) reported that more female than male inmates in a Massachusetts prison reported having an alcohol problem and having a drug problem. The percentages of Alaska's inmates reported having been dependent on or had a problem with each specific drug were: cocaine (29%), marijuana (22%), opiates (8%), stimulants (6%), inhalants (2%), and hallucinogens (1%). There was a remarkably close match between these lifetime percentages and the percentages of the sample who needed treatment for these substances in the last year.

Substance Use Disorders

Lifetime Substance Use Disorder Diagnoses. A remarkable ninety-one percent of Alaska's prisoners have had a substance use disorder (abuse or dependence) according to DSM-IV criteria at some time in their lives (Table 11). Only two subjects failed to qualify for the diagnostic questions. Most often, the subjects who had a lifetime substance use disorder met the DSM-IV's clinical criteria for substance dependence at some time in their lives. Eighty-four percent of the Rhode Island prison inmates had a lifetime substance use disorder. Four out of five (81%) of the Alaskan prisoners have had an alcohol use disorder, and three out of five (61%) have had a drug use disorder in their lives. Many more (24%) met formal criteria for alcoholism than the 57% who admitted that they had a problem or felt dependent on alcohol when asked directly. Two out of five (38%) respondents had a cocaine use disorder. The males at Palmer Minimum and Wildwood were more likely than the females at Hiland Mt. to have had alcohol use disorders, while the females at Hiland Mt. were more likely than the males in the other two prisons to have had a cocaine use disorder. Males were also more likely than females to have abused hallucinogens. With the exception of hallucinogens and sedatives, most of these substance use disorders were dependence rather than abuse. Clearly, the prisoners had extensive histories of substance use disorders involving the full range of legal and illegal substances.

Table 11. Lifetime Substance Use Disorders

	% At Individual Institutions			% Total Alaska Prisoners (n=208)[a]		
Substance	Hiland Mt. (n=40)	Palmer Min. (n= 85)	Wildwood (n=83)	Abuse	Dependence	Substance Use Disorder
Alcohol	65	85	80	21	59	81

Table 11. Lifetime Substance Use Disorders

Substance	% At Individual Institutions: Hiland Mt. (n=40)	Palmer Min. (n= 85)	Wildwood (n=83)	% Total Alaska Prisoners (n=208)[a]: Abuse	Dependence	Substance Use Disorder
Cocaine	63	33	39	3	35	38
Marijuana	33	41	35	13	25	38
Stimulants	15	8	16	2	10	12
Opiates	13	9	10	2	8	10
Hallucinogens	3	9	12	7	3	10
Sedatives	5	2	6	2	2	4*
Inhalants	0	1	8	2	3	4
Any Controlled Drug	68	56	64	8	53	61
Any Substance	85	92	90	16	75	91

*N = 205 for sedatives. [a] Reweighted by gender.

Treatment Need: Substance Use Disorder Diagnoses in the Last Year. Consistent with findings from other states reported in previous studies (see Table 1), a large majority (79%) of the recently incarcerated prisoners in Alaska had a substance use disorder (abuse or dependence) during the past year when on the outside (Table 12). Sixty-seven percent of the Alaskan prisoners had an alcohol use disorder in the last year when not in prison during the past year, and 43% had a drug use disorder in the last year when on the outside. Cocaine and marijuana use disorders (30% and 22% respectively) were the most common causes of drug use disorders. Thirty-three percent of the total sample had a use disorder for a drug other than marijuana during the 12 prior to the interview when the respondent was on the outside. These data suggest that most of the Alaskan prisoners in the study's three subsamples had an active substance use disorder that warranted treatment services prior to their incarceration, and they would presumably benefit from treatment services during and upon release from custody.

Table 12. Treatment Need in the Last Year on the Outside

Substance	% Rhode Island Prisoners (n=198)[b]			% Alaska Prisoners (n=208)[a]		
	Abuse	Dependence	Needed Treatment	Abuse	Dependence	Needed Treatment
Any Substance	9	73	82	12	67	79
Alcohol	15	43	58	13	54	67
Any Controlled Drug	4	58	62	4	39	43
Cocaine	2	36	38	1	27	28
Marijuana	5	21	26	6	17	23
Stimulants	0.2	1	2	1	5	6
Heroin**	4	25	28	1	4	5
Hallucinogens	1	4	5	2	2	4
Sedatives***	3	7	9	1	2	3*
Inhalants**	0.2	0	0.2	0	1	1

*n=205;**n=197; ***n=196. [a] Reweighted by gender. [b] Reweighted by gender and admission in last month.

Alaska's prisoners, specifically the men, were more likely than Rhode Island prisoners to have needed treatment for alcohol use disorders in the past year (67% versus 58%), while Rhode Island's prisoners were more likely than Alaskan prisoners to have needed treatment for controlled drug use disorders (62% versus 43%) (Table 12). The biggest difference involved abuse and dependence on heroin and other opiates (28% in Rhode Island versus 5% in Alaska).

Table 13. Need for Treatment During the Last Year When on the Outside, by Prison

Substance	Hiland Mt. (n = 40)	Palmer Min. (n = 85)	Wildwood (n = 83)
Any Substance	79	80	78
Alcohol	58	73	63
Any Controlled Drug	60	40	42
Cocaine	53	22	28
Marijuana	18	25	22
Stimulants	10	2	6
Heroin	5	4	4
Hallucinogens	0	2	7
Sedatives*	5	0	6
Inhalants	0	0	2

*N = 39 for Hiland Mt., 83 for Palmer Min., and 83 for Wildwood.

These differences between the two states are consistent with findings from the present authors' social indicator analyses of alcohol and drug problems among states (McAuliffe et al. 1999, 2000). In 1994-1996, whereas Alaska had the second greatest level of need for alcoholism treatment in the country, Rhode Island had the 34th highest level of need for alcohol treatment. During the same period, Rhode Island ranked 18th with regard to drug treatment needs, while Alaska ranked 31st on the same composite drug need index. Alaska had only 134 opiate treatment admissions in 1997, and the present data suggests that there is no large body of opiate addicts in Alaska who are ending up in jail for lack of treatment services. Like the prisoner interview results, treatment admissions statistics reported to TEDS in 1998 indicated that most of the people who obtained treatment in Alaska reported a primary problem with alcohol, cocaine, or marijuana (Office of Applied Studies 2000a, p. 106). Thus, any new treatment services in Alaska's prisons most likely should focus on treatment of alcohol, cocaine, and marijuana use disorders.

Treatment Need by Gender and Race. The percentage of inmates who ever needed treatment in their lives and in the last year were similar at all three prisons, although the women at Hiland Mountain were more likely to need treatment for cocaine and other stimulants while the men at the other two prisons were somewhat more likely to need treatment for alcohol, marijuana, and hallucinogens (Tables 13 and 14). The males had a higher rate of lifetime substance use disorders (91% versus 85%). The difference between the genders narrowed so that the males and females had virtually the same rate of current substance use disorders.

Table 14. Lifetime Use Disorder Diagnoses and Current Treatment Need, by Demographic Characteristics

Characteristic		% with Lifetime Substance Use Disorder Diagnosis	% Needing Treatment in the Last Year
Gender	Male (n = 168)	91	79
	Female (n = 40)	85	78
Race	Alaska Native, American Indian (n = 89)	97	88
	White (n = 79)	90	76
	African American (n = 35)	83	74

Note: The race estimates have been reweighted by gender.

The category of Native Alaskans/American Indians had the highest lifetime (97%) and current rates (88%) of substance use disorders among Alaskan Prisoners. These statistics are consistent with other research documenting the high rates of alcohol problems among Native Alaskans (Beauvais 1998; Segal 1998). Whites had the next highest rates (90% lifetime, 76% current), while African Americans had the lowest rates (83% lifetime, 74% current) among the three largest racial groups in the sample.

Medical Complications of Alcohol and Drug Use Disorders. During the interview, the interviewers asked a series of questions on general health that included items on medical and psychiatric conditions that are associated with substance use disorders but only one of which explicitly mentioned alcohol or drugs (Table 15). The first set were contagious diseases, and the second set were injuries. When asked about diseases and injuries associated with substance use disorders, the Alaskan prison samples did not differ markedly. The women at Hiland Mt. were more likely to report contagious diseases and high blood pressure, while the men were more likely to have automobile accidents and head injuries. All prison samples were equally likely to have an overdose or untoward reaction to drugs or alcohol.

Table 15. Medical Complications of Drug-use Disorders (Percent)

Have you ever been told by a doctor or other medical professional that you	Hiland Mt. (n=40)	Palmer Min.	Wildwood (n=83)	Weighted Total

have:		(n=85)		Prisoner Sample
Tuberculosis, Syphilis, Hepatitis, or endocarditis?	35	20	21	22
Gastritis, cirrhosis, or cancer of the lip, throat or stomach?	8	7	4	6
High blood pressure?	23	18	15	17
In the past year while on the outside, have you gone to an emergency room, hospital, health center, or doctor's office because of . . .				
A fall, burn, or injuries from a fight?	18	19	15	17
An automobile accident that was your fault?	3	2	7	6
An overdose or bad reaction from alcohol or drugs?	8	8	7	8
A head injury?	10	6	13	10

Treatment History

Alaska's prisoners reported receiving substance abuse treatment services from a variety of providers outside of prison. The present analysis includes a broad array of treatment forms but distinguishes between treatment provided on the outside by specialists, self-help organizations such as Alcoholics Anonymous (AA) and Narcotics Anonymous (NA), and by nonspecialists (e.g., pastoral counselors or general therapists). Substance abuse treatment funded by the federal Substance Abuse Prevention and Treatment (SAPT) Block-Grant and other state funds is provided mostly by professionals or paraprofessionals who are substance abuse treatment specialists. As described in Table 18, this form of treatment includes detoxification in a hospital or specialty treatment facility, residential rehabilitation or halfway house, outpatient counseling, and special medications such as methadone and Antabuse. Many substance abusers who receive specialty treatment also depend on self help groups as part of their care, while other substance abusers may utilize only self help treatment. There is also a range of other providers who do not specialize in substance abuse services but who provide a significant proportion of substance abuse services. When asking about treatment from these providers, the instrument carefully specified that care was for alcohol or drug problems.

Table 16. Treatment Received on the Outside, Lifetime and Past Year

Type of Treatment on Outside	% Lifetime (n=208)	% Past Year (n=208)
Any Type of Treatment	79	53
Specialty	68	27
Self Help	66	37
Nonspecialty	47	33
Combinations of Providers:		
Specialty Only	5	2
Specialty and Self Help, or Nonspecialty, or Both	63	25
Self Help and/or Nonspecialty	11	26

The interviewers asked all of the prisoners who reported ever using alcohol or controlled drugs, "Alcohol [drug] treatment might include a stay in a hospital, treatment center, or halfway house. Treatment could also consist of seeing a counselor, attending a self-help meeting (like AA [Narcotic Anonymous]), or receiving medication such as Antabuse [methadone]. Have you ever received any kind of treatment or counseling for alcohol [drug] use outside of prison?" If the respondents answered *yes* to either of these questions, the interviewers asked a series of follow-up questions regarding the number of episodes of treatment lifetime and during the months when the inmates were on the outside during the past year. The interviewers also asked about specific modalities of treatment, including care from specialty, self help, and nonspecialty providers. Even if the respondents said that they had never received drug or alcohol treatment per se, the interviewers skipped to the questions about nonspecialty and self help treatment. For example, they asked, "Did you ever obtain counseling for drinking or drug use from a psychiatrist, social worker, family therapist, or counselor who does not specialize in treating substance abuse or work in a substance abuse program?" The questions about nonspecialty treatment covered services from providers that were not explicitly mentioned in the general question about receiving treatment. Nonspecialty treatment included employee assistance counselors, pastoral counselors, family doctors, outreach workers, acupuncturists, general health counselors or advisors, drunk-driving classes or court-appointed treatment classes, and emergency care facilities or programs for acute intoxication. The questions about sources after family doctors focused only on the last year.

Any Type of Treatment. In the broadest definition of treatment used in this analysis, all of these forms of care have been included as nonspecialty treatment, as distinct from professional and paraprofessional specialty care and self help (Table 16). During their lives, 79% of the

Alaskan prisoner sample received treatment on the outside from specialty, self help, or nonspecialty providers. A larger percentage of the female inmates at Hiland Mountain (85%) than the male inmates at Palmer Minimum (80%) and Wildwood (76%) and had ever received treatment of any kind on the outside.

In the past year, 53% of the Alaska prisoners received some form of treatment on the outside. There was little difference between the women incarcerated at Hiland Mountain (55%) and the men at the other two prisons (53%) in the percentage that received treatment on the outside in the past year.

Specialty, Self Help, and Nonspecialty Providers. Sixty-eight percent of the total sample received specialty treatment at some time in their lives, 66% attended self help groups, and 47% received help with alcohol or drug problems from nonspecialty services at some point in their lives. While a small group of respondents (5%) had received only specialty treatment in their lives, most of the Alaska prisoner respondents received specialty treatment in combination with self help or nonspecialty services (63% of the total sample lifetime). Another group (11%) of the inmates had received only self help or nonspecialty treatments in their lives.

In the past year, twenty-seven percent received treatment from specialty providers, in nearly all cases receiving care from self help or nonspecialty providers as well. Twenty-six percent of the total sample received treatment from only self-help groups or nonspecialty providers in the last year. In nearly all instances, the Alaskan prisoners received treatment just once in the last year, which is not surprising since they were on the outside slightly less than half of the year on average. Because of the importance of specialty services funded by the Block Grant and state funds, the analyses will focus on the respondents who received specialty care versus those who did not.

Lifetime Specialty Treatment History. More of the Alaskan inmate sample (68%) than the Rhode Island inmate sample (52%) and the 1997 national samples of state (35%) and federal (25%) prison inmates reported having received specialty treatment during their lives (Mumola 1999).[5] Many of the prisoners had received treatment repeatedly during their lives. When the interviewers asked the Alaskan prisoners how many different times (episodes of care) they had received treatment for a substance use disorder, forty-two percent said that they had received treatment once or twice, and 25% said that they had received it three or more times. The Rhode Island prisoners were more likely than the Alaskan prisoners to have received treatment three or more times (34%), but the Rhode Island inmates were less likely than the Alaskan prisoners to have received treatment once or twice versus (18%) in their lives. Thus, a substantial majority of the Alaskan prisoners who received substance abuse tr tment on the outside, and a quarter of

[5]Because most studies have ignored nonspecialty care for substance abuse services, what we have distinguished as specialty and self help treatment other studies typically refer to as "treatment."

the sample had a history of multiple episodes of some form of care during their lives. The Hiland Mountain inmates were more likely to have received specialty treatment at least once in their lives (78%) than were the Palmer Minimum inmates (69%) or the Wildwood inmates (65%).

Of the prisoners in the Alaska sample who received professionally-delivered specialty substance abuse treatment at least once in their lives, more had ever received residential rehabilitation treatment than other forms of specialty treatment. The relative frequency of residential treatment is an indication of the severity of the inmates' substance abuse problems, since only 11% of Alaska's treatment clients in 1998 were in residential treatment according to the federal Uniform Facilities Data Set (UFDS) study (Office of Applied Studies 2000b, p. 64). The Alaskan prison respondents reported having received outpatient counseling delivered by professional specialty providers next most often after residential treatment.

With the exception of detoxification treatment, more of the Alaskan prisoners than the Rhode Island prisoners reported lifetime treatment in specialty treatments, although the relative proportions who received different types of treatment were fairly similar in the two samples. For example, long-term residential treatment was the most common specific form of professionally-delivered specialty treatment in both samples. The largest differences were the much higher proportion of Alaskan prisoners than Rhode Island prisoners who had ever been in short-term residential treatment and intensive outpatient treatment. Rhode Island prisoners were more likely than the Alaskan prisoners to have received methadone treatment in their lives.

Table 17. Lifetime and Past-Year Professional Specialty Treatment for Substance Abuse When Outside of Prison

Measure	% Rhode Island Prisoners (n=198)[a]		% Alaska Prisoners (n=208)[a]	
	Lifetime	Past Year	Lifetime	Past Year
Specialty Treatment (With and Without Self Help And/or Nonspecialty Treatment)	52	31	68	27
Types of Specialty Treatment Received:				
Detox Treatment	34	17	25	3
In Hospital	16	4	7	0
In Residential Facility	27	11	22	3
Outpatient	6	4	4	1
Inpatient/Residential Rehabilitation	34	18	53	15
Residential, Long-term (> 30 days)	30	16	38	11

Table 17. Lifetime and Past-Year Professional Specialty Treatment for Substance Abuse When Outside of Prison

Measure	% Rhode Island Prisoners (n=198)[a]		% Alaska Prisoners (n=208)[a]	
	Lifetime	Past Year	Lifetime	Past Year
Residential, Short-term (< 30 days)	8	3	24	5
Hospital	8	1	5	1
Halfway House	11	5	19	4
Outpatient	28	15	45	15
Less intensive	22	11	33	11
Intensive	9	3	19	6
Methadone	7	6	1	1
Antabuse	5	0	5	0

[a] The Alaska prisoner sample was reweighted to adjust for oversampling females, while the Rhode Island prisoner sample was reweighted to adjust for oversampling females and newly incarcerated persons (incarcerated within the last month). One Alaska prisoner's responses for treatment in the past year was missing due to interviewer error.

Specialty Treatment in the Past Year. In the past year, 26% of the inmates received specialty treatment once or twice, while just 1% received it more than twice. Inmates at Palmer Minimum were more likely (32%) than were the inmates at Hiland Mountain (25%) or Wildwood (23%) to have received specialty treatment in the last year when on the outside. The professionally-delivered specialty treatment consisted most often of outpatient counseling (11%) or long-term residential care (11%). The next most common treatments were intensive outpatient treatment and short-term residential. With the exception of admissions to detox and methadone maintenance, the past-year treatment experiences reported by the Rhode Island prisoners were remarkably similar to those reported by the Alaskan prisoners.

Self Help and Nonspecialty Sources of Substance Use Disorder Treatment. The most frequently utilized source of treatment by far was self help groups such as Alcoholics Anonymous (Table 16). Three times as many prisoners obtained care from self help groups than from any other specialty or nonspecialty treatment source (Table 18). The next most frequently used nonspecialty professional treatment sources were psychological therapists (20% lifetime and 8% in the past year) and faith-based counselors (18% lifetime and 12% past year). Fourteen percent of the sample had attended a DUI or court-appointed treatment class. Only a small percentage of respondents received care from the remaining sources in Table 18.

The Hiland Mountain inmates were slightly more likely (80%) than the Palmer Minimum (78%) or the Wildwood (69%) inmates to have received nonspecialty substance abuse treatment at least once on the outside. The Hiland Mountain inmates were about as likely (55%) as the Palmer Minimum (54%) and slightly more likely than the Wildwood inmates (47%) to have received this form of treatment in the last year when they were on the outside.

Treatment in Prison. A substantial proportion of the inmates had received treatment when they were incarcerated at some time in their lives. The interviewers asked all subjects who had used alcohol whether they had ever received treatment in prison. Fifty-five percent of the total sample had been treated for alcohol problems when in prison at some point in their lives. Because the male prisoners were more likely than the female prisoners, it was not surprising that the male prisoners in Palmer Minimum (64%) and Wildwood (51%) were much more likely than the female prisoners in Hiland Mountain (30%) to have been treated for alcohol problems while in prison at least once in their lives.

The interviewers asked the 107 prisoners who said that they had ever received alcohol treatment in prison, how often they had received treatment and whether they received it during the current incarceration. Eighty-five percent of them had received substance abuse treatment once or twice, 9% received it three or four times, and 6% received it more often. Somewhat more of the female male prisoners (66%) than the male prisoners (59%) who have ever been treated for alcoholism in prison have received some form of treatment during their current incarceration. According to Department of Corrections information (Williams 1995), all three of the institutions sampled in this study have outpatient treatment programs for substance use disorders.

Prisoners who received treatment for drug abuse on the outside were asked whether they ever received treatment for drug abuse in prison. Fifty-six percent responded affirmatively.

Table 18. Nonspecialty Sources of Alcohol and Drug Use Disorder Treatment

Nonspecialty Treatment Sources	% Received Treatment (n=208)	
	Lifetime	Last Year
Nonspecialty Therapists, Such as General Psychiatrist, Counselor	20	8
Religious or Pastoral Counselors	18	12
Family Doctor	8	3
Employee Assistance Counselor	5	2
Drunk-driving or Court-appointed Treatment Class	NA	14

Table 18. Nonspecialty Sources of Alcohol and Drug Use Disorder Treatment

Nonspecialty Treatment Sources	% Received Treatment (n=208)	
	Lifetime	Last Year
Acupuncturist, Outreach Worker, or General Health Counselor or Advisor	NA	8
Emergency Care or Acute Intoxication Facility or Program	NA	3

NA=Not available because the questionnaire asked about the last year only for the bottom three treatment sources in this table.

Met Need for Treatment

On the Outside. Although most inmates who have ever needed treatment have obtained it at some time in their lives, nearly half of those who needed treatment in the past year did not obtain treatment. Of the 187 Alaskan prisoners who ever had a substance use disorder, 82% (reweighted) received some form of substance abuse treatment on the outside at some time in their lives (Table 19). Thus, 18% of the newly incarcerated prisoners have lifetime histories of substance use disorders but have never received any form of treatment. While most (71%) of the those with lifetime need received specialty treatment, with or without self help and nonspecialty treatment, 11 percent of the persons with lifetime need for treatment received only nonspecialty or self help treatment services. The female prisoners at Hiland Mountain who had a lifetime substance use disorder were more likely to have received treatment on the outside (91%) than were the males prisoners at Palmer Minimum (82%) and at Wildwood (80%). Alaska Natives in need during their lives were about as likely to have obtained some form of treatment on the outside at least once (81%) as were Whites (81%) and African Americans (79%). These statistics show that the percentage who have obtained some form of treatment in their lives is quite high in virtually every segment of the inmate population.

Of the 163 inmates who had a substance use disorder during the last year, 57% received treatment in the last year (Table 19). Twenty-nine percent received substance abuse treatment from specialty sources with or without self help or nonspecialty care as well in the last year when they were on the outside, and another 28% of those with a current diagnosis received treatment from self help or nonspecialty sources only. In previous studies of the general population, McAuliffe et al. (1991; 2000b) found that about one in five or six respondents who had a current diagnosis had received treatment in the past year.

Table 19. Met Need for Treatment (Percent)

	Highland Mt.	Palmer Min.	Wildwood	Total Alaska Sample
% of Persons with a Lifetime Substance Use Disorder Diagnosis Who Were Ever Treated on the Outside	91	82	80	82
% of Persons with a Substance Use Disorder Diagnosis in the Last Year Who Obtained Treatment in the Last Year on the Outside	55	63	52	57

Note: total sample n=187 for lifetime diagnoses, and total sample n=163 for current diagnoses.

Clearly, a substantial proportion (43%) of prisoners in need had not received treatment services prior to incarceration. If that percentage generalized to the total population of Alaska's prisoners, 481 persons currently in prison needed treatment on the outside during the last year. That is the figure that should be added to the estimated number of state residents who needed treatment as estimated from the household survey. Of that number, 141 received specialty treatment, 135 received only self help or nonspecialty treatment, and 205 received no treatment at all. It would be reasonable to assume that the 135 may be somewhat underserved and that the 205 were unserved. Those 340 inmates were therefore in need of specialty services in the last year.

There were 18 inmates who did not have a diagnosis in the last year but who nevertheless obtained some form of treatment (half specialty and half only self help and nonspecialty treatment) on the outside. Fifteen of these 18 prisoners were in sustained full remission from dependence (12 cases) or were past abusers (three cases). The remaining three respondents never met criteria for abuse or dependence, although all three qualified for diagnostic questions and reported one or more symptoms of dependence. One of the three said that he/she had a problem or dependence on marijuana when asked directly, and the other two subjects reported having experienced three symptoms of dependence but denied that the symptoms that the symptoms clustered within a one-year period as required by the DSM-IV criteria for dependence. With one exception, these subjects with no diagnoses reported receiving treatment from either self-help groups or from a general health counselor or a DUI class. It appears likely therefore that these three subjects were on the borderline, while the other 15 were in remission.

The existence of these cases suggests several implications. By focusing on only persons who have a current diagnosis of substance use disorder, the analysis is conservative in its measurement of the need and demand for treatment. Because addiction is a chronically relapsing condition, it is reasonable to assume that these 15 subjects needed the treatment that they received (e.g., attendance at AA meetings), even though they were technically in remission or did not have a substance use disorder. Although the three subjects who did not have a diagnosis may have used the treatment as a form of secondary prevention, it is likely that they represent instances of insensitivity of the diagnostic instrument, perhaps due to the respondents' underreporting of symptoms or difficulty pinpointing the timing of symptoms. Reporting the clustering of symptoms and when it occurred was the most demanding aspect of the diagnostic interview. The subjects who were in remission nevertheless committed a crime for which they were incarcerated. Consequently, successful treatment of a substance use disorder may not insure that the criminal will abstain from criminal activity, but there is little doubt that recovery would reduce the probability or amount of crime.

In Prison. Among the 164 prisoners who needed alcoholism treatment in their lives, 64% ever received alcohol treatment when in prison. Among the 27 prisoners who ever needed alcohol treatment but said that they had never received treatment on the outside, 53% received alcohol treatment in prison. Although this percentage was lower than the percentage who had received specialty treatment on the outside (66%) and non-specialty treatment only (63%), more than half of those who had a problem but never received treatment on the outside obtained it in prison at least once.

Among the prisoners who were in need of alcohol treatment on the outside during the past year and who ever received alcohol treatment in prison, 48% received treatment in prison during the current prison sentence.

Unmet Demand For Treatment

Questioning the subjects who qualified for the diagnostic questions based on use alcohol or drugs in the last year but who did not obtain any type of treatment on the outside, the interviewers asked whether they would have sought treatment if it had been available. Among the subjects who had a diagnosis (needed treatment) but who failed to obtain care in the last year, thirty-seven percent (26 of 69) said that they would have sought treatment. If the number of prisoners in the study sample were generalized to the entire Alaskan prison population, there would be 293 prisoners in the last year who represented unmet demand for treatment. That number should be added to the similar figure in the telephone survey to obtain a more comprehensive estimate of unmet demand for treatment in the state.

The interviewers asked those 26 subjects whether they had taken any steps to obtain treatment. A majority (14 of 26, or 54%) said that they had taken steps. The interviewers then asked them whether the steps included any items on a list which contained an open-ended item asking about any other steps the person might have taken. A majority of the 14 subjects who took steps, reported taking two or more steps. One subject responded *yes* to seven different steps that the person took to obtain care. Two subjects who did not have a current diagnosis also said that they would have sought treatment and had taken steps to obtain it. The steps, in the order of frequency, included calling a detox or other program (9 prisoners), talking to a knowledgeable person, such as clergy, a relative, or a family friend (9), getting a referral (6), asking friends about what is available (4), visiting a treatment program including AA (3), talking to a doctor or nurse (2), or talking to an employee assistance counselor (1). None of the prisoners mentioned any other steps. The interviewers also asked those subjects who had taken steps to obtain treatment whether they had ever been on a waiting list. Five of 14 said that they had been on a waiting list in the last year.

Type of Treatment Desired. The interviewers then asked those respondents which types of treatment they would have sought (Table 20). While no single form of treatment stood out, the largest percentages of subjects said that they would have sought mostly long-term forms of care (halfway house [21%], intensive outpatient care [18%], self help groups [18%], lower intensity outpatient counseling [17%], and residential treatment that lasted less than 30 days [15%]).

Table 20. Type of Treatment Sought by Respondents Who Did Not Receive Treatment

Type of Treatment That Would Have Been Sought	Percentage of Respondents Who Qualified for Diagnostic Questions But Had Not Been Treated Last Year (Weighted Sample)
Detox Treatment	12
Residential	11
Hospital	6
Outpatient	6
Methadone	0
Inpatient/Residential	20
Residential, < 30 days	15
Hospital	7
Residential, > 30 days	13
Halfway House	21
Outpatient	22
Less Intensive	17
Day Treatment	14
Intensive	18

Table 20. Type of Treatment Sought by Respondents Who Did Not Receive Treatment

Type of Treatment That Would Have Been Sought	Percentage of Respondents Who Qualified for Diagnostic Questions But Had Not Been Treated Last Year (Weighted Sample)
Methadone	8
Nonspecialty Therapists	14
Employee Assistance Program	10
Self-Help Group	18
Religious	12

Unmet Demand for Additional or a Higher Level of Treatment. Of the subjects who received treatment in the last year, nearly half (49%) said that they would have wanted longer, more intensive, or additional services than they received if the services had been available. If these results were projected to the state population, 149 prisoners were estimated as wanting additional treatment in the past year when on the outside. This finding suggests a level of motivation among the prisoners who obtained treatment. The largest proportion of them wanted treatment outside of formal programs, outpatient counseling, and self-help groups (Table 21).

Table 21. Unmet Demand for Additional Treatment: Type of Treatment Wanted

Type of Treatment	Percent Who Wanted It (n = 54)
Treatment Outside of a Formal Program	93
Outpatient Counseling	92
Self-Help Groups such as AA or NA	88
Residential or Inpatient Rehabilitation	76
Halfway House, Recovery House or Group Home	72
Other types of services such as child care, family counseling, case management, food stamps, and so on	69
Detox	54

Note: The sample size is reweighted to reflect the percentage of females in the prison population The unweighted sample size was 55.

Obstacles to Obtaining Treatment

The interview asked a subgroup of subjects about obstacles to obtaining treatment. The subjects were those who wanted and needed treatment or additional treatment but did not obtain it. The most common reason for failing to obtain treatment was the absence of insurance or a way to pay for treatment (Table 22). The prisoners also cited red tape and hassles during the admissions process. A number of prisoners mentioned that the treatment programs were full, that the respondent lacked transportation, or that the programs were too far away. Relatively few of the prisoners said that they were deterred from obtaining or seeking treatment because the programs did not represent the prisoners' language or ethnic background. By contrast, the small number of females in each group were somewhat more likely to feel that the programs were insensitive to the special needs of women. Few complained that the desired type of treatment or their preferred treatment was not available in Alaska.

Table 22. Obstacles to Obtaining Treatment On the Outside in the Last Year (Percent of Weighted Sample)

"I am going to read a list of reasons some people give for not getting/for why they have not tried to get help or treatment for drug or alcohol problems. I will read each item on the list, and you tell me if it was a reason you did not get treatment/ additional treatment/try to get help during the last 12 months."	Obstacle to Obtaining Additional or More Intensive Treatment (n = 54)	Obstacle to Obtaining Treatment That Respondent Would Have Sought (n =30)	Obstacles to Obtaining Treatment Even Though Didn't Try to Obtain It (n=16)
You didn't have insurance or any way to pay	62	71	44
The facility, program, or provider put you through too much red tape or hassles getting admitted to treatment	54	58	52
The treatment facilities or programs were full	52	36	13
You did not have transportation to get to or from treatment	36	51	14
The treatment was available only during hours when you had to work or care for children	51	24	27

Table 22. Obstacles to Obtaining Treatment On the Outside in the Last Year (Percent of Weighted Sample)

"I am going to read a list of reasons some people give for not getting/for why they have not tried to get help or treatment for drug or alcohol problems. I will read each item on the list, and you tell me if it was a reason you did not get treatment/ additional treatment/try to get help during the last 12 months."	Obstacle to Obtaining Additional or More Intensive Treatment (n = 54)	Obstacle to Obtaining Treatment That Respondent Would Have Sought (n =30)	Obstacles to Obtaining Treatment Even Though Didn't Try to Obtain It (n=16)
The nearest available services were too far away	41	31	21
Your insurance company would not pay for the type of treatment that you needed (wanted)/additional or more intensive treatment	40	23	23
(IF FEMALE) The facility, program, or provider was not sensitive to the special needs of women.	42 (n=6)	11 (n=4))	40 (n=2)
You did not meet the admission requirements of the program or treatment	39	17	NA
You did not want anyone to know you had a substance abuse problem	35	30	17
The type of treatment that you wanted is not available in [STATE NAME]	20	9	10
(IF DISABLED) The facility was not accessible to you because you had a handicap or disability	22 (n=10)	12 (n=10)	0 (n=3)
The facility, program, or provider did not have counselors or doctors from your ethnic group or who spoke your language	15	4	10
Your counselor or doctor did not think that you needed the additional or more intensive treatment	16	NA	NA
You were on the waiting list, but you had	43	17	NA

Table 22. Obstacles to Obtaining Treatment On the Outside in the Last Year (Percent of Weighted Sample)

"I am going to read a list of reasons some people give for not getting/for why they have not tried to get help or treatment for drug or alcohol problems. I will read each item on the list, and you tell me if it was a reason you did not get treatment/ additional treatment/try to get help during the last 12 months."	Obstacle to Obtaining Additional or More Intensive Treatment (n = 54)	Obstacle to Obtaining Treatment That Respondent Would Have Sought (n =30)	Obstacles to Obtaining Treatment Even Though Didn't Try to Obtain It (n=16)
changed your mind by the time you were called			
The facilities or programs did not have the special services you needed, such as medical or mental health care, housing, employment counseling, or child care.	NA	22	16

SUMMARY AND CONCLUSIONS

Between July 11 and October 13, 2000, the study completed 208 interviews with Alaskan adult residents who entered state correctional facilities during the past year. The inmates had at least one month during the last year when they were not incarcerated. The female respondents (n=40) came from the Hiland Mountain Correctional Center, while the 168 male respondents came from the Palmer Correctional Center's minimum security unit (n=85) and the Wildwood Correctional Center (n=83). The study drew a 100% sample of the three prison units and interviewed all eligible inmates who were willing to participate. The study achieved a 77% response rate, with a range from 74% to 84% at the three prisons. Respondents understood and responded fully to the study's questions. The interviews averaged one hour in length. Measures built into the study design indicated that the data were high in quality.

The interviewed prison inmates were primarily males (81% actual, 91% weighted), aged 35 years, employed (72%) when not incarcerated, and had completed a median of 11 years of education. Thirty-nine percent of the subjects were Alaska Natives, 31% white, and 16% were African Americans. The age and race/ethnicity statistics closely matched statistics for all inmates in the state's prison facilities, except that the female inmates at Hiland Mountain were less likely to be Alaska Natives and less likely to be employed just prior to incarceration. One in five inmates were homeless during the year before imprisonment. On average (unweighted), the respondents had been on the outside for five and a half (5.6) months during the last year. The median prisoner in all three prisons had been incarcerated four times.

The Alaskan prisoners had extensive histories of alcohol use and nonmedical use of contr 'led drugs. All of the prisoners reported using alcohol at some point in their lives, and 95% reported using a controlled drug for nonmedical purposes. The comparable rate of lifetime controlled drug use in a national sample of state prisoners was 83%. The most widely used drugs by the Alaskan inmates were marijuana (93%) and cocaine (76%). Nearly three out of four (74%) of the Alaskan inmates admitted illegal drug use in the year before they were incarcerated, and more than half (61%) of the respondents used an illegal drug in the month before entering jail. Forty percent used cocaine in the past year, and over a quarter (27%) reported cocaine use in the 30 days prior to incarceration. These findings are consistent with or higher than the findings of other published prisoner studies, nd the willingness of every study participant to admit extensive illegal drug use suggests that underreporting was not an overwhelming problem. Nevertheless, it would be reasonable to assume that the study's estimates are conservative.

Histories of substance abuse disorders were nearly universal among Alaska's inmates. Nine out of ten prisoners met formal DSM-IV diagnostic criteria for a substance use disorder at some time in their lives. These statistics are based on the same criteria required to justify admission to treatment services across the nation. Moreover, the study's questionnaire used DIS questions that are the most fully validated in the field. Although it comes as no surprise that many prisoners have drug and alcohol problems, the State now knows the full extent of these problems. The lifetime prevalence rate of substance use disorders among Alaska prisoners' was higher than the rates reported in any previously published studies that included standardized diagnostic measurements of prisoner samples (Table 1).

Four out of five Alaskan inmates have had an alcohol use disorder at some time in their lives, and two out of five had a cocaine use disorder. The males at Palmer Minimum and Wildwood were more likely to have had lifetime alcohol use disorders, while the females at Hiland Mt. were more likely to have had a lifetime cocaine use disorder. Males were also more likely than females to have abused hallucinogens at some time. With the exception of hallucinogens and sedatives, most of these substance use disorders were dependence rather than abuse.

Most (79%) of the Alaskan newly incarcerated inmates were actively abusing or dependent on a substance in the last year and therefore needed treatment provided during the past 12 months when they are not incarcerated. The rate of current substance use disorders was among the highest reported rates in the published literature (Table 1). Sixty-seven percent of the Alaskan prisoners had an alcohol use disorder when not in prison during the past year, and 43% had a drug use disorder in the last year when on the outside. Eighteen of the subjects who lacked a current substance use disorder had received treatment in the last year because either they were in remission or were borderline cases that may have been missed by the assessment instrument.

By comparison with the study's diagnostic findings, only 25% of female prisoners and 10% of male prisoners on December 31, 1999, had been sentenced for a drug-related offense

(Department of Correction 1999). Clearly, focusing on that statistic leads one to underestimate the level of treatment need among prisoners.

There was no difference between males and females in the rate with which they needed treatment during the last year, but Alaska Natives were more likely to have needed treatment in the past year (88%) than were Whites and African Americans (76% and 74% respectively). Nearly all (97%) of the Native Alaskan prisoners had lifetime histories of substance use disorders.

Many of the prisoners had received treatment for substance use disorders in the past when not incarcerated. Seventy-nine percent had received some form of substance abuse treatment (specialty, self help or nonspecialty) during their lives. While the largest percentage (43%) of these prisoners had received treatment once or twice in the past, 26% of this group had received treatment three or more times. In most cases (63% of the total sample), the prisoners had received specialty treatment as well as self help or nonspecialty treatment for their alcohol or drug problems. During the past year, 53% of the prisoners received treatment for substance use disorder in the months before they entered prison. There was no difference between the prison samples in this regard.

A substantial proportion of these subjects had unmet need for treatment services prior to incarceration. Of the Alaskan prisoners who had a lifetime substance use disorder, 18% never received treatment of any kind. Of the subjects who had a substance use disorder in the last year, 43% did not receive substance abuse treatment of any kind in the last year when they were on the outside. Outreach and expanded treatment availability to prisoners in need is an attractive intervention strategy.

There was also evidence of unmet need and demand for treatment in the prisoner sample that needed it. Of the subjects who received treatment in the last year, nearly half (49%) said that they would have wanted longer, more intensive, or additional services than they received if the services had been available.

The interviewers asked the 69 subjects who needed treatment in the last year but had not obtained treatment if they would have sought treatment if it had been available. Thirty-seven percent of the subjects responded affirmatively. Half of them said that they had taken concrete steps in an effort to obtain care. In most cases, they called a program, asked knowledgeable people about the availability of care, or obtained a referral. Some were on waiting lists for treatment. If that percentage of all prisoners in the state needed and wanted treatment but did not receive it, there would have been 293 prisoners in the last year who represented unmet demand for treatment.

The interview asked subjects who qualified for diagnostic questions but did not receive treatment or who wanted additional treatment what explained their fail to seek or obtain desired treatment. The most common reason was the absence of insurance or a way to pay for treatment. The prisoners were also concerned about red tape and hassles during the admissions process. A number of prisoners mentioned that the treatment programs were full, that the respondent lacked transportation, or that the programs were too far away.

Implications

The results showed that the prisoners had extensive histories of substance abuse and high levels of treatment need. The vast majority of inmates had problems with alcohol or drugs. Many had received needed treatment, but some of these seriously ill substance abusers are apparently falling through the cracks in the system. Of those who needed but did not receive treatment, more than a third said that they would have sought it if it had been available or had sought it without success. Of those who did receive treatment in the past year, half said that they would have sought more treatment if it had been available. Thus, the treatment needs of Alaska's prisoner-to-be population are great, many have received treatment, but many would utilize additional care if it is made available. These findings can be used to justify expansion of services in Alaska.

The study showed that failing to estimate the treatment needs of state residents who were in custody would result in underestimation of the overall state need for treatment services, although the actual number was small when compared to the total state population. While the rate of need among prisoners is probably greater than any group besides clients in treatment, the number of recently incarcerated prisoners at any point in time is not very large. In Alaska, the estimated number was 610. Part of the explanation is that on any day many of persons who were incarcerated during a year have been discharged. As a result, their treatment needs are part of the estimate obtained from the household survey of the general population or in estimates of the needs of homeless people, people in households without telephones, and persons who have died of diseases related to their substance use disorders. Despite their relatively small size, this population is at extremely high risk of substance abuse, medical complications, and committing crimes as a result of their continued dependence on alcohol and drugs.

The study confirmed the growing realization that substance abuse treatment should be a central feature of the rehabilitation of today's prisoners. The prevalence of substance use disorders has been steadily increasing over the last decade, and now we know that it is nearly a universal condition. Recent publications suggest that the correctional system's budget for treatment has increased little over the same period (Alaska Justice Statistical Analysis Unit and Justice Center 2000c). Many inmates who failed to obtain treatment on the outside have obtained it in prison. Addiction to alcohol and controlled drugs is a chronic condition, and most of these prisoners will soon be released. It would therefore be logical for the State to consider the potential value of undertaking an expansion of treatment services to meet the needs of all who require and want help.

APPENDIX A. POPULATION WEIGHTING OF THE ALASKA PRISON STUDY

This appendix provides further details of the creation of weights used by the study to project the sample results to the total population of prisoners in in-state institutions. This weighting adjusted the age, gender, and race distributions of the sample to that of the eligible population residing in in-state correctional institutions (excluding Alaskan prisoners in out-of-state correctional institutions, in Community Residential Centers, and in special offsite programs). Readers should bear in mind that the study did not sample from the total target population, and therefore generalizing from the sample to the total eligible in-state prison inmate population must be made on the basis of assumption empirical similarity rather than statistical inference. The purpose of the weighting is to remove observed differences due to these demographic characteristics (age, gender, and race), but the weighting would have no direct effect on any differences due to other factors unrelated to these demographic characteristics. Also, the weighting does not address differences between the in-state prisoners and the out-of-state prisoners or prisoners in community residential centers that are not part of the target population.

Target Population

The first step in creating weights is to define the population. The primary purpose of the Alaskan family of studies was to estimate the total number of Alaskan residents in the State's nonprison population who needed treatment during the past year. The telephone survey interviewed a sample of household residents about their need for treatment at any time during the trailing 12 months from the day of the interview. Of course, some of the people in the household population had been in prison for part of that year, and their treatment needs are subsumed by the results of the telephone survey. The prisoner study sought to interview persons who were not reachable by the telephone survey because they were incarcerated at the time of the survey. The Alaska Prisoner Study therefore sampled current inmates who were residents of the general Alaskan population and who may have needed treatment when they were on the outside for a month or more during the previous 12 months. Consequently, the eligible population of current inmates had to be Alaskan residents and outside of prison for at least one month during the year before they were interviewed.

In order to estimate the size of this "target population," the authors contacted the Alaska Department of Corrections (DOC) to obtain a count of the number prisoners at one point in time who had been sentenced during the past year. According to the Alaska Department of Corrections' *1999 Offender Profile*, there were 2,529 inmates in state correctional institutions on December 31, 1999. Many of these prisoners were in custody prior to sentencing, and therefore were incarcerated for more than one year. After removing those cases, the remaining total number of recently incarcerated prisoners in Alaska was 678. Prisoners who entered DOC custody in the first month of the fiscal year, and who were still in prison at the end of the year would not meet the criterion that they were in the general population for a month or more in the year. In order to eliminate those cases, the authors assumed a flat rate of intake during the year, and estimated that 11/12ths of the 678 prisoners or 622 prisoners satisfied the criterion for length of time not incarcerated. Finally, it was necessary to decrease that number by removing inmates who were not Alaskan residents. Because the DOC count did not identify whether the prisoners were Alaskan residents, the authors used results from its screening of prisoners in order to recruit the sample for the present study. Six of the 315 screened inmates (1.9%) in the three prisons reported that they were not residents. The authors applied this rate of non-residents to the remaining DOC count of 622 prisoners. Thus, an estimated 12 nonresidents were eliminated from the 622. The final result was an estimate that the population size of the study-eligible prisoners was 610.

Representativeness of the Individual Prison Samples and the Total Interviewed Sample

The Alaska Prisoner Study sought to interview every eligible prisoner at each of the three participating correctional centers, Hiland Mountain, Palmer Minimum Security, and Wildwood. Because the authors thought that it would have to interview all eligible inmates in order to achieve its goal of two hundred interviews, all eligible prisoners were invited to participate. As a result, the study samples need no adjustment for unequal probabilities of selection that might make the study samples unrepresentative of all eligible prisoners at each site.

However, the total sampled population had a disproportionate number of female prisoners. As shown in Table A1, only nine percent (8.9% to be precise) of the Alaskan inmates were female. Nine percent of 200 would be just 18 cases, too small for a reliable analysis of differences between the treatment needs of male and female prisoners. In order to have enough females in the sample, the authors decided to oversample the females. Consequently, when describing the results for the sampled inmates, the authors have reweighted the results to reduce the weight of females to nine percent.

Projection to the Total Population

Although the study could not generalize its results from the sampled subject to the total inmate population on the basis of statistical inference, the authors felt that it was useful to consider what the study's results would imply if the sample were assumed to be representative of the total population. The Alaska Prison Study could not use a sampling plan that randomly selected correctional centers. Most (81%) of the women in Alaska prisons are incarcerated at the Hiland Mountain Correctional Center. Hiland Mountain had to be selected or the study goals would not be met. Some sites were not accessible. For example, the study could not interview prisoners at the Point McKenzie Rehabilitation Project because cellular phone transmission was not possible from that location. Budget constraints precluded conducting interviews at small prisons in remote locations. A key remote location was the Arizona Detention Center to which the State had sent 865 inmates (25% of the total prisoner population) as of December 31, 1999. According to the Alaska Department of Corrections' *1999 Offender Profile*, that group of prisoners had a somewhat higher percentage of charges related to substance abuse that the prisoners housed in in-state institutions.

Despite a non-random selection of prisons, the authors assumed that the study's results would be relevant to the entire system in the absence of any other studies of this sort. If the results were used to plan for the entire system, then the authors should weight the study's sample results so that they would be as comparable as possible to the total population of eligible prisoners. The study interviewed a large proportion of all the eligible prisoners, i.e., 55% of the population of eligible female prisoners and 31% of the male prisoners. According the 1999 *Offender Profile* (page 53), the sampled prisons spanned the range with regard to the percentage of prisoners with substance abuse charges. Highland Mountain ranked highest out of 15 in-state prisons with regard to the percent with alcohol related charges and 2nd with regard to controlled-drug related charges. Wildwood ranked 4th on alcohol and 8th on controlled drugs, while Palmer Minimum ranked 12th on alcohol and 5th on controlled drugs. The demographic characteristics of the sampled prisoners did not differ markedly from the demographic characteristics of the total population. Demographic information was not available on the subgroup of study-eligible prisoners. We compared the age and race distributions of the study sample to the distribution of all prisoners (Table A1). T e age and race characteristics of the study sample were not significantly different from those of all prisoners. However, to make the study sample as representative as possible, the authors employed population weights that would project the study sample to the size of the total study-eligible population of recently incarcerated prisoners with an age and race distribution that matched the total population. Information was not available on the joint distribution of race and age. The weighting procedure used the marginal frequencies to generate separate weights for age and race. The extent to which the weighted study sample characteristics differed from those of all prisoners was a function of the extent to which the age distributions differed across race groups.

Table A1. Race and Age, by Gender for Survey Sample and Inmate Population on 12/31/99

	Females			Males		
Race	Survey Sample (N = 40)	Inmate Population (N = 225)	Weighted Survey Sample (N = 73)	Survey Sample (N = 168)	Inmate Population (N = 2304)	Weighted Survey Sample (N = 537)
Native Alaskans	33	28	30	42	39	39
White	42	53	53	35	44	44
Black	18	14	13	15	12	12
Other	7	5	4	8	5	5
Total	100%	100%	100%	100%	100%	100%
	Chi-square = 1.82, NS			Chi-square = 7.34 , NS		
Age						
18 to 24	15	19	18	18	17	17
25 to 34	37	29	29	31	32	32
35 to 44	35	37	36	36	32	32
Over 44	13	15	17	15	19	19
Total	100%	100%	100%	100%	100%	100%
	Chi-square = 1.20, NS			Chi-square = 2.49, NS		

NS= not significant; Inmate data from the 1999 Offender Profile, Alaska Department of Corrections 1999)

Representativeness

For each gender, the race and age distributions of the survey sample and the in-state inmate population in Alaskan prisons did not differ significantly. For both males and females, there were slightly fewer white inmates and more Native Alaskan inmates in the survey sample than in the total population. The age distribution of the survey sample also did not differ significantly from the age distribution of the total inmate population.

The weight assigned to each study respondent was the product of the population weight, the race weight, and the age weight. For each gender, the population weight was the ratio of the estimated total population to the number of prisoners who completed valid interviews. The age weight was the ratio of the percent of the total inmates in the respondent's age group to the percent of the study sample in that age group. A similar computation generated the race weight. The characteristics of the weighted study sample matched those of the total population (Table 1). The differences between the weighted sample and the total population were not more than two percent in any of the 16 cells defined by gender, race, and age group.

SPSS Commands for Alaska Prisons Study Sample Weighting

This section of Appendix A describes the SPSS commands that generated the weights.

```
***
*** Weights for AK Prison study
***

RECODE
 d1age
 (1 thru 24=1) (25 thru 34=2) (35 thru 44=3) (45 thru Highest=4) INTO
 agecoded .
VARIABLE LABELS agecoded 'Age recoded to intervals'.
EXECUTE .

***
*** Female weights
***

COMPUTE popwate = 1.825 .

COMPUTE Racewate = 1 .
IF (d1race1 = 1) Racewate = 1.2518 .
IF (d1race1 = 2) Racewate = 0.78286 .
IF (d1race1 = 5) Racewate = 0.87077 .
IF (d1race1 = 9) Racewate = 0.62667 .

COMPUTE Agewate = 1.0 .
IF (agecoded = 1) Agewate = 1.2333 .
IF (agecoded = 2) Agewate = 0.7787 .
```

```
IF (agecoded = 3) Agewate = 1.0657 .
IF (agecoded = 4) Agewate = 1.25 .

VARIABLE LABELS popwate 'Weight to size of population ' .
VARIABLE LABELS racewate 'Weight to race distribution ' .
VARIABLE LABELS agewate 'Weight to age distribution ' .

COMPUTE Totwate = popwate * racewate * agewate .
VARIABLE LABELS totwate 'Product of all weights ' .

EXECUTE .

***
*** Male weights
***

COMPUTE popwate = 3.19643 .

COMPUTE Racewate = 1 .
IF (d1race1 = 1) Racewate = 1.168 .
IF (d1race1 = 2) Racewate = 0.7485 .
IF (d1race1 = 5) Racewate = 0.94647 .
IF (d1race1 = 3) Racewate = 1.0 .
IF (d1race1 = 4) Racewate = 1.0 .
IF (d1race1 = 6) Racewate = 1.0 .
IF (d1race1 = 7) Racewate = 1.0 .
IF (d1race1 = 9) Racewate = 1.0 .

COMPUTE  Agewate = 1.0 .
IF (agecoded = 1) Agewate = 0.94413 .
IF (agecoded = 2) Agewate = 1.05161 .
IF (agecoded = 3) Agewate = 0.87603.
IF (agecoded = 4) Agewate = 1.25503.
VARIABLE LABELS popwate 'Weight to size of population ' .
VARIABLE LABELS racewate 'Weight to race distribution ' .
VARIABLE LABELS agewate 'Weight to age distribution ' .

COMPUTE Totwate = popwate * racewate * agewate .
VARIABLE LABELS totwate 'Product of all weights ' .

EXECUTE .
```

APPENDIX B. CHANGES IN THE CORE QUESTIONNAIRE AND ADMINISTRATION GUIDE

This appendix describes the changes made when updating the core needs assessment questionnaire of the National Technical Center for the Alaska Prisoner Study.

Demographic Questions (Modules B and J). Because the subject matter of this study is sensitive, it is important to have a series of warm-up questions in the beginning of the interview. Consequently, we split the demographic questions into two modules. The first demographic module consists of non-threatening questions, and we lengthened this module by moving some demographic items up from the NTC instrument's second demographic section at the interview's end. Age is generally asked as part of the eligibility and respondent selection process; if not, we put an age question at the end of the introduction rather than in the demographic module in order to avoid the possibility of asking about age twice or including an item that would almost always be skipped. The gender question in the earlier questionnaire was simplified by asking the respondent to report his or her gender. Only if the person refused were the interviewers instructed to attempt to guess the respondent's gender from the respondent's voice. We updated the race and ethnicity questions to comply with the new Year 2000 Census categories and OMB requirements on this point. The instrument determines whether the respondent is of Hispanic or Latino origin first, and then asks about which Hispanic group, with categories for the most common Hispanic populations in the US. The race item follows and allows respondents to report as many as five race responses. We simplified the questions on employment to eliminate unnecessary questions regarding what unemployed persons were doing, and we moved the questions to this module from it place in the second demographic module of the earlier instrument. Our revisions of the response categories in the schooling questions now provide information on the respondent's year of education rather than broader categories. The remaining questions in this module on marital status and military duty, were moved up from the second part of the demographic module to this one, and we modified the items slightly.

The second part of the demographic module, which covers the more sensitive demographic topics, comes near the end of the interview after the diagnostic and treatment modules. We added questions to this module to obtain more precise information on pregnancy and child care for the measurement of treatment service mix and unmet demand for ancillary services. The interviewer asks women of childbearing age (under 55) about pregnancy, prenatal referrals, and prenatal care. This information would be relevant if the subject had needed treatment in the past year. If the woman was pregnant in the last year, the interviewer asks whether she received prenatal care and whether she had any serious consequences that required hospitalization. These questions will be relevant to this study and are asked only if a respondent had a substance use disorder, received treatment in the last year, or had unmet demand for treatment in the last year.

The questions on criminal activities and arrests relate to measurement of treatment service mix and efforts to determine whether the survey can accurately estimate substance-related arrest statistics. For the inmate study, we also added questions about incarceration and having received treatment in prison during the past year. Persons who needed treatment in the last year and who received it in prison would be relevant for estimating the amount of unmet need and demand in prison.

Several questions were added to this module regarding suicide and being a danger to others. These items measure the severity of the need for treatment as well as the level of care that a person in need should receive. The sensitive nature of the items dictated their placement near the end of the questionnaire.

Finally, we revised the question about the respondent's family income. This item was the most frequently refused question in the previous version of the questionnaire, and so we revised it to minimize the number of refusals. Measuring income is usually essential to the study because it helps determine the respondent's eligibility for state-funded substance abuse treatment services. Typically, a respondent's family income and the number of people dependent on that income determine whether the State would pay for any of the respondent's treatment, and if so, what proportion of the costs that the State will pay. The presence of a pregnant person also bears on eligibility for public funding in some states.

Health Status and Insurance Questions (Module B): At the end of the first demographic module we have created a new submodule regarding health. Although general health is not a topic of interest for this questionnaire, there are several substance-abuse-related health issues on which we needed information. The questions assess general physical and psychological health status, disabilities, as well as health problems or injuries that are often found in people with alcohol or drug problems. Some of these items were scattered throughout the prior NTC questionnaire, but most are new to this instrument. To bolster the health context of the interview, we decided to gather the health-related questions together to create this health section and to place it early in the questionnaire.

The first questions in this module address general physical and emotional health. Taken from the Behavioral Risk Factor Surveillance Survey (BRFSS) telephone questionnaire (CDC 1997) , the general physical and psychological health questions can be compared to BRFSS results to assess the validity of the current survey, but the items' primary role is to assess health status as part of our measure of treatment service mix. Poor physical or psychiatric health is a primary justification for needing a higher level of care, such as detoxification in a hospital or residential facility. We also ask whether the person was hospitalized in the last year, obtained psychiatric treatment, or required psychiatric medication as a way of measuring the seriousness of any health or psychiatric problems that might have warranted hospitalization if the respondent had sought treatment for substance abuse.

In the health section, we covered measuring disability. This information is relevant for assessing unmet treatment services needs due to disability and for ensuring that the disabled have equal access to treatment services. Because we collect these data by interview, we did not include a question on functional hearing impairment. For the purposes of the needs assessment study, we were interested in measuring disabilities besides substance abuse.

In order to ease respondents into describing their substance-abuse-related problems and to help identify cases where substance abuse problems were likely but not reported, we included a series of questions about health problems associated with substance abuse. Covered in these questions are tuberculosis, syphilis, gastritis, cirrhosis, endocarditis, hepatitis, cancers of the lip, throat or stomach, falls, burns, automobile accidents and adverse reactions. The link between these health problems and substance abuse is not mentioned in the question, however. Included in this module are several items on high blood pressure and head injuries that were also needed for the treatment service mix scales.

The health section ends with questions, taken from the BRFSS questionnaire, about the source of payment for the respondent's health insurance coverage. We included these items to determine how any substance abuse treatment the respondent might have received or needed in the last year would have been financed. In particular, the questions determine whether the insurance coverage was paid privately, by Medicare, Medicaid, Indian Health Service, the military, by some other payer. We also asked whether there were any gaps in coverage, whether the coverage included substance abuse services, and whether any health care services received in the past year were paid for by the State. Eligibility for state payment of substance abuse services is determined in the second demographic section rather than here. By moving the insurance coverage questions to the health module, we substantially eliminated many of the insurance questions that were included in the treatment module of the previous questionnaire.

<u>Recent and Ever Use of Tobacco, Alcohol, and Other Drugs (Adult Modules C and E):</u> To the previou of other substance use in adults. Also, beginning with questions on tobacco use helps our strategy of leading the respondents gradually into questions on alcohol and then illicit drugs. The adult tobacco items come from the BRFSS's telephone survey questionnaire, and therefore they have the added value of being useful for validating the current telephone survey questionnaire. Because every state administers these BRFSS tobacco items in a telephone survey that runs continuously every year, states can compare the data of these item with the BRFSS data to obtain an indication of whether the current survey has obtained valid information. The questions determine whether the person had ever been a smoker (defined as having had 100 or more cigarettes in his or her life), whether the person is a current smoker, and if so how many cigarettes were smoked in the past 30 days.

Because tobacco use is a relatively more important issue for adolescent than adult substance abuse services, the module on tobacco is more extensive in the adolescent division of the instrument. The questions on lifetime use and use in the last 30 days are the BRFSS questionnaire (CDC 1997).

The items in this module measuring alcohol use and then the items measuring nonmedical use of controlled drugs ask a limited number of questions about the extent of use in the last year, the year before, and lifetime. These questions include assessments of ever use, any use in the last year, and the quantity and frequency of use in the last year. This module also contains several treatment service mix items designed to identify persons who had recent episodes of binge drinking and extremely high levels of intoxication during the past year. Subjects who reported binge drinking and very high levels of consumption per drinking episode would be candidates for hospital detoxification if they needed treatment. We also ask a series of questions about lifetime substance use, including being hospitalized, being told to cut down or seek treatment by a health professional, having a "drinking/drug problem" or feeling dependent on substances, or having received alcohol or drug treatment. Although these last items are standard epidemiological questions, they play several different roles in this instrument–one of which we describe next.

Qualifying Criteria: One purpose of the alcohol and drug use items is to identify respondents who should not be asked questions in the remaining modules regarding substance use disorders and substance abuse treatment. It makes little sense to ask people who have not had a drink in the last year or two whether they needed treatment for alcohol abuse in the last year. Similarly, some respondents have had only a few drinks in their lives. It is inefficient for a survey to spend its resources questioning these subjects about symptoms of lifetime alcohol abuse or dependence. Because only about 10% of the general population is likely to have a current substance use disorder, investigators can realize substantial gains in survey efficiency by confining the diagnostic and treatment modules to only those respondents with a high likelihood of having a current or lifetime substance use disorder. If subjects do not qualify for the diagnostic and treatment-related questions, they skip most of the questionnaire. Using this strategy in the previous questionnaire, we found that the average length of this interview in a general household population was less than 10 minutes, even though the instrument was long.

In this instrument, a primary basis for deciding whether respondents should "qualify" for the diagnostic and treatment modules is the amount of substance use in the last year[6]. Most respondents report some drinking in the last year, but relatively few report enough drinking to warrant their being asked the diagnostic, treatment need, and patient placement questions.

Using data on the quantity and frequency of drinking in the last year from the NIAAA National Longitudinal Alcohol Epidemiology Survey (NLAES), we developed objective "qualifying criteria" for the alcohol diagnostic module in the previous version of our instrument (McAuliffe et al. 1995, pp. 6-9 to 6-13). The goal of the qualifying criteria was to skip the diagnostic and treatment modules with as many respondents as possible who were highly unlikely to have a current diagnosis. At the same time, we required that the qualifying criteria identify at least 90% of the persons who had a current alcohol dependence diagnosis. This analysis revealed that the levels of use reported by people who meet the criteria for alcohol

[6]We did not use the term "screening" in this context because we used that term when discussing whether subjects would be eligible to participate in the survey.

dependence is surprisingly small in many cases, and women with diagnoses of alcohol dependence report lower levels of drinking than do men with alcohol dependence diagnoses. In order to insure that our qualifying criteria were as efficient for both sexes, we used different cutoffs for men and women.. We have used the same alcohol items and cutoffs in the present survey instrument.

It is noteworthy that these empirically-derived cutoffs for women were so low that a few women who meet these qualifying criteria will object to being asked questions which seem to imply that the respondents may have had an alcohol use disorder. We have given much discussion and thought to how best to respond to these complaints. Raising the cutoff would result in missing a larger number of women who have alcohol dependence problems. The instrument would therefore underestimate women's dependence rate and need for services. Using the cutoffs at all implies some underestimation of the dependence rate. Keeping the cutoffs low would result in a slightly longer average length of the interview, possibly missing a few nonusers, and taking more time with the few complaining respondents. We concluded that it would be better for the survey's results, if not for the survey contractor, to instruct interviewers about how to manage these complaints than to increase the cutoffs.

One goal of this instrument is to estimate the lifetime prevalence of substance use disorders. That goal is important for epidemiological purposes and for assessing the validity results by comparing them with results from other studies. Lifetime events are most commonly measured in the same way, and research suggests that lifetime use is more accurately reported than recent use. In order to enhance the reliability of our qualifying criteria and to make sure that we did not miss respondents who had an alcohol or drug use disorder in the past but had been abstinent or using very small amounts in the last year (e.g., due to being in treatment or prison), we also included a series of qualifying criteria that were based on consequences of lifetime use. A respondent qualified for the alcohol diagnostic module if he or she reported having ever: 1) gone on binges of several days or more, 2) been hospitalized or visited an emergency room due to alcohol, 3) been warned by a doctor to cut down on drinking, 4) had a drinking problem or been addicted to alcohol, or 5) received treatment for alcoholism. Although explained here, these "qualifying" items are contained in Module D of the adult questionnaire.

We also used alcohol qualifying criteria from the DIS-IV that were based on the frequency of lifetime use. In order to ensure that the epidemiological results of the present survey could be compared to the results of epidemiological surveys using the DIS-IV, we added several qualifying questions that are employed for the same purpose in the DIS-IV. The DIS-IV's alcohol qualifying items focus on a respondent's ever having at least six drinks, having at least one drink a month during the year of heaviest drinking, and averaging more than five drinks a week during the weeks when the respondent drank in his or her year of heaviest drinking. Each respondent who meets either the DIS-IV or NCRPG qualifying criteria is asked the diagnostic modules, while all other respondents are skipped to the few remaining questions at the end of the instrument. Because the levels of use in the DIS-IV qualifying criteria are so low, it seems unlikely that we would screen out any subjects who had a lifetime diagnosis.

For the drug use qualifying criteria, we used the criteria that we had used in the previous

NTC instrument. Any respondent who reported using marijuana more than five times in the year prior to incarceration was asked the diagnostic questions for marijuana, and any respondent reporting using any of the other illicit drugs at least once in that year was asked the diagnostic questions for each such drug. These low levels of use appeared to be required as the qualifying standards because household respondents tend to underreport illicit drug use in the interview, and the authors wished to use the same qualifying criteria for the nonhousehold populations so that the data would be comparable.

A respondent also qualified for the diagnostic and treatment modules if he or she had ever been in a hospital or emergency room as a result of drug use, reported ever having a drug problem or addiction, ever having received treatment for drug abuse, and ever having used drugs by injection. These items are contained in Module E of the adult questionnaire. Finally, we also used the DIS-IV's criterion of anyone who reported ever using a drug six or more times in their life. The DIS-IV criterion was apparently derived from research by Robins and Murphy (1967) that found that anyone who used heroin six times or more eventually became addicted to the drug. As with alcohol, this rate of use is so low that it is unlikely that anyone with adverse effects of drug use would fail to meet these criteria if the respondent was forthcoming about her/his use. The authors believe that this combination of last-year and lifetime criteria based on the amount of use and adverse consequences of use offer the best chance of identifying all persons who are likely to have had a substance use disorder diagnosis at some time in their lives.

<u>Diagnostic Questions (Adult Modules D and F):</u> Each diagnostic section contains a series of questions designed to assess whether the respondent would meet the criteria developed by the American Psychiatric Association's (1994) fourth edition of its Diagnostic and Statistical Manual (DSM-IV) for diagnosis of a substance use disorder, including abuse and dependence. The diagnostic questions are derived, with modifications for telephone administration, from the latest versions of the Diagnostic Interview Schedule (DIS-IV) (Robins et al. 1998) for the adults and the Diagnostic Interview Schedule for Children (Shaffer et al. 1998).

Changes from DSM-III-R to DSM-IV: There were several major changes made in the DSM criteria in the transition from DSM-III-R to DSM-IV. The measurement of abuse was substantially modified in the DSM-IV by increasing the number of specific symptoms from two to four. One of the new items concerned failure to live up to role obligations, and the other concerned legal problems. The number of criteria for dependence were reduced from nine to seven by eliminating overlap with abuse and combining two items regarding withdrawal into one with two subparts. Other significant changes involved the "clustering" of abuse and dependence symptoms and the criteria for remission from dependence.

Substance Abuse: According to the DSM-IV (American Psychiatric Association 1994, page 182-183), substance abuse does not include tolerance, dependence or a pattern of compulsive use, although abuse does involve continued use despite negative consequences. Abuse includes "only the harmful consequences of repeated use." The criteria of recurrent and significant consequences related to repeated use include: "repeated failure to fulfill major role obligations, repeated use in situations in which it is physically hazardous, multiple legal problems, and recurrent social and interpersonal problems." Like the DSM-III-R, the DSM-IV's substance abuse criteria do not include "course specifiers," such as partial or full remission. A diagnosis of abuse is superceded by a diagnosis of substance dependence. That is, a person can have an abuse diagnosis only if her or she has never met the criteria for substance dependence for that substance.

The specific DSM-IV criteria for a substance abuse diagnosis are:

1. Recurrent substance use resulting in failure to fulfill major role obligations at work, school, or home.
2. Recurrent substance use in situations in which it is physically hazardous.
3. Recurrent substance-related legal problems.
4. Continued substance use despite having persistent or recurrent social or interpersonal problems caused by or exacerbated by the effects of the substance (e.g., fights).

To receive a diagnosis of substance abuse, the person must meet one or more of the four criteria *within a 12-month period*. This requirement is called, the "clustering" criterion for an abuse diagnosis. It is worth noting that the DSM-IV says nothing about the logical possibility of a person who reported multiple symptoms of abuse in a year but none of the symptoms occurred repeatedly within a 12-month period. By the current criteria, that person does not have a diagnosis of abuse.

Substance Dependence: To receive a diagnosis of substance dependence according to DSM-IV criteria, a person has to manifest three or more of the following criteria, "occurring at any time in the same 12-month period:

1. Tolerance development
2. Withdrawal symptoms or using the substance to relieve or avoid withdrawal
3. Taking more of substance or for longer than intended
4. Persistent desire or unsuccessful efforts to quit or cut down
5. A great deal of time spent obtaining, using or getting over substance effects
6. Giving up important social, occupational or recreational activities because of use
7. Continued use despite having a persistent or recurrent physical or psychological problem caused by or exacerbated by the substance

Symptom Clustering: It is the requirement that the symptoms must occur within a 12-month period that is referred to as symptom "clustering" for dependence, which is somewhat different than it was for abuse. Clustering is probably the most important new feature of the DSM-IV criteria for abuse and dependence. Whereas the DSM-III-R criteria required only that one ever experienced at least three out of nine symptoms to have a lifetime diagnosis of dependence, the DSM-IV criteria require that at least three of seven symptoms occur within a 12-month period. DSM-IV criteria for abuse require that at least one of the abuse symptoms occur more than once in a 12-month period. These clustering requirements will probably reduce the number of people who meet criteria for a substance use disorder.

To measure this clustering of symptoms, the DIS-IV and our instrument have added new items at the end of the relevant sections of the modules to determine whether the symptoms occurred within a 12-month period. Although clustering is conceptually simple, it is cognitively demanding for survey respondents, especially when the questionnaire is attempting to determine annual prevalence--how many respondents were dependent on a substance at any time during the past year. In this process of measuring symptom clustering, the respondent who has reported three or more symptoms of dependence must be reminded of all of the seven possible symptoms that he or she has reported, and then asked if three or more of these symptoms occurred within a 12-month period. Because the symptoms are complex ideas with several alternative manifestations and are not everyday concepts (e.g., narrowing of the behavioral repertoire), referring to these symptoms when asking the subjects about whether they occurred in a time period that is not anchored by specific date is challenging. A similar, although somewhat less taxing process is required for measuring the clustering of abuse symptoms. Although abuse involves only one "symptom" at a time, many of the abuse "symptoms" are composed of several sub-symptoms. For example, failure to fulfill role obligations involves family, job, and school responsibilities.

The techniques employed by the DIS and DISC to measure these complex concepts are not entirely satisfactory for telephone administration. Developed for in-person administration, the DIS uses a checklist of brief descriptions of the symptoms as a visual cue to help respondents keep track of the number of symptoms and sub-symptoms that they have experienced. For telephone administration, we have created "read-back tables" for the interviewers that use brief descriptions of the symptoms. For example, at the end of the questions on dependence, the interviewer "reminds" the respondent of the number of symptoms that he or she has reported and repeats the read-back of the dependence symptoms. Then the interviewer asks whether there was ever a time when three or more of those "problems" occurred within a 12-month period.

Dependence Course Specifiers: A person with a lifetime diagnosis of substance dependence may be actively dependent, in partial remission, or in full remission. The course specifiers for dependence in the DSM-III-R were revised in the DSM-IV. Whereas use of the substance was a key determinant of remission in the DSM-III-R, substance use is not part of the remission criteria in the DSM-IV. Also, the DSM-III-R used a six-month time frame for defining remission. A person had to be substance use or symptom free for at least six months to be in full remission. The DSM-IV changed the time frame and added new distinctions and requirements. Both partial and full remission now require at least a month free of all symptoms. DSM-IV added a new course specifier dimension, "early" and "sustained" remission. A person is in early remission if it has continued from one to eleven months. Once remission has continued for twelve months or more, it is sustained remission. In the previous NTC instrument, we assumed that anyone who had active abuse or dependence or was in partial remission in the past year needed some form of treatment. In light of the new distinctions regarding remission in the DSM-IV, we have assumed that respondents who were actively abusing or dependent or in early remission in the last year, or partial remission were in need of treatment, whereas those in sustained full remission were not.

It is worth mentioning the rationale for including sustained partial and early full remission in the treatment-need group. Because a person in sustained partial remission can have as many as two symptoms of dependence, any number of symptoms of abuse, and was once dependent, we felt that these cases required some form of treatment (e.g., follow-up or self-help group participation). We felt that early full remission would call for aftercare, follow-up, or self-help group participation. While probably few managed care systems would provide treatment for people who were symptom free for six months or more, follow-up studies show that relapse is still sufficiently frequent to warrant low-cost forms of care.

Combined with the requirement of symptom clustering, these new DSM-IV course specifiers substantially increased the complexity of measuring the number of people who were in need of treatment in the past year. It is noteworthy, the authors of the DIS-IV and the DISC-IV made no attempt to measure partial remission at all, and they included only crude measures of sustained full remission. In the remainder of this section, we will describe changes in the DIS that have resulted from the changes in the DSM, and then we will describe unique aspects of our approach to measuring the DSM criteria, especially the course specifications, in a telephone survey of adults.

Changes in the DIS: Compared to the DIS-III-R, the DIS-IV included small wording changes in virtually every question, and there were several major structural changes dictated by the transition from the DSM-III-R to the DSM-IV. The current version of the DISC differed from previous versions even more than the DIS-IV differed from its previous versions. However, since the new version of the DISC is more like the adult DIS than were the previous versions of the DISC, we had less difficulty making one instrument combining the DIS and DISC than we would have if we had attempted doing so in the past.

However, the changes from the DSM-III-R to the DSM-IV turned out to be more complex than they first appeared, and they were difficult to measure. This difficulty is also apparent when comparing the DIS and DISC. The DIS-IV and the DISC-IV take somewhat different approaches to clustering and remission. For example, the DISC-IV focuses on measuring clustering of abuse symptoms in the last year, and does not attempt to obtain the information needed to determine whether the adolescent meets the clustering criterion for a lifetime diagnosis of substance abuse. Neither instrument attempted to measure partial remission, and measurement of full remission does not appear to be entirely satisfactory in either instrument.

The structure of the diagnostic questions follow the structure used in the DIS-IV. The interviewer asks all of the alcohol diagnostic questions first. Then, referring to all controlled drugs together, the interviewer asks whether the respondent ever experienced the first abuse symptom as result of drug use. If the respondent answers *yes*, the interviewer repeats the question again for each drug for which the respondent has qualified. If the respondent answers *no*, the interviewer goes to the next abuse or dependence symptom, and he/she continues through all of the abuse and dependence symptoms. Once lifetime presence of the diagnostic symptoms is established, the DIS-IV asks about recent occurrence of the symptom. This same procedure was followed in older versions of the NTC questionnaire.

The DSM-IV diagnosis of abuse requires that the symptoms occur more than once in a 12-month period. In the DIS, respondents are asked whether they had ever experienced each of the symptoms. The questions are phrased in a fashion that explicitly or implicitly refers to the symptoms occurring recurrently. For example, "have you sometimes," "frequently," or "more than once [ever implied]." Those respondents who respond positively to any of these problems are asked, "Was there ever any year in your life when [the problem/one of the problems] from using alcohol occurred more than once." If so, the person meets the criteria for lifetime abuse if the person was never dependent. To determine whether the person currently meets the criteria for abuse due to any of the symptoms, the interviewer asks, "Did any of these problems occur several times in the last 12 months?"

Changes in the NTC Instruments: These changes from the DSM-III-R to the DSM-IV, additional changes from the DIS-III-R to the DIS-IV, and the differences between the DIS-IV and the DISC-IV required us to make significant changes in our adult telephone survey questionnaire as well. The differences between the DIS and the DISC diagnostic questions raised a fundamental dilemma from the outset. How could we follow instruments that differed substantially from one another while still producing an instrument that could be used in one survey and to compare adults with adolescents? While we recognized the need to modify some of the wording of the questions in the DIS in order to make them age-appropriate and more comprehensible for adolescents, the authors of the DISC made many changes that went far beyond those objectives. The rationale for other changes (e.g., the ordering of some related questions) was not obvious, and there was no documentation that we could obtain from the authors of the DISC that explained the many differences between the DISC and the DIS. While both instruments clearly sought to operationalize the DSM-IV, taking different approaches without strong justifications raises the possibility that the results of the two instruments will differ unnecessarily (Eaton et al. 1984). Different results might be found, for example, with a person who was interviewed by the DISC-IV at 17 and a month later was interviewed with the DIS-IV because he or she had turned 18. In a survey of the entire population 12 and older, such differences are a concern, especially if the investigator or survey sponsor is interested in comparing adolescents and adults. Although in most cases we decided to adhere closely to the DISC and the DIS respectively in the adolescent and adult divisions in this version of our questionnaire, we made some changes as needed to maintain comparability. In some cases, we decided to follow one rather than the other because the one approach appeared to be superior, especially for telephone administration. Also, we occasionally found what we judged to be clear-cut errors in the DIS and DISC questions.

Measuring Substance Abuse: The DIS included a question about having a traffic accident in its questions regarding social and interpersonal problems stemming from alcohol use. We decided to move that question below the items on criterion #2 about intoxication in hazardous situations. We made this decision primarily because the question fit better conceptually in criterion #2, there was nothing comparable in the DIS's drug questions, there was nothing comparable in the adolescent questions, and we could not fashion a read back that could summarize the traffic question and the other questions in that set of items.

Measuring Clustering of Abuse Symptoms: One place in which our instrument differs substantially from both the DIS and the DISC concerns the clustering of the abuse symptoms. As we note earlier, the DIS asks its clustering question for all four symptoms of abuse at one time. The interviewer reads back a shortened version of the symptoms and asks, "Was there any year in your life when one of these problems from using alcohol occurred more than once." If so, the DIS asks a series of questions including one regarding whether "Any of these problems occurred several times in the last year." Although we liked the questions used for clustering, we felt that the read back could be confusing because the symptoms were multifaceted. The DISC, by contrast, asked a question about clustering immediately after each symptom, and only asked about several symptoms at once when several symptoms were experienced but no one symptom occurred more than once in a 12-month period. Because we felt that the DISC approach was cognitively less demanding and would work better in a telephone interview, we adapted its approach for both our adult and adolescent questions on abuse.

Another important difference between our instrument and the DIS and the DISC concerned the time period about which we asked respondents in the questions concerning clustering and remission. In our judgment, there is a key difference between clinical goals of the DSM criteria and their use in epidemiological and service research studies. The typical clinician seeks to determine the diagnosis of a person who is seeking treatment. The time referent is the day of the interview, and the twelve months lag employed in the instrument refers to the twelve months prior to the day of the interview. From an epidemiological perspective, counting the number of people who would have a diagnosis on the day of the interview would be a point-prevalence estimate. As we read the DIS and the DISC, we believe that their questions can only measure that type of prevalence estimate. Frequently, authors describe this estimate as a one-year prevalence, but we do not believe that the DIS and DISC obtain all the information needed for a one-year prevalence estimate of a disease that has clustering and remission-period features.

Because of the importance of this point, we will discuss it in some detail (also see McAuliffe et al. 1995). It is likely that during the past year there were individuals who would not have a diagnosis on the day that they were interviewed, but who would have had a diagnosis at some point during the previous year. For example, a person who was in sustained full remission might no longer have an active diagnosis when interviewed, but would have had an active diagnosis of dependence earlier in the year. Similar technical problems are present in estimating the prevalence of diseases, like cancer, that recur and which require a period free of symptoms before declaring that the disease has remitted. If a person is assumed to have a diagnosis until five years have passed without any symptoms, that person should be counted in a one-year prevalence estimate. To obtain a one-year prevalence estimate, a researcher would have to ask about disease symptoms in the period covering up to the last six years. Consequently, epidemiological studies of one-year prevalence have a more complex measurement task than would a clinician who is attempting to determine whether a person has a diagnosis.

Health services studies, such as those estimating the need for treatment services in the last year, have a task similar to that of the epidemiologists. For example, a person who met the criteria for a diagnosis 11 months prior to the day of the interview would have needed treatment at that time, even if the person does not meet the diagnostic criteria on the day of the research interview. It is possible, for example, that the person may have had one symptom 11 months ago and two symptoms 11 months before that. The three symptoms occurred within a 12 month period, and therefore 11 months ago the person needed treatment, technically speaking. A person who was in partial remission eleven months before the interview was conducted would also have needed treatment (e.g., aftercare) during the first month of the past year. Thus, to estimate the need for treatment services for substance use disorders over the entire course of the last year and allow for the 12-month clustering requirement and the one-year lag required by the remission criteria, we had to measure the occurrence of symptoms in the past two years.

Thus the 12-month lag in achieving sustained full remission requires a 24-month period to conclude that no treatment was needed during any part of the previous 12 months. Clearly, the 12-month lag in the substance use diagnosis course specifiers complicates estimation of the need for treatment services in the past year.

In order to cope with this technical issue, we asked respondents who had a symptom of abuse several times in one year,

"When was the last time that this happened more than once in a 12-month period? Was it,

Entirely within the past two years?
More than two years ago?"

If the respondent agrees with the first response category, we are confident that the respondent had an active diagnosis at some time in the past year. In the most extreme case, the subject who had the symptom exactly two years ago would have needed treatment on the first day of the last year. Consequently, if the one year occurs within the last 24 months, the respondent needed treatment at some time in the last year.

Measuring Substance Dependence: At the end of the series of questions on dependence symptoms, the interviewer asks a respondent a series of questions designed to measure whether the person had a lifetime diagnosis and to determine the course specification.

The questionnaire follows a specific sequence of questions to assess the course specification. If the respondent reports three or more symptoms, the interviewer asks whether there was ever a 12-month period in which at least three of those symptoms occurred. If the respondent answers no, he or she fails the clustering criterion and therefore has never had a dependence diagnosis according to DSM-IV criteria. Thus, the respondent never met the minimum requirements for needing treatment. If the respondent says yes, he or she meets the clustering criterion for a lifetime dependence diagnosis.

However, further questioning is needed to determine whether the person was actively dependent, in early or sustained partial remission, or in early or sustained full remission during the last year. Because a person may have more than one course specification in a year, we assume that he or she would have sought treatment when the disease was at its most severe during the period. That is, if the person is actively dependent at the beginning of the year and full remission for the rest of the current year, we assume that the treatment would have been needed when the person was actively dependent.

According to DSM-IV criteria, remission begins when the person has had at least one month that was entirely free of dependence *and* abuse symptoms outside of an institution and not counting chemotherapy such as methadone maintenance. Consequently, we ask a subject who clustered for alcohol or another drug, whether there has been a month free of all symptoms since the last time the person had three or more symptoms in one year. If not, the person is actively dependent, and no additional questions are needed. If yes, then we ask questions designed to determine whether the person is in partial or full remission.

Sustained full remission from dependence occurs when the respondent has had at least 12 months entirely free of all dependence and abuse symptoms. Until then, the person is in early full remission. If the person has had a reoccurrence of one or two symptoms, the person is in partial remission, which can also be either early or sustained depending on how long ago the person had a period entirely free of symptoms.

We determine whether the remission is "early" or "sustained" by a combination of when the symptom-free period began and when the symptoms last occurred. We first ask when the symptom-free period started. If it began during the current year, the person must have been actively dependent for part of the current year, and he/she receives that course specification. If the symptom-free period began in the year before last, then remission may be *early* full or partial remission, depending on whether any symptoms recurred and when that happened last. If the symptom-free period began more than two years ago, the person may have been in *sustained* full or partial remission, again depending on whether and when any symptoms last recurred.

For example if the person has not had any symptoms since the period with out symptoms began more than two years ago, then he or she is in sustained full remission. If the last symptom was in the year before last, the person is in early full remission. If there has been a recurrence of one or two symptoms and that happened most recently in the last year, then the person is in sustained partial remission as the year began. If the symptom-free period began in the year before last and some symptoms have occurred in the last year, the person is in early partial remission.

Substance Abuse Course Specifiers: Because there are no course specifiers for abuse within the DSM-IV system, we were concerned that the DSM-IV criteria for abuse seemed incomplete. According to the DSM-IV, substance abuse is established when at least one of the abuse criteria has recurred in a 12-month period, and the person never met criteria for dependence. The symptoms include recurrent 1) substance use resulting in failure to fulfill major role obligations at work, school, or home; 2) substance use in situations in which it is physically hazardous; 3) substance-related legal problems; and 4) continued substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance. Consequently, if one of these symptoms occurred more than once in the last two years, the person who has never been dependent has an active substance abuse diagnosis. It follows that if none of these symptoms occurred in the last two years, then the person who previously had an abuse diagnosis is in remission, and he or she would not require treatment.

Secondary Prevention: We added several items designed to measure the need for secondary prevention services in the last year. Secondary prevention seeks to prevent a substance user (a heavy alcohol user or a user of controlled drugs) from becoming a person with a substance use disorder. We assumed that people who have not yet developed a full-blown substance use disorder, but who have developed a symptom of a substance use disorder would benefit from secondary prevention services. Consequently, we ask subjects who reported these symptoms when they were last experienced. If any abuse or dependence symptoms were experienced in the last year, but the person has not met criteria for a diagnosis of abuse or dependence, we assume that the person was in need of secondary prevention in the last year.

Treatment Questions: Met and Unmet Demand (Modules G, H, and I): Respondents who qualify for any substance use disorder diagnosis will then be asked a series of questions about treatment. In Module G, we ask respondents who have had any treatment about their treatment history and treatment utilization in the last year. We also ask about how these services were funded. An important modification in this section was to change the system of modalities of treatment to conform with the system employed in the most recent ASAM patient placement model. The number of detox modalities was expanded to include social setting detox and outpatient detox. Residential treatment was expanded to include therapeutic community treatment, chemical dependency programs, and "extended care" or "long-term care" treatments.

One major change to this module was to cover more non-specialty sources of treatment. The questionnaire now covers treatment by a psychological counselor, including psychiatrists, psychologists, and social workers. Family doctors and other nonspecialist physicians are a new category. We also ask about outreach workers, acupuncturists, general health advisors, and drunk-driving or court-appointed "treatment" classes.

The prisoner version of the questionnaire included questions about obtaining treatment in prison. The items asked whether the respondent had ever received treatment in prison, how many times, and whether the person had received treatment during the current incarceration.

In Module H, we ask respondents if they would have wanted additional treatment services in the past year had the services been readily available. If the respondents wanted additional treatment, we asked them a series of questions to find out what additional services they would have wanted, what prevented them from getting these services, and how the services would have been paid for, especially if it would have been partly or wholly funded by the State.

In Module I, we ask respondents who needed treatment but did not receive any in the last year whether they would have wanted and sought services had the services been readily available. We also ask the respondent what steps if any they took to obtain treatment, and why they did not obtain the treatment that they wanted. We expanded the list of possible reasons for not getting desired services to include a broader range of factors. In the previous version of the questionnaire, we confined the list to factors that a planner could influence. In this version, we added reasons that could be addressed by clinical program modifications (e.g., adding outreach) We also ask the respondents what types of services they would have sought and how those services would have been paid for.

Treatment Mix Index (TMI) Questions: The treatment mix questions are located throughout the questionnaire. Although many of the treatment mix index questions are in the demographics and diagnostic sections, most are in the treatment modules. Many of the previous TMI items were revised for this version of the questionnaire, and many were added. One change was to expand the number of treatment modalities to match the new ASAM levels. In the first edition of their Patient Placement Criteria, the ASAM authors distinguished only four levels of care. In this version, the number of settings in which detoxification can take place was expanded from two (medically monitored residential facility and a medically managed hospital) to include in a doctor's office, a day treatment setting, and a residential social detox program. In the previous ASAM system, level II included partial hospitalization and intensive outpatient treatment. In this version, that level has been split into two sublevels. Level III has been split into four sublevels. With many new sublevels, the number of placement criteria and standards for each has also increased markedly. We created a series of new items to measure these new criteria. Also, since there are different groups of respondents who need to get these questions (those who got treatment, those who wanted treatment, and those who needed it but did not want it), these questions have had to take several different forms and are located in several different places in the questionnaire. Therefore, each respondent will be asked the questions once, but he/she will get the version of the questions which is appropriate for his/her treatment history.

Confidentiality and Truthfulness Questions Changes (Module K): A set of questions about the confidentiality of the interview was added after the second set of demographic questions. These questions assess whether there was anyone else in the room or listening in on another phone during the interview, and whether that possibility affected the respondent's responses. After the confidentiality items, the questions about truthfulness were also modified to try to obtain more accurate information.

REFERENCES

Alaska Department of Corrections. (1999). *1999 Offender Profile*. Juneau, AK: Department of Corrections. (www.correct.state.ak.us/corrections/admin)

Alaska Justice Statistical Analysis Unit and Justice Center. (2000c). "Alaska Department of Corrections: The Drug Treatment Picture." *Alaska Justice Forum* 17(1):5-6.

Alaska Justice Statistical Analysis Unit and Justice Center. (2000b). "Drug Use Among Arrestees in Anchorage." *Alaska Justice Forum* 17(1):1, 7, 8.

Alaska Justice Statistical Analysis Unit and Justice Center. (2000a). "Incarceration on Drug Offenses." *Alaska Justice Forum* 17(1):6.

American Psychiatric Association. (1980). *Diagnostic and Statistical Manual of Mental Disorders*. Washington, D.C.: American Psychiatric Association.

American Psychiatric Association. (1987). *Diagnostic and Statistical Manual of Mental Disorders (Third Edition- Revised): DSM-III-R*. Washington, DC: American Psychiatric Association.

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition): DSM-IV*. Washington, DC: American Psychiatric Association.

Appel, Philip W. (1995). *Substance Abuse Among Adults in Transient Housing in New York State: Validation of Self-Report by Use of Hair Analysis*. New York: New York State Office of Alcoholism and Substance Abuse Services.

Barton, William I. (1980). "Drug Histories and Criminality: Survey of Inmates of State Correctional Facilities, January 1974." *International Journal of the Addictions*. 15(2): 233-58.

Baumer, Terry L., David G. Blough, and Nicole L. Kincaid. (1995). *Final and Summary Final Report: Drug and Alcohol Dependence in Indiana Arrestees: Indiana Demand and Needs Assessment Studies--Alcohol and Other Drugs: Study Three*. Indianapolis, Indiana: Indiana University, Purdue University.:1-82.

Beck, A and D. Gillard. (1993). *Jail Inmates, 1992*. Washington, D.C.: Bureau of Justice Statistics, U.S. Department of Justice.

Bhardwaj, Ajay, David Moore, Max Larsen, and The Gallup Organization. (1998). *Substance Abuse Indicator Study for Treatment Resource Allocation: Technical Report*. Rockville, MD: The Gallup Organization.

Bland, Roger C., Stephen C. Newman, Ronald J. Dyck, and Helene T. Orn. (1990). "Prevalence of Psychiatric Disorders and Suicide Attempts in a Prison Population." *Canadian Journal of Psychiatry*. 35:407-13.

Blane, Howard T., Joseph H. Hoffman, Pamela Varker, Michelle Burke, John W. Welte, and Research Institute on Addictions. (1995). *State Demand and Needs Assessment: New York State Substance Abuse and Need for Treatment Among Arrestees.* Buffalo, New York: New York State Office of Alcoholism and Substance Abuse Services.

Beauvais, Fred. (1998). "American Indians and Alcohol." *Alcohol Health & Research World*. 22(4): 253-259.

Centers for Disease Control and Prevention (CDC). (1997). *Behavioral Risk Factor Surveillance System Questionnaire*. Atlanta, GA: Centers for Disease Control and Prevention.

Chaiken, J. M. and M. R. Chaiken. (1982). *Varieties of Criminal Behavior*. Santa Monica, California: The Rand Corporation.

Chaiken, M. R. and B. D. Johnson. (1988). *Characteristics of Different Types of Drug-Involved Offenders*. Washington, D.C.: U.S. Department of Justice.

Cochran, Deborah C., Richard C. Stephens, Huey-tsyh Chen, Heather K. Huff, and William McNutt. (1996). *Executive Summary: Ohio Needs Assessment Study on Substance Abuse Needs for Treatment of Adult Arrestees (ADULT SANTA)*. Cleveland, OH: Ohio Department of Alcohol and Drug Addiction Services.

Computer-Assisted Survey Methods Program. (1998). *A Transitional Guide to CASES 4.3*. Berkeley, CA.

Conklin, Thomas J., Thomas Lincoln, and Robert W. Tuthill. (2000). "Self-Reported Health and Prior Health Behaviors of Newly Admitted Correctional Inmates." *American Journal of Public Health*. 90(12): 1939-41.

Corrections Program Office. (1997). *Residential Substance Abuse Treatment for Prisoners: FY*

1997 Program Guidance and Application Kit. Washington, D.C.: Department of Justice, Office of Justice Programs.

Crandell, P. A. (2000a). *DOC Census June 2000* [personal communication, email]. June 20, 2000.

Crandell, P. A. (2000b). *Wildwood Admissions* [personal communication, email]. October 3, 2000.

Early, Kevin E. (1996). *Drug Treatment Behind Bars: Prison-Based Strategies for Change.* Westport, CT: Praeger.

Farabee, David. (1995). *Substance Use Among Female Inmates Entering the Texas Department of Criminal Justice - Institutional Division: 1994.* Austin, TX: Texas Commission on Alcohol and Drug Abuse.

Farabee, David.. (1994). *Substance Use Among Male Inmates Entering the Texas Department of Criminal Justice -- Institutional Division: 1993.* Austin, Texas: Texas Commission on Alcohol and Drug Abuse.

Farabee, David, Carl G. Leukefeld, Deena D. Watson, Michael Townsend, Hugh Spalding, and Richard Purvis. (1997). *Substance Abuse Treatment Needs Among Kentucky Prison Inmates.* Kentucky: University of Kentucky Center on Drug and Alcohol Research, Kentucky Division of Substance Abuse, and Kentucky Department of Corrections.

Feeley, M. M. and J. Simon. (1992). "The New Penology: Notes on the Emerging Strategy of Corrections and Its Implications." *Criminology* 30(4):449-74.

The Gallup Organization. (1998). *Alaska Adult Household Needs Assessment Survey, Alaska Adult Household Telephone Survey Statewide and Substate Planning Regions.* Alaska: Alaska Department of Health and Social Services, Division of Alcoholism and Drug Abuse.

Gendreau, Paul. (1993). "The Principles of Effective Intervention With Offenders." Presented at What Works in Community Corrections: A Consensus Conference, Philadelphia, PA

Gerstein, Dean R. and Henrick J. Harwood. (1990). *Treating Drug Problems: A Study of the Evolution, Effectiveness, and Financing of Public and Private Drug Treatment Systems.* Washington, D.C.: National Academy Press.

Green, B. (1981). "Examination of the Relationship Between Crime and Substance Use in a Drug/Alcohol Treatment Population." *International Journal of the Addictions* 16:627-45.

Gropper, B. A. (1985). *Probing the Links Between Drugs and Crime.* Washington, D.C.: U.S. Department of Justice.

Hayes, Thomas J. and Dennis J. Schimmel. (1993). "Residential Drug Abuse Treatment in the Federal Bureau of Prisons." *Journal of Drug Issues.* 23(1):61-73.

Hudik, Terry L., David Huff, Lettie Prell, Laura Roeder, Becky Bell, and Kim Porter. (1994). *An Assessment of the Substance Abuse Treatment Needs of the Inmates of Iowa's Correctional Institutions.* Iowa: Iowa Department of Human Rights.

Hudik, Terry L., Lettie Prell, Laura Roeder, Clarence J. Key, Becky Bell, Richard G. Moore, and Iowa Department of Human Rights. (1996). *Final Report of the Substance Abuse Need for Treatment Among Arrestees (SANTA) Project.* Iowa: Iowa Department of Human Rights.

Illinois Department of Corrections. (1995). *Adult Prison Study: Draft Version.* Illinois Department of Alcoholism and Substance Abuse.

Inciardi, J. A. (1986). *The War on Drugs: Heroin, Cocaine, Crime, and Public Policy.* Palo Alto, California: Mayfield Publishing Company.

Inciardi, James A. (1994). *Screening and Assessment for Alcohol and Other Drug Abuse Among Adults in the Criminal Justice System.* Rockville, MD: U.S. Department of Health and Human Services.

Institute of Public Affairs, University of South Carolina. (1997). *South Carolina Treatment Needs Assessment Survey of Arrestees.* South Carolina: South Carolina Department of Alcohol and Other Drug Abuse Services.

Johnson, Bassin &. S. and Alaska Department of Health and Social Services, Division of Alcoholism and Drug Abuse. (1998). *Alaska Substance Abuse Need for Treatment Among Arrestees (SANTA).* Alaska: Alaska Department of Health and Social Services, Division of Alcoholism and Drug Abuse.

Katzman, Robert, Theodore Brown, Paula Fuld, Arthur Peck, Ruben Schechter, and Herbert Schimmel. (1983). "Validation of a Short Orientation-Memory-Concentration Test of Cognitive Impairment." *American Journal of Psychiatry* 140(6):734-39.

Kerber, Lisa. (2000). *Substance Use Among Male Inmates: Texas Department of Criminal Justice--Institutional Division: 1998.* Austin, Texas: Texas Commission on Alcohol and Drug Abuse.

Kroliczak, Alice, Amanda Nothaft, Max D. Larsen, and the Gallup Organization. (1996). *Executive Summary: Hawaii Study of Substance Abuse and Need for Treatment Among Non-Arrestees.* Rockville, MD: Gallup Organization.

Lipton, Douglas S. (1995). *The Effectiveness of Treatment for Drug Abusers Under Criminal Justice Supervision.* Washington, D.C.: U.S. Department of Justice.

McAuliffe, William E., Paul Breer, Nancy White Ahmadifar, and Cathie Spino. (1991). "Assessment of Drug Abuser Treatment Needs in Rhode Island." *American Journal of Public Health.* 81(3):365-71.

McAuliffe, William E., Stephanie Geller, Richard A. LaBrie, Susannah B. F. Paletz, and Elizabeth A. Fournier. (1998). "Are Telephone Surveys Suitable for Studying Substance Abuse Epidemiology? Cost, Administration, Coverage and Response Rate Issues." *Journal of Drug Issues.* 28(2):455-82.

McAuliffe, William E., Richard LaBrie, Stephen Haddad, Eric Sevigny, Scott Ronis, Ryan Woodworth, Sarah Williamson, JoAnn Scherer-Gonzales, and Jocelyn Leary. (2000a). *The Substance Abuse Treatment Needs of Rhode Island's Prisoner and Training School Populations.* Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, William E., Richard LaBrie, Scott Ronis, Ryan Woodworth, JoAnn Scherer-Gonzales, Jocelyn Leary, Eric Sevigny, Stephen Haddad, Sarah Williamson. (2000b). *Commonwealth of Virginia's Adolescent Substance Abuse Treatment Needs Assessment: Adolescent Telephone Household Survey: Final Report.* Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, William E., Richard LaBrie, Eric Sevigny, Kenneth Nielsen, Scott Ronis, Stephen Haddad, Ryan Woodworth, Sarah Williamson, Jocelyn E. Leary, and JoAnn Scherer-Gonzales. (2000c). *The Substance Abuse Treatment Needs of Rhode Island's Neediest Citizens.* Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, William E., Richard LaBrie, Eric Sevigny, Scott Ronis, Ryan Woodworth, Kenneth Nielsen, Julie Finch, Caroline Sunshine, and Stephen Haddad. (1999a). *Substance Abuse Epidemiology and Services Research Questionnaire: Administration* *and Coding Guide.* Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, William E., Richard LaBrie, and Ryan Woodworth. (1999b). *An Interstate Substance Abuse Indicator Chartbook.* Cambridge, MA: North Charles Research and Planning Group.

McAuliffe, William E., Richard A. LaBrie, Nicoletta A. Lomuto, Nancy E. Pollock, Rebecca Betjemann, and Elizabeth Fournier. (2000c). "Measuring Interstate Variations in Problems Related to Alcohol Use Disorders." Pp. 213-44 in *The Epidemiology of Alcohol Problems in Small Geographic Areas*, First ed. vol. 36, (Eds). Robert A. Wilson and Mary C. Dufour. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.

McAuliffe, William E., Richard A. LaBrie, Norah Mulvaney, Howard J. Shaffer, Stephanie Geller, Elizabeth A. Fournier, Eliot B. Levine, Qiuyun Wang, Susan M. Wortman, and Kathleen A. Miller. (1995). *Assessment of Substance Dependence Treatment Needs: A Telephone Survey Manual and Questionnaire, Revised Edition.* Cambridge, MA: National Technical Center on Substance Abuse Needs Assessment.

McAuliffe, William E., Richard A. LaBrie, Nancy Pollock, Nicoletta Lomuto, Elizabeth A. Fournier, and Rebecca Betjemann. (1999c). "Measuring Interstate Variations in Drug Problems." *Drug and Alcohol Dependence.* 53(2):125-45.

Mumola, Christopher J. (1999). "Substance Abuse and Treatment, State and Federal Prisoners, 1997." *Bureau of Justice Statistics Special Report.* Washington, DC: US Department of Justice.

National Institute of Justice. (1995). *Drug Use Forecasting: 1994 Annual Report on Adult and Juvenile Arrestees.* Washington, D.C.: U.S. Department of Justice.

National Institute on Drug Abuse. (1994). *The Washington, DC, Metropolitan Area Drug Study: Prevalence of Drug Use in the DC Metropolitan Area Institutionalized Population: 1991.* Rockville, MD: National Institute on Drug Abuse.

Nurco, David N., Thomas E. Hanlon, Richard W. Bateman, and Timothy W. Kinlock. (1995). "Drug Abuse Treatment in the Context of Correctional Surveillance." *Journal of Substance Abuse Treatment.* 12(1):19-27.

Office of Applied Studies. 2000a. *Treatment Episode Data Set (TEDS) 1993-1998.* Rockville, MD: Substance Abuse and Mental Health Services Administration.

Office of Applied Studies. 2000b. *Uniform Facility Data Set (UFDS): 1998.* Rockville, MD: Substance Abuse and Mental Health Services Administration.

Peters, A[illegible], Tony Davies, and Alison Richardson. (1998). "Multi-Site Samples of Injecting Drug Users in Edinburgh: Prevalence and Conelates of Risky Injecting Practices." *Addiction.* 93(2):253-67.

Peters, R[illegible] H.; Greenbaum, Paul E., and Edens, John F. (1998). "Prevalence of DSM-IV substance abuse and dependence disorders among prison inmates." *American Journal of Drug and Alcohol Abuse.* 24(4): 573-587.

Petersilia, [illegible] 1990. "When Probation Becomes More Dreaded Than Prison." *Federal Probation* [illegible]-27.

Peterson, [illegible] and Bryan M. Johnstone. (1995). "The Atwood Hall Health Promotion Program, Federal Medical Center, Lexington, KY: Effects on Drug-Involved Federal Offenders." *Journal of Substance Abuse Treatment.* 12(1):43-48.

Regier, D[illegible] A., Mary E. Farmer, Donald S. Rae, Ben Z. Locke, Samuel J. Keith, Lewis L. Ju[illegible], and Frederick K. Goodwin. (1990). "Comorbidity of Mental Disorders With Alcohol and Other Drug Abuse: Results From the Epidemiologic Catchment Area (ECA) Study." *Journal of the American Medical Association.* 264(19):2511-18.

Robins, L[illegible], Linda B. Cottler, Kathleen K. Bucholz, and Wilson M. Compton. (1998). *Diagnostic Interview Schedule for DSM-IV (DIS-IV). September 1998 Revised Version.* St. Louis, MO: National Institute of Mental Health.

Robins, L[illegible] N. and Darrel A. Regier, Eds. 1991. *Psychiatric Disorders in America: The Epidemiologic Catchment Area Study.* New York: The Free Press.

Rolph, J[illegible] and J. M. Chaiken. 1987. *Identifying High-Rate Serious Criminals From Official Records.* Rand Publication Number: R-3433-NIJ. Santa Monica, California: The Rand Corporation.

Schiraldi, Vincent, Barry Holman, and Philip Beatty. 2000. *Poor Prescription: The Costs of Imprisoning Drug Offenders in the United States.* Washington, DC: Justice Policy Institute.

Segal, Bernard. (1998). "Drinking and Drinking-Related Problems Among Alaska Natives." *Alcohol Health & Research World.* 22(4): 276-80.

SPSS. (1999). *SPSS Base 10.0 User's Guide*. Chicago: SPSS, Inc.

Stewart, . . 1997. *A Criminal Justice System Strategy for Treating Cocaine-Heroin Abusing Offenders in Custody*. Washington, D.C.: National Institute of Justice .

Taylor, Stephen M., Marc Galanter, Helen Dermatis, Neal Spivack, and Susan Egelko. (1997). "Dual Diagnosis Patients in the Modified Therapeutic Community: Does a Criminal History Hinder Adjustment to Treatment?" *Journal of Addictive Diseases*. 16(3):31-38.

Teplin, Linda A. (1984). "Criminalizing Mental Disorder: The Comparative Arrest Rate of the Mentally Ill." *American Psychologist*. 39:794-803.

Teplin, Linda A. (1994). Psychiatric and substance abuse disorders among male urban jail detainees. *American Journal of Public Health*. 84(2): 290-293.

University of Alabama at Birmingham, Department of Psychiatry, Substance Abuse Programs. (. . *Substance Abuse Need for Treatment Among Arrestees in Jefferson County, Alabama (D.AFT)*. Birmingham, Alabama: Alabama Department of Mental Health and Mental Retardation, Substance Abuse Division.

Visher, C. . 1990. "Using Drug Testing to Identify High-Risk Defendants on Release: a Study in the District of Columbia." *Journal of Criminal Justice* 18:321-32.

Wexler, Harry K. (1994). "Progress in Prison Substance Abuse Treatment: A Five Year Report." *Journal of Drug Issues*. 24(2):349-60.

Williams, Sarah. (1995). "Inmate Substance Abuse Treatment Program Questionnaire for the Community Epidemiology Workshop Groups." July 13, 14.

Wilson, Doris James. (2000). "Drug Use, Testing, and Treatment in Jails." *Bureau of Justice Statistics Special Report*. Office of Justice Programs, U.S. Department of Justice. May. 1-12.

Woodward, Albert, Joan F. Epstein, Joseph C. Gfroerer, Daniel Melnick, Richard Thorenson, and Douglas Willson. (1997). "The Drug Abuse Treatment Gap: Recent Estimates." *Health Care Financing Review*. 18(3):5-17.

THE IMPACT OF MARIJUANA ON PARENTS AND CHILDREN

(Department of Health and Social Services Office of Children's Services)

I. **<u>Marijuana is the primary substance abused in a significant number of homes generating reports of harm and CINA cases due to illegal drug abuse.</u>**

- Parental neglect of children is often a consequence of substance abuse and addiction. Such neglect often leads to sexual or physical abuse by others.

- A 1998 national survey found that children whose parents abuse drugs or alcohol were almost three times (2.7) likelier to be physically or sexually assaulted and more than four times (4.2) likelier to be neglected than children of parents who are not substance abusers. *Children of Substance-Abusing Parents, (1999) <u>citing</u>, Sedlak, A.J., & Broadhurst, D.D. (1996). Third National Incidence Study of Child Abuse and Neglect: Final Report. U.S. Dept. of Health and Human Services, Administration for Children; <u>and</u>, National Center on Child Abuse and Neglect, (1998). Living Arrangements of Children Under 18 Years Old: 1960 to the Present; U.S. Advisory Board on Child Abuse and Neglect. (1993) Neighbors helping Neighbors.*

- 20.5% of the 915 social workers and family court professionals surveyed cited marijuana as the leading substance of abuse in child abuse or neglect cases involving illegal drugs.

- Marijuana is a problem for Alaska families, and can result in contacts with OCS in a variety of ways. Parental neglect, abuse, or arrest for drug dealing - (News articles attached)

- OCS spends $________ per year investigating reports of harm and handling CINA cases.

Suggested Witness: James Steele, OCS Children Services Manager, Southcentral Region

ALASKA JUSTICE FORUM

A Publication of the Justice Center

Alaska Justice Statistical Analysis Unit

Spring 2000 | UNIVERSITY OF ALASKA ANCHORAGE | Vol. 17, No. 1

Drug Use Among Arrestees in Anchorage

Cassie Atwell and Matthew Giblin

A survey of 718 male and female arrestees in 1999 has revealed that cocaine and marijuana are the drugs used most often by those arrested in the Anchorage area. The group was studied by the Justice Center as part of the Arrestee Drug Abuse Monitoring (ADAM) project, a national research initiative undertaken by the National Institute of Justice (NIJ). The program, originally established in 1987 as the Drug Use Forecasting Program (DUF) and subsequently redesigned and renamed in 1997, operates in thirty-five sites across the country. Its purpose is to generate extensive and timely data on drug use among the arrestee population.

The drug use data obtained from ADAM have implications for both national and local research and policymaking. On a national level, the data provide a national picture of drug use and abuse among a population that is difficult to reach from other drug use data collection programs (e.g., National Household Survey on Drug Abuse). In addition, data are used to analyze the relationship between drugs and crime. On a local level, the data provide local policymakers, law enforcement officials, and treatment professionals with a valuable resource from which to identify local drug trends, evaluate existing treatment programs and ascertain the need for additional or improved programs, advise local law enforcement personnel, and assist in formulating better policy decisions.

HIGHLIGHTS INSIDE THIS ISSUE

Methodology

Data collection, using a uniform protocol, takes place in thirty-five sites across the country. The uniform protocol enhances the validity of program findings while also helping to make findings comparable across ADAM sites.

Four times a year (once every quarter) the Justice Center collects data for a two-week period in both Anchorage booking facilities, Cook Inlet Pretrial and Sixth Avenue Correctional Center. The Justice Center and the Alaska Department of Corrections have worked together to administer a secure confidential collection procedure. The only criteria for inclusion in the study are that inmates must not have been in custody for more than forty-eight hours and that they must not be federal prisoners, Immigration and Naturalization Service detainees, or transfers from another facility. Once identified as eligible, the inmate is asked to participate in a two-pronged study protocol. The first part is an interview with a professionally trained interviewer. The main content of the interview focuses on current and prior drug use, and additional questions deal with criminal histories, drug treatment,

Please see Anchorage Arrestees, page 7

An earlier *Forum* article, "The National Drug Strategy: Escalation of the War on Drugs" by John Angell, Fall 1989, is available online at the Justice Center Web Site.

http://www.uaa.alaska.edu/just/

Table 1. Percentage of Arrestees Found Positive for Drugs, by Sex, Age, and Race, Anchorage, 1999

	Total sample (N)		Any drug		Cocaine		Marijuana		Opiates		Methamphetamine		PCP		Multiple drugs	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Per cent positive	563	155	53.8 %	56.1 %	25.6 %	36.1 %	37.5 %	31.0 %	3.0 %	1.9 %	0.5 %	0.0 %	0.0 %	0.0 %	12.1 %	12.9 %
By age																
15-20	51	19	66.7 %	52.6 %	13.7 %	21.1 %	60.8 %	36.8 %	0.0 %	5.3 %	0.0 %	0.0 %	0.0 %	0.0 %	7.8 %	10.5 %
21-25	95	28	57.9	60.7	18.9	21.4	55.8	50.0	3.2	0.0	1.1	0.0	0.0	0.0	18.9	10.7
26-30	87	22	55.2	40.9	27.6	31.8	42.5	13.6	0.0	0.0	0.0	0.0	0.0	0.0	14.9	4.5
31-35	97	28	56.7	71.4	35.1	53.6	27.8	39.3	5.2	0.0	1.0	0.0	0.0	0.0	10.3	21.4
35+	233	57	47.6	52.6	26.2	40.4	27.0	21.1	3.9	3.5	0.4	0.0	0.0	0.0	9.9	12.3
By race																
White	288	70	57.3 %	58.6 %	27.1 %	47.1 %	39.6 %	27.1 %	4.2 %	1.4 %	1.0 %	0.0 %	0.0 %	0.0 %	13.5 %	17.1 %
American Indian/ Alaska Native	144	63	–	–	11.8	15.9	32.6	33.3	1.4	3.2	0.0	0.0	0.0	0.0	–	–
Black	92	17	67.4	82.4	45.7	64.7	35.9	29.4	1.1	0.0	0.0	0.0	0.0	0.0	15.2	11.8
Hispanic	23	1	52.2	100.0	13.0	0.0	47.8	100.0	8.7	0.0	0.0	0.0	0.0	0.0	13.0	0.0
Asian	13	4	–	–	30.8	50.0	38.5	50.0	0.0	0.0	0.0	0.0	0.0	0.0	–	–
Other	2	0	–	–	0.0	–	0.0	–	0.0	–	0.0	–	0.0	–	–	–

***Source of data**: Arrestee Drug Abuse Monitoring Program, National Institute of Justice*

Measuring the Drug Problem

The ADAM program, which the Justice Center is administering with the Department of Corrections, is one of several national sources of data on the extent of the use of illicit drugs. As discussed in the article in this issue "Drug Use Among Arrestees in Anchorage," data from ADAM will be available to local agencies, and in the future the testing and survey questions will be tailored to elicit more information in response to the specific data needs of Alaska agencies. At present, while there are several sources of national data, there are few established, ongoing sources of accurate data on the extent of the illicit drug problem in Alaska.

Availability of Drugs

Law enforcement agencies in Alaska, including the in-state offices of the U.S. Drug Enforcement Agency (DEA), can only measure drugs which are seized and estimate the extent of the market using the size of their seizures and other information derived from investigations and case processing. In general, officers consider the estimates that they make to be conservative, that is, underestimates of the availability of drugs.

As a group, Alaska drug enforcement officials describe changes and trends in the drug market based on their work over a period of time—growth in marijuana cultivation, increasing availability of amphetamines, persistence in the importation of large amounts of cocaine—and arrests on drug-related charges have increased over the last two decades, but the efforts of law enforcement agencies are not primarily directed toward measurement.

Federal Measurements of Drug Use

In addition to ADAM, the federal government has three other major drug use indicators: the National Household Survey on Drug Abuse (NHSDA), the Drug Abuse Warning Network (DAWN), and Monitoring the Future.

The National Household Survey on Drug Abuse, which is administered by the U.S. Department of Health and Human Services, has been conducted annually since 1990. Before then it was conducted periodically beginning in 1971. In-person interviews on past and current use of a wide range of licit and illicit substances are conducted with a probability sample of persons aged twelve or older drawn from the nation. Table 1 shows results from the NHSDA since the mid-1980s.

DAWN captures data semiannually on reports of deaths from drug abuse and emergency room treatment related to drug abuse from a national sample of emergency rooms and medical examiners. The program has been collecting data since 1975.

Monitoring the Future, which is sponsored by the National Institute on Drug Abuse, surveys a national sample of high school students on availability and use of drugs and attitudes toward use. This survey has also been conducted since the mid-70s.

While the instruments provide different types of national data which may have relevance for Alaska, ADAM is currently the only national program which holds possibility for providing specific state-related data.

State Measurement of Drug Use

There seems to be no continuing in-state measurement of illicit drug use among the state population as a whole, although there are certainly data assembled by many agencies which belong to the overall drug abuse picture. The Alaska State Plan for Alcoholism and Drug Abuse Services, presented by the Advisory Board on Alcoholism and Drug Abuse as a statewide agenda for 1999 through 2003, has as part of its agenda improving the consistency and maintenance of data from various sources.

Various agencies, particularly the Alaska Department of Health and Human Services, have commissioned occasional individual

Table 1. Estimated Prevalence of Drug and Alcohol Use During Lifetime

Type of drug	1985 (N=8,021)	1988 (N=8,814)	1990 (N=9,259)	1991 (N=32,594)	1992 (N=28,832)	1993 (N=26,489)	1994 (N=17,809)	1995 (N=17,747)	1996 (N=18,269)	1997 (N=24,505)
Any illicit drug[a]	34.4 %	34.0 %	34.2 %	34.1 %	33.3 %	34.2 %	34.4 %	34.2 %	34.8 %	35.6 %
Marijuana and hashish	29.4	30.6	30.5	30.5	30.2	31.0	31.1	31.0	32.0	32.9
Cocaine	11.2	10.6	11.2	11.5	10.9	11.3	10.4	10.3	10.3	10.5
Crack	–	1.3	1.5	2.1	1.5	1.9	1.9	1.8	2.2	1.9
Inhalants	7.9	6.4	5.7	6.1	5.3	5.9	5.8	5.7	5.6	5.7
Hallucinogens	6.9	7.6	7.9	8.4	8.3	9.0	8.7	9.5	9.7	9.6
Heroin	0.9	0.9	0.8	1.2	0.8	1.0	1.0	1.2	1.1	0.9
Nonmedical use of any psychotherapeutic[b]	15.3	11.2	11.3	11.9	11.0	10.5	10.0	10.1	9.5	9.1
Stimulants	7.1	5.7	5.5	5.6	5.0	4.8	4.6	4.9	4.7	4.5
Sedatives	4.8	2.6	2.8	3.2	2.6	2.6	2.6	2.7	2.3	1.9
Tranquilizers	7.6	4.4	4.0	5.1	4.7	4.2	4.0	3.9	3.6	3.2
Analgesics	7.6	5.8	6.3	6.8	6.1	6.4	6.0	6.1	5.5	4.9
Any illicit drug other than marijuana[c]	22.4	19.3	19.5	19.8	18.9	19.7	18.8	19.1	18.9	18.9
Alcohol	84.9	84.0	82.2	83.6	81.9	82.6	84.2	82.3	82.6	81.9

a. Includes at least one use of marijuana or hashish, cocaine (including crack), inhalants, hallucinogens (including PCP and LSD), heroin, or any prescription-type psychotherapeutic used nonmedically.

b. Includes nonmedical use of any prescription-type stimulant, sedative, tranquilizer, or analgesic; does not include over-the-counter drugs.

c. Includes at least one use of any of these listed drugs, regardless of marijuana/hashish use; marijuana/hashish users who have used any of the other listed drugs are included.

Source: Sourcebook of Criminal Justice Statistics 1998, based on National Household Survey on Drug Abuse, U.S. Department of Health and Human Services studies which look at the drug issue from various angles. In particular, in 1998 the Division of Alcohol and Drug Abuse and the Epidemiology Section of HHS sought to measure the extent of substance abuse as a basis for determining the need for treatment programs. The study, which was conducted by The Gallup Organization, concluded above all, as have other studies, that the substance abused most widely in Alaska is, by far, alcohol, and the number of adults needing treatment for alcoholism is much higher than number needing treatment for other drugs. Among controlled drugs, dependency on marijuana was most common, with 4.2 per cent of the population estimated as dependant and an additional 1.0 per cent defined as abusers. The survey also found that 0.2 per cent of adult household residents showed evidence of a dependency on cocaine; 0.1 per cent, a dependency on amphetamines; and 0.1 per cent on hallucinogens.

The state also conducts the Youth Behavior Risk Survey every two years through the schools to assess attitudes and behaviors which present risks to health. This survey, however, is not administered in all parts of the state.

While the plan presented by the Advisory Board on Alcoholism and Drug Abuse advocates improvements in coordination among existing data and studies and also recommends more regular surveys of the prevalence of alcoholism and drug abuse, the establishment of such testing measures will depend on resource allocations from the state legislature as well as acquisition of federal funds.

National Drug Control and the Budget

On a national level, the ADAM program discussed in this issue of the *Forum* cost 1.3 million dollars in 1999. Over the last two decades the money allocated by the federal government for drug control has grown over 1100 per cent. For FY 2000 the federal government will spend an estimated 18.5 billion dollars on its drug control efforts – about one per cent of the total federal budget. In FY 1981 the drug budget was 1.5 billion

*Please see **Drug Budget**, page 4*

Table 1. Federal Drug Control Spending by Goal and Function, FY 1999-2001

Budget authority in millions of dollars.

	FY 1999 actual		FY 2000 estimated		FY 2001 request		Change from FY 2000 to FY 2001	
	Amount	%	Amount	%	Amount	%	Amount	%
Drug goals								
Goal 1	2,028.8	11.5 %	2,166.4	11.7 %	2,234.8	11.6 %	68.3	3.2 %
Goal 2	7,574.5	42.8	7,568.8	41.0	8,233.8	42.9	665.0	8.8
Goal 3	3,300.6	18.6	3,539.2	19.2	3,741.6	19.5	202.4	5.7
Goal 4	2,724.9	15.4	2,243.4	12.2	2,500.3	13.0	256.8	11.4
Goal 5	2,082.5	11.8	1,982.6	10.7	2,185.9	11.4	203.3	10.3
Subtotal	**17,711.2**		**17,500.6**		**18,896.4**		**1,395.9**	**8.0 %**
Goal 5 (U.S. Support for Plan Colombia and the Andean Region)			954.4	5.2 %	318.1	1.7 %		
Total	**17,711.2**		**18,455.0**		**19,214.5**		**759.6**	**4.1 %**
Functions								
Criminal justice system	8,557.6	48.3 %	8,631.2	46.8 %	9,365.5	48.8 %	754.3	8.7 %
Drug treatment	2,949.0	16.7	3,147.0	17.1	3,382.0	17.6	234.9	7.5
Drug prevention	1,953.5	11.0	2,064.5	11.2	2,122.3	11.0	57.8	2.8
Interdiction	2,417.9	13.7	1,922.7	10.4	2,213.4	11.5	290.8	15.1
Research	781.3	4.4	856.2	4.6	898.3	4.7	42.1	4.9
Intelligence	277.3	1.6	289.9	1.6	305.3	1.6	15.4	5.3
International	774.7	4.4	589.0	3.2	589.6	3.1	0.6	0.1
Subtotal	**17,711.2**		**17,500.6**		**18,896.4**		**1,395.9**	**8.0 %**
International (U.S. Support for Plan Colombia and the Andean Region)			954.4	5.2 %	318.1	1.7 %		
Total	**17,711.2**		**18,455.0**		**19,214.5**		**759.6**	**4.1 %**
Functional areas								
Demand reduction	5,570.6	31.5 %	5,953.2	32.3 %	6,283.9	32.7 %	330.8	5.6 %
Domestic law enforcement	8,948.1	50.5	9,035.7	49.0	9,809.4	51.1	773.7	8.6
Interdiction	2,417.9	13.7	1,922.7	10.4	2,213.4	11.5	290.8	15.1
International	774.7	4.4	589.0	3.2	589.6	3.1	0.6	0.1
International (U.S. Support for Plan Colombia and the Andean Region)	–	0.0	954.4	5.2	318.1	1.7	–	–
Total	**17,711.2**		**18,455.0**		**19,214.5**		**759.6**	**4.1 %**

Source: *Office of National Drug Control Policy*

Drug Budget
(continued from page 3)

dollars, about .2 per cent of the national budget at that time.

The overall statement of national drug policy with its application to specific programs is presented in two documents entitled "National Drug Control Strategy" and "Strategic Goals and Objectives of 1999 National Drug Control Strategy." The documents, which are published by the Office of National Drug Control Policy (ONDCP), the executive agency bearing responsibility for coordinating the drug control effort within the federal government, present five goals as the underlying structure of the drug war and its appropriation of funds: to educate and enable America's youth to reject illegal drugs as well as alcohol and tobacco; to increase the safety of America's citizens by substantially reducing drug-related crime and violence; to reduce health and social costs to the public of illegal drug use; to shield America's air, land and sea frontiers from the drug threat; and to break foreign and domestic drug sources of supply. These goals subsume seven functions: criminal justice, drug treatment, prevention, interdiction, research, intelligence and international efforts. The tables accompanying this article detail the drug control budget in terms of these goals and functions.

As Tables 1 and 2 show, the criminal justice system receives the largest sub-portion of the money, with the Department of Justice by far the recipient of the greatest amount among the major federal departments, but it is important to recognize that major thrust of the drug control effort is, in essence, directed toward enforcement and almost all of the main federal departments administer some drug-related enforcement program. Considerably more funds go into policing, corrections, interdiction, intelligence and international control efforts than go into treatment and prevention.

For many federal agencies the percentage of the agency budget now devoted to the drug control effort is growing (Table 3). For some agencies, such as the Federal Bureau of Prisons, the U.S. Marshals Service and the National Institutes of Health, the portion of the budget which is drug related is now over fifty per cent.

Table 2. Federal Drug Spending by Department
In millions of dollars

	FY 1999 actual	FY 2000 estimated	FY 2001 request	Change FY 00-01 Amount	%
Defense	974.9	1,005.2	1,029.1	238.8	2.4 %
Education	663.2	698.1	750.9	52.8	7.6
Health and Human Services	2,866.1	3,078.9	3,264.8	185.9	6.0
Housing and Urban Development	310.0	310.0	315.0	5.0	1.6
Justice	7,398.5	7,443.2	8,236.9	793.7	10.7
Office of National Drug Control Policy	453.2	461.4	496.8	35.4	7.7
State	498.7	282.8	276.8	(6.0)	(2.1)
Transportation	871.1	631.0	684.9	53.8	8.5
Treasury	1,756.5	1,499.6	1,688.3	188.7	12.6
Veterans Affairs	1,041.7	1,111.4	1,155.5	44.1	4.0
All other	877.3	978.8	997.5	18.7	1.9
Subtotal	**17,711.2**	**17,500.6**	**18,896.4**	**1,395.9**	**8.0 %**
Plan Columbia and Andean Region		954.4	318.1		
Total	**1,771.2**	**18,455.0**	**19,214.5**	**759.6**	**4.1 %**

Source: *Office of National Drug Control Policy*

Table 3. Selected Federal Agencies: Percentages of Budget Related to Drug Control

	FY 1999 actual	FY 2000 estimated	FY 2001 request
Federal Bureau of Prisons	58.0 %	57.8 %	57.5 %
U.S. Marshals Service	52.6	52.6	52.4
Immigration and Naturalization Service	15.5	15.8	16.6
Bureau of Alcohol, Tobacco and Firearms	41.9	41.7	43.0
U.S. Customs	45.4	35.2	35.0
Office of Justice Programs	27.5	28.2	31.9
Federal Judiciary	18.7	18.7	18.7
U.S. Attorney	17.8	17.9	16.9
COPS	33.0	33.0	33.0
Department of Education	1.7	1.6	1.7
National Institutes of Health	74.6	74.5	74.2

Source: *Office of National Drug Control Policy*

Drug Cases in the Courts

The available figures for federal courts show a steady rise in the percentage of the caseload related to drug charges (Table 1) since the early 1980s. Between FY 1992 and FY 1999 the percentage of drug cases as part of the total caseload more than doubled, rising from 13.3 per cent to 29 per cent. The actual number of drug cases filed in U.S. District Courts nationwide more than quadrupled, from 4193 in FY 82 to 17,483 in FY 99. Figures for case filings for U.S. District in Alaska do not reflect this national rise; in 1982 the percentage of total caseload was already 25 per cent and in 1999, 22.5 per cent. It has ranged from a high of 34.5 per cent to a low of 10.4 per cent.

The percentage of total felony filings in the Alaska Court System which are drug cases has remained relatively stable since the early 1980s, neither rising nor falling significantly, although the actual number of felony drug cases being filed each year has risen steadily, with 342 filed in 1982 and 809 filed in 1999—a growth of 137 per cent. (The Alaska Court System felony drug case

Table 1. Federal Drug Cases Filed in U.S. District Courts–U.S. and Alaska

	United States			Alaska		
Fiscal year	Total criminal cases	Drug cases Number	Drug cases % of total	Total criminal cases	Drug cases Number	Drug cases % of total
1982	31,623	4,193	13.3 %	190	48	25.3 %
1987	42,156	8,869	21.0	221	23	10.4
1992	47,472	12,833	27.0	286	68	23.8
1997	50,363	13,656	27.1	220	76	34.5
1998	57,691	16,281	28.2	261	49	18.8
1999	59,923	17,483	29.2	227	51	22.5

Sources: *Sourcebook of Criminal Justice Statistics, 1983, 1988, 1993; Administrative Office of the U.S. Courts*

The Alaska Department of Corrections: The Drug Treatment Picture

Although some plans for general screening of inmates for drug and alcohol problems are now being considered, the Alaska Department of Corrections at present does not test inmates for drug or alcohol problems at the time they begin serving their sentences. As a result, no firm numbers are available on the extent of the drug problem among the inmate population. DOC does state that the available treatment programs are always full, with those ordered by the courts into treatment receiving priority for available spaces and others being treated on a voluntary, first-come, first-served basis. More inmates request treatment than there are spaces available. (Table 1 provides national data on the extent of prior drug use among prisoners.)

Table 1. Level of Prior Drug Use by State and Federal Prisoners by Type and Drug and Frequency of Use, 1991 and 1997

	Ever used in the past		Ever used drugs regularly[a]		Used drugs in the month prior to offense		Used drugs at the time of offense	
	1991	1997	1991	1997	1991	1997	1991	1997
State prisoners								
Marijuana/hashish	73.8 %	77.0 %	51.9 %	58.3 %	32.2 %	39.2 %	11.4 %	15.1 %
Cocaine/crack	49.4	49.2	31.9	33.6	25.2	25.0	14.5	14.8
Heroin/opiates	25.2	24.5	15.3	15.0	9.6	9.2	5.8	5.6
Depressants[b]	24.0	23.7	10.8	11.3	3.8	5.1	1.0	1.8
Stimulants[c]	29.7	28.3	16.6	16.3	7.4	9.0	2.9	4.2
Hallucinogens[d]	26.9	28.7	11.5	11.3	3.7	4.0	1.6	1.8
Inhalants	–	14.4	–	5.4	–	1.0	–	–
Any drug[e]	**79.4 %**	**83.0 %**	**62.2 %**	**69.6 %**	**49.9 %**	**56.5 %**	**31.0 %**	**32.6 %**
Federal prisoners								
Marijuana/hashish	52.8 %	65.2 %	32.2 %	46.6 %	19.2 %	30.4 %	5.9 %	10.8 %
Cocaine/crack	37.3	44.8	20.6	28.2	15.4	20.0	7.7	9.3
Heroin/opiates	14.1	16.1	9.3	8.9	5.5	5.4	3.7	3.0
Depressants[b]	13.1	16.5	5.3	8.0	1.4	3.2	0.3	1.0
Stimulants[c]	16.8	20.9	8.3	12.9	3.9	7.6	1.8	4.1
Hallucinogens[d]	14.8	19.0	4.8	6.4	1.2	1.7	0.5	0.8
Inhalants	–	7.7	–	2.6	–	0.5	–	–
Any drug[e]	**60.1 %**	**72.9 %**	**42.1 %**	**57.3 %**	**31.8 %**	**44.8 %**	**16.8 %**	**22.4 %**

Note. Details add to more than total because prisoners may have used more than one type of drug.

a. Used drugs once a week or more for at least a month.
b. Includes barbiturates, tranquilizers, and Quaalude.
c. Includes amphetamine and methamphetamine.
d. Includes LSD and PCP.
e. Other unspecified drugs are included in the totals.

Source: Sourcebook of Criminal Justice Statistics 1998

The annual budget for DOC substance abuse programs is just under one million dollars. It has not increased in eight years. The department contracts with state-approved substance abuse treatment providers in the community for all of its programs. The department itself has only one regular position in this area, the Substance Abuse Program Coordinator, who administers the DOC programs. Because funding available for the programs has not increased, the number of treatment providers willing to contract with DOC is declining.

The department offers an inmate substance abuse program in each facility, but those at the Ketchikan, Palmer, Yukon-Kuskokwim, and Anvil Mountain Correctional Centers are educational programs only. At Sixth Avenue and Mat-Su Pretrial, orientation programs are offered. At Cook Inlet Pre-Trial and Fairbanks Correction Center education programs with an introduction to treatment component are available. At Lemon Creek, Meadow Creek, Spring Creek, and Wildwood Correctional Centers and at the Point MacKenzie Rehabilitation Center, the programs offer a level of treatment comparable to that labeled as "outpatient treatment" in the general community. The only intensive residential treatment program is one for women at Hiland Mountain Correctional Center. Another intensive residential program, for men, which will be located at Wildwood, is in the planning stages. These intensive residential treatment programs are being primarily funded by federal monies, with some state matching funds required. (Federal funds are currently available only for residential

Please see ***Alaska DOC****, page 6*

figures also include cases related to the importation of alcohol.)

Because of changes in data systems it is impossible to assemble consistent regular figures on the specific charges associated with drug case filings in the Alaska Court System over the last two decades, but a cursory examination of data from 1997, 1998 and 1999 reveals that most felony drug cases are filed under AS 11.71.030 and .040—misconduct involving a controlled substance in the third and fourth degrees.

Alaska does not have a discrete drug court which solely handles drug cases. According to figures from the Bureau of Justice Statistics, at the end of FY 98, there were 430 such courts nationwide in operation or in the planning stages. The majority of those in operation had been so for less than two years. Plans to establish a drug court within the Alaska system have run into funding difficulties.

Table 2. Drug Cases Filed in the Alaska Court System

	Total criminal cases filed	Drug cases	
		Number	% of total
1982	1,607	342	21.3 %
1987	2,661	473	17.8
1992	2,763	519	18.8
1997	3,362	791	23.5
1998	3,588	836	23.3
1999	3,429	809	23.6

Note: Drug case totals include cases filed under statutes pertaining to contraband, controlled substances, drugs and the importation of alcohol.

Source: Alaska Court System annual reports

Alaska DOC
(continued from page 5)

programs.)

According to DOC figures, during FY 1999, 1583 inmates were admitted to the programs comprising the substance abuse educational component and 306 to the outpatient-level programs. Since the residential treatment program for women opened at Hiland Mountain, 94 inmates have been admitted. The Central Arizona Detention Center, the private correctional facility owned by Corrections Corporation of America in Florence, Arizona, which contracts with DOC, also offers a substance abuse day treatment program.

This Arizona facility, with close to 900 Alaska inmates, is, in effect, the state's largest institution. The rise in the number of inmates being sent to Arizona has an effect on the drug treatment situation within other Alaska facilities. The shifts among inmate populations which occur as an administrative consequence of the use of the out-of-state prison can undermine the establishment of stable treatment program environments.

In addition to providing the treatment programs under contract, DOC also facilitates the formation of twelve-step programs such as Narcotics Anonymous and Alcoholics Anonymous in its facilities.

Incarceration on Drug Offenses

Table 1. Federal Prison Prisoners Sentenced for Drug Offenses, 1980-1998

	Total sentenced and unsentenced population	Sentenced population: Total	Drug offenses: Number	Drug offenses: Per cent of total
1980	24,252	19,023	4,749	25.0 %
1981	26,195	19,765	5,076	25.7
1982	28,133	20,938	5,518	26.4
1983	30,214	26,027	7,201	27.7
1984	32,317	27,623	8,152	29.5
1985	36,042	27,623	9,491	34.4
1986	40,505	31,831	12,119	38.1
1987	43,683	34,163	14,354	42.0
1988	43,401	34,680	15,526	44.8
1989	50,173	38,969	19,459	49.9
1990	57,331	47,847	25,037	52.3
1991	63,711	53,526	30,498	57.0
1992	70,346	61,026	36,349	59.6
1993	79,483	70,557	42,945	60.9
1994	85,290	76,186	46,743	61.4
1995	89,564	79,347	48,118	60.6
1996	94,215	83,515	50,754	60.8
1997	100,639	89,748	54,099	60.3
1998*	106,536	95,522	56,291	58.9

Note: These data represent inmates housed in Federal Bureau of Prison facilities; inmates housed in contract facilities are not included.

* 1998 data are preliminary and subject to revision.

Source: *Sourcebook of Criminal Justice Statistics 1998, based on data from the Federal Bureau of Prisons*

Table 2. Alaska Department of Corrections: Inmates with Drug Offense as Primary Offense

	Male	Female	Drug offenses: Number	Drug offenses: % of total population	Total prison population
1985	–	–	105	4.9 %	2,124
1986	–	–	115	5.1	2,245
1991	–	–	167	6.7	2,483
1995	–	–	240	6.8	3,520
1996	–	–	251	6.7	3,721
1997	–	–	298	7.2	4,164
1998	–	–	276	6.7	4,097
1999	202	45	247	6.1	4,077

Note: Includes inmates in community residential centers.

Source of data: *Alaska Department of Corrections*

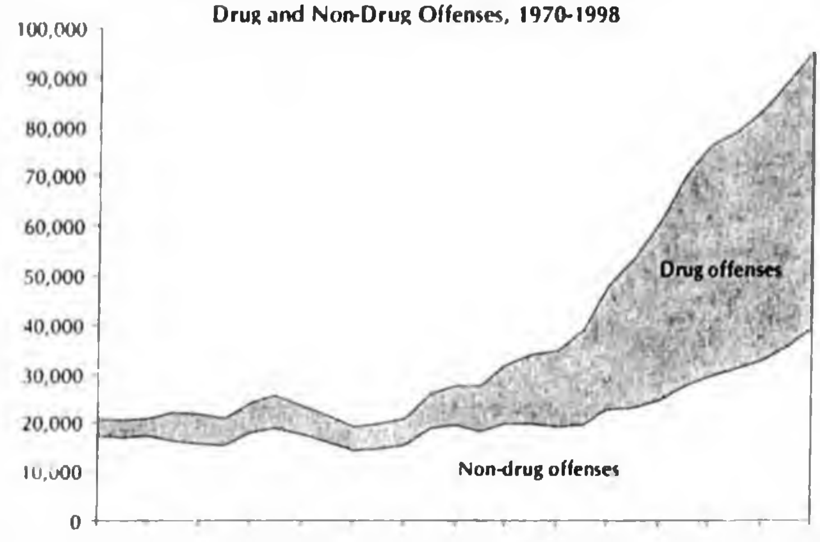
The "war on drugs" has led to an enormous increase in both the numbers and percentages of inmates in the federal system incarcerated primarily for drug offenses (Table 1), but to less of a proportional increase in similar imprisonments in the Alaska state system.

The inmate population sentenced for drug offenses is now almost 60 per cent of the total federal inmate population. Between 1985 and 1998 the *number* of federal inmates sentenced for drug charges grew by nearly 500 per cent.

The Alaska Department of Corrections does not show such a precipitous rise in the numbers or percentages of inmates sentenced primarily for drug offenses.

In December 1985, out of the total inmate population of 2124 reported in the corrections data base, 105, or 5 per cent, were sentenced on a drug-related offense as the primary offense (Table 2). (Corrections became a separate state department in 1984; before then it was a division within Health and Human Services. The data base from which these figures were taken was put in place in late 1983.) By the end of 1999, the total DOC inmate population, including that in community residential centers, was 4077. Of these, 247—6.1 per cent—had a controlled substance charge as the primary charge. (These figures do not include those imprisoned on a parole or probation violation which was itself a drug offense, so they are undoubtedly somewhat low.) While the percentage of prisoners in the Alaska system on drug charges has grown only slightly, the actual number has increased by more than 135 per cent, paralleling the climb in the overall DOC population.

Figure 1. Federal Prison Population Sentenced for Drug and Non-Drug Offenses, 1970-1998



Note: These data represent inmates housed in Federal Bureau of Prison facilities; inmates housed in contract facilities are not included. 1998 Data are preliminary and subject to revision.

Source of data: *Sourcebook of Criminal Justice Statistics 1998, based on data from the Federal Bureau of Prisons*

Table 2. Percentage of Arrestees Reporting Drug Use in the Past 30 Days, by Age and Sex, Anchorage, 1999

	Crack		Cocaine		Crack and cocaine		Marijuana and cocaine		Opiates and cocaine		Any two or more drugs	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
All ages	19.2 %	29.7 %	12.1 %	14.8 %	5.5 %	11.6 %	9.4 %	11.6 %	1.2 %	2.6 %	26.0 %	26.6 %
By age												
15-20	0.0 %	15.8 %	13.7 %	5.3 %	0.0 %	5.3 %	9.8 %	5.3 %	2.0 %	0.0 %	27.5 %	21.1 %
21-25	10.5	25.0	11.6	21.4	5.3	17.9	11.6	17.9	3.2	3.6	28.7	21.4
26-30	23.0	18.2	11.5	22.7	4.6	18.2	9.2	18.2	1.1	9.1	26.7	27.3
31-35	27.8	35.7	16.7	10.7	11.3	7.1	6.3	10.7	0.0	3.6	31.3	18.5
35+	21.9	36.8	10.4	14.0	4.7	10.5	9.9	8.8	0.9	0.0	22.1	33.3

Source of data: Arrestee Drug Abuse Monitoring Program, National Institute of Justice

Anchorage Arrestees
(continued from page 1)

educational background, desire for treatment, and demographics. The second part of the ADAM protocol involves the collection of a urine sample from the interviewee used to corroborate the information given in the interview. The specimen is shipped to a lab where it undergoes testing for the presence of ten different drugs.

Participation is strictly voluntary with the inmate having the right to refuse to answer any question asked or terminate the interview at any time. The urine sample is also voluntary and the interviewee may refuse to provide a specimen despite participating in the self-report interview. However, the sample is only collected if the inmate has completed the interview. All of the information obtained during the interview process is strictly confidential, and individual results cannot be made available to any law enforcement or prosecutorial agency. Strict measures are taken to ensure that the interviewer does not know the names of the persons being interviewed, and the survey instrument and urine sample are not marked in any way which could be traced back to the individual.

At the end of data collection the questionnaires are sent to Washington, D.C. for analysis; aggregate data are returned to each individual site for further study.

1999 Results

Though participation in the study is voluntary, the participation rate is relatively high. In 1999, 1,117 arrestees were approached; 76 per cent (n=844) contributed an interview. Of those who agreed to be interviewed, 85 per cent provided a urine specimen for testing (n=718). The results discussed below reflect findings from the participants that contributed both an interview and urine specimen.

In 1999, a total of 563 male and 155 female adult arrestees were surveyed. (Anchorage is not currently surveying juveniles.) The results are for those arrested for all offenses—not just on drug related charges. The data show that cocaine and marijuana were used most frequently by both male and female arrestees. Slightly more than half tested positive for any drug, while 25 per cent of the males and 36 per cent of the females tested positive for cocaine, and 37 per cent of males and 31 per cent of females were positive for marijuana. Less than five per cent of those arrested tested positive for opiates or methamphetamines. (See Table 1.)

The self-reported drug information shows that 31 per cent of males and 45 per cent of females admitted using either crack or powder cocaine within the last 30 days (Table 2).

Among those reporting the use of either crack or powder cocaine, males (n=108) used crack a mean 8.8 days and females (n=46), 12.7 days. The mean number of days for powder cocaine usage was 6.5 for males (n=68) and 8.6 for females (n=23). The number of days per month of reported use for marijuana was 11.2 for males (n=269) and 11.0 for females (n=69). (See Table 3.) As Table 4 shows, the data also underscore the fact that drug use is common among individuals arrested across the spectrum of crimes.

Since 1999 was the first full year of data for the Anchorage site, no statistical comparisons with previous years are possible. As data collection continues it will be possible to examine trends in drug use among Anchorage arrestees.

Applications of ADAM Data

In addition to providing a barometer of

Please see Anchorage Arrestees, page 8

Table 3. Mean Number of Days Arrestees Used Drugs in the Past 30 Days, Anchorage, 1999

	Male N=563		Female N=155	
	N	Mean number of days	N	Mean number of days
Crack	108	8.8 days	46	12.7 days
Cocaine	68	6.5	23	8.6
Marijuana	269	11.2	69	11.0
Opiates	15	5.9	5	11.0
Methamphetamines	13	6.5	4	8.3

Source: Arrestee Drug Abuse Monitoring Program, National Institute of Justice

Table 4. Percentage of Arrestees Found Positive for Any Drug, by Offense Category, Anchorage, 1999

	Male N=563		Female N=155	
Offense	N	% positive	N	% positive
Violent offense	**152**	**46.1 %**	**35**	**37.1 %**
Robbery	7	42.9	3	100.0
Assault	126	46.8	29	34.5
Weapons	12	66.7	1	100.0
Other violent offense	17	29.4	4	25.0
Property offense	**106**	**57.5 %**	**31**	**61.3 %**
Larceny/theft	46	67.4	23	65.2
Burglary	11	54.5	0	0.0
Stolen vehicle	10	80.0	2	100.0
Other property offense	43	47.2	10	50.0
Drug offense	**16**	**87.5 %**	**6**	**50.0 %**
Drug sales	1	100.0	0	0.0
Drug possession	15	86.7	6	50.0
Prostitution	**0**	**0.0 %**	**7**	**71.4 %**
Other offense	**369**	**57.5 %**	**97**	**60.8 %**

Note: Detail may not add to total because some arrestees may have been arrested for more than one offense.

Source: Arrestee Drug Abuse Monitoring Program, National Institute of Justice

Anchorage Arrestees
(continued from page 7)

local drug use patterns among the arrested population, ADAM data have a variety of other uses. A brief overview of how the data are being used in other cities can suggest possibilities for use in Alaska.

Researchers in Philadelphia are using ADAM data to explore the impact of certain "gateway" drugs on subsequent escalation to harder drug use. In addition, the same researchers are attempting to develop a typology of drug users, which can potentially lead to varied interventions or treatment based on user type. Other researchers are examining the relationship between drugs and crime.

It should be noted, however, that the ADAM data collection effort is not limited only to information about drugs. Researchers maximize the amount of data that can be collected through ADAM by creating addenda to the survey instrument. For example, after being interviewed about their drug use patterns, arrestees in 11 ADAM sites were questioned about firearms, including their reasons for owning a firearm, method of obtaining guns, and attitudes toward firearms.

Future of the Program in Anchorage

In January 2000, the ADAM survey instrument was expanded to include more relevant data for both law enforcement and treatment professionals. It will be possible to cross-link results to other national databases such as the National Household Survey on Drug Abuse and the Treatment Episode Data Set. This, in turn, will provide even more specific information on drug use for local policymakers, treatment professionals and law enforcement. Furthermore, the Justice Center intends to supplement the new instrument with addenda specifically aimed at local issues such as alcohol use. The National Institute of Justice and the Institutional Review Board that oversees the project must first approve all addenda used.

In order to disseminate the aggregate data and enhance ADAM's utility to the Anchorage community, the Anchorage site will also assemble a Local Coordinating Council. It will include members of the community at-large as well as professionals in the areas of drug abuse treatment, the judiciary, and law enforcement. We anticipate the implementation of an outreach program that will collect one quarter's data from other areas of the state such as Fairbanks, Juneau, Barrow and Bethel.

The ADAM program is in its infancy in Alaska but has the potential to increase useful information available for professionals across the state.

Cassie Atwell and Matthew Giblin are research associates with the Justice Center.

Alaska Justice Forum

Published quarterly by the Justice Center and the Alaska Justice Statistical Analysis Unit at the University of Alaska Anchorage, 3211 Providence Drive, Anchorage, AK 99508; (907) 786-1810; fax 786-7777; Internet address ayjust@uaa.alaska.edu; World Wide Web http://www.uaa.alaska.edu/just/

ISSN 0893-8903

Search for Historical Records

Dr. Lawrence Trostle of the Justice Center is compiling historical materials on Alaska Native policing from 1867 through 1959. He is interested in looking at any material—diaries, letters, government records, missionary or other church records, newspaper accounts—which relate to the contribution of Alaska Natives to law enforcement or to the general provision of justice services in the period after the purchase of Alaska from Russia through the enactment of statehood. He is also interested in speaking with anyone who may have personal reminiscences to recount. Trostle can be reached through the Justice Center at (907) 786-1815 or aflct@uaa.alaska.edu.

Alaska Justice Forum
Justice Center
University of Alaska Anchorage
3211 Providence Drive
Anchorage, AK 99508

Return service requested

Non-Profit Organization
U.S. Postage
PAID
Anchorage, Alaska
Permit No. 107

ALASKA JUSTICE FORUM

A Publication of the Justice Center

Alaska Justice Statistical Analysis Unit

Spring 2000 | **UNIVERSITY OF ALASKA ANCHORAGE** | **Vol. 17, No. 1**

Drug Use Among Arrestees in Anchorage

Cassie Atwell and Matthew Giblin

A survey of 718 male and female arrestees in 1999 has revealed that cocaine and marijuana are the drugs used most often by those arrested in the Anchorage area. The group was studied by the Justice Center as part of the Arrestee Drug Abuse Monitoring (ADAM) project, a national research initiative undertaken by the National Institute of Justice (NIJ). The program, originally established in 1987 as the Drug Use Forecasting Program (DUF) and subsequently redesigned and renamed in 1997, operates in thirty-five sites across the country. Its purpose is to generate extensive and timely data on drug use among the arrestee population.

The drug use data obtained from ADAM have implications for both national and local research and policymaking. On a national level, the data provide a national picture of drug use and abuse among a population that is difficult to reach from other drug use data collection programs (e.g., National Household Survey on Drug Abuse). In addition, data are used to analyze the relationship between drugs and crime. On a local level, the data provide local policymakers, law enforcement officials, and treatment professionals with a valuable resource from which to identify local drug trends, evaluate existing treatment programs and ascertain the need for additional or improved programs, advise local law enforcement personnel, and assist in formulating better policy decisions.

Methodology

Data collection, using a uniform protocol, takes place in thirty-five sites across the country. The uniform protocol enhances the validity of program findings while also helping to make findings comparable across ADAM sites.

Four times a year (once every quarter) the Justice Center collects data for a two-week period in both Anchorage booking facilities, Cook Inlet Pretrial and Sixth Avenue Correctional Center. The Justice Center and the Alaska Department of Corrections have worked together to administer a secure confidential collection procedure. The only criteria for inclusion in the study are that inmates must not have been in custody for more than forty-eight hours and that they must not be federal prisoners, Immigration and Naturalization Service detainees, or transfers from another facility. Once identified as eligible, the inmate is asked to participate in a two-pronged study protocol. The first part is an interview with a professionally trained interviewer. The main content of the interview focuses on current and prior drug use, and additional questions deal with criminal histories, drug treatment,

*Please see **Anchorage Arrestees**, page 7*

An earlier *Forum* article, "The National Drug Strategy: Escalation of the War on Drugs" by John Angell, Fall 1989, is available online at the Justice Center Web Site.

http://www.uaa.alaska.edu/just/

Table 1. Percentage of Arrestees Found Positive for Drugs, by Sex, Age, and Race, Anchorage, 1999

	Total sample (N)		Any drug		Cocaine		Marijuana		Opiates		Methamphetamine		PCP		Multiple drugs	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Per cent positive	563	155	53.8 %	56.1 %	25.6 %	36.1 %	37.5 %	31.0 %	3.0 %	1.9 %	0.5 %	0.0 %	0.0 %	0.0 %	12.1 %	12.9 %
By age																
15-20	51	19	66.7 %	52.6 %	13.7 %	21.1 %	60.8 %	36.8 %	0.0 %	5.3 %	0.0 %	0.0 %	0.0 %	0.0 %	7.8 %	10.5 %
21-25	95	28	57.9	60.7	18.9	21.4	55.8	50.0	3.2	0.0	1.1	0.0	0.0	0.0	18.9	10.7
26-30	87	22	55.2	40.9	27.6	31.8	42.5	13.6	0.0	0.0	0.0	0.0	0.0	0.0	14.9	4.5
31-35	97	28	56.7	71.4	35.1	53.6	27.8	39.3	5.2	0.0	1.0	0.0	0.0	0.0	10.3	21.4
35+	233	57	47.6	52.6	26.2	40.4	27.0	21.1	3.9	3.5	0.4	0.0	0.0	0.0	9.9	12.3
By race																
White	288	70	57.1 %	58.6 %	27.1 %	47.1 %	39.6 %	27.1 %	4.2 %	1.4 %	1.0 %	0.0 %	0.0 %	0.0 %	13.5 %	17.1 %
American Indian/ Alaska Native	144	63	–	–	11.8	15.9	32.6	33.3	1.4	3.2	0.0	0.0	0.0	0.0	–	–
Black	92	17	67.4	82.4	45.7	64.7	35.9	29.4	1.1	0.0	0.0	0.0	0.0	0.0	15.2	11.8
Hispanic	23	1	52.2	100.0	13.0	0.0	47.8	100.0	8.7	0.0	0.0	0.0	0.0	0.0	13.0	0.0
Asian	13	4	–	–	30.8	50.0	38.5	50.0	0.0	0.0	0.0	0.0	0.0	0.0	–	–
Other	2	0	–	–	0.0	–	0.0	–	0.0	–	0.0	–	0.0	–	–	–

***Source of data**: Arrestee Drug Abuse Monitoring Program, National Institute of Justice*

Measuring the Drug Problem

The ADAM program, which the Justice Center is administering with the Department of Corrections, is one of several national sources of data on the extent of the use of illicit drugs. As discussed in the article in this issue "Drug Use Among Arrestees in Anchorage," data from ADAM will be available to local agencies, and in the future the testing and survey questions will be tailored to elicit more information in response to the specific data needs of Alaska agencies. At present, while there are several sources of national data, there are few established, ongoing sources of accurate data on the extent of the illicit drug problem in Alaska.

Availability of Drugs

Law enforcement agencies in Alaska, including the in-state offices of the U.S. Drug Enforcement Agency (DEA), can only measure drugs which are seized and estimate the extent of the market using the size of their seizures and other information derived from investigations and case processing. In general, officers consider the estimates that they make to be conservative, that is, underestimates of the availability of drugs.

As a group, Alaska drug enforcement officials describe changes and trends in the drug market based on their work over a period of time— growth in marijuana cultivation, increasing availability of amphetamines, persistence in the importation of large amounts of cocaine—and arrests on drug-related charges have increased over the last two decades, but the efforts of law enforcement agencies are not primarily directed toward measurement.

Federal Measurements of Drug Use

In addition to ADAM, the federal government has three other major drug use indicators: the National Household Survey on Drug Abuse (NHSDA), the Drug Abuse Warning Network (DAWN), and Monitoring the Future.

The National Household Survey on Drug Abuse, which is administered by the U.S. Department of Health and Human Services, has been conducted annually since 1990. Before then it was conducted periodically beginning in 1971. In-person interviews on past and current use of a wide range of licit and illicit substances are conducted with a probability sample of persons aged twelve or older drawn from the nation. Table 1 shows results from the NHSDA since the mid-1980s.

DAWN captures data semiannually on reports of deaths from drug abuse and emergency room treatment related to drug abuse from a national sample of emergency rooms and medical examiners. The program has been collecting data since 1975.

Monitoring the Future, which is sponsored by the National Institute on Drug Abuse, surveys a national sample of high school students on availability and use of drugs and attitudes toward use. This survey has also been conducted since the mid-70s.

While the instruments provide different types of national data which may have relevance for Alaska, ADAM is currently the only national program which holds possibility for providing specific state-related data.

State Measurement of Drug Use

There seems to be no continuing in-state measurement of illicit drug use among the state population as a whole, although there are certainly data assembled by many agencies which belong to the overall drug abuse picture. The Alaska State Plan for Alcoholism and Drug Abuse Services, presented by the Advisory Board on Alcoholism and Drug Abuse as a statewide agenda for 1999 through 2003, has as part of its agenda improving the consistency and maintenance of data from various sources.

Various agencies, particularly the Alaska Department of Health and Human Services, have commissioned occasional individual

Table 1. Estimated Prevalence of Drug and Alcohol Use During Lifetime

Type of drug	1985 (N=8,021)	1988 (N=8,814)	1990 (N=9,259)	1991 (N=32,594)	1992 (N=28,832)	1993 (N=26,489)	1994 (N=17,809)	1995 (N=17,747)	1996 (N=18,269)	1997 (N=24,505)
Any illicit drug[a]	34.4 %	34.0 %	34.2 %	34.1 %	33.3 %	34.2 %	34.4 %	34.2 %	34.8 %	35.6 %
Marijuana and hashish	29.4	30.6	30.5	30.5	30.2	31.0	31.1	31.0	32.0	32.9
Cocaine	11.2	10.6	11.2	11.5	10.9	11.3	10.4	10.3	10.3	10.5
Crack	-	1.3	1.5	2.1	1.5	1.9	1.9	1.8	2.2	1.9
Inhalants	7.9	6.4	5.7	6.1	5.3	5.9	5.8	5.7	5.6	5.7
Hallucinogens	6.9	7.6	7.9	8.4	8.3	9.0	8.7	9.5	9.7	9.6
Heroin	0.9	0.9	0.8	1.2	0.8	1.0	1.0	1.2	1.1	0.9
Nonmedical use of any psychotherapeutic[b]	15.3	11.2	11.3	11.9	11.0	10.5	10.0	10.1	9.5	9.1
Stimulants	7.3	5.7	5.5	5.6	5.0	4.8	4.6	4.9	4.7	4.5
Sedatives	4.8	2.6	2.8	3.2	2.6	2.6	2.6	2.7	2.3	1.9
Tranquilizers	7.6	4.4	4.0	5.1	4.7	4.2	4.0	3.9	3.6	3.2
Analgesics	7.6	5.8	6.3	6.8	6.1	6.4	6.0	6.1	5.5	4.9
Any illicit drug other than marijuana[c]	22.4	19.3	19.5	19.8	18.9	19.7	18.8	19.1	18.9	18.9
Alcohol	84.9	84.0	82.2	83.6	81.9	82.6	84.2	82.3	82.6	81.9

a. Includes at least one use of marijuana or hashish, cocaine (including crack), inhalants, hallucinogens (including PCP and LSD), heroin, or any prescription type psychotherapeutic used nonmedically

b. Includes nonmedical use of any prescription-type stimulant, sedative, tranquilizer, or analgesic; does not include over-the-counter drugs

c. Includes at least one use of any of these listed drugs, regardless of marijuana/hashish use; marijuana/hashish users who have used any of the other listed drugs are included

Source: Sourcebook of Criminal Justice Statistics 1998; based on National Household Survey on Drug Abuse, U.S. Department of Health and Human Services studies which look at the drug issue from various angles. In particular, in 1998 the Division of Alcohol and Drug Abuse and the Epidemiology Section of HHS sought to measure the extent of substance abuse as a basis for determining the need for treatment programs. The study, which was conducted by The Gallup Organization, concluded above all, as have other studies, that the substance abused most widely in Alaska is, by far, alcohol, and the number of adults needing treatment for alcoholism is much higher than number needing treatment for other drugs. Among controlled drugs, dependency on marijuana was most common, with 4.2 per cent of the population estimated as dependant and an additional 1.0 per cent defined as abusers. The survey also found that 0.2 per cent of adult household residents showed evidence of a dependency on cocaine: 0.1 per cent, a dependency on amphetamines; and 0.1 per cent on hallucinogens.

The state also conducts the Youth Behavior Risk Survey every two years through the schools to assess attitudes and behaviors which present risks to health. This survey, however, is not administered in all parts of the state.

While the plan presented by the Advisory Board on Alcoholism and Drug Abuse advocates improvements in coordination among existing data and studies and also recommends more regular surveys of the prevalence of alcoholism and drug abuse, the establishment of such testing measures will depend on resource allocations from the state legislature as well as acquisition of federal funds.

National Drug Control and the Budget

On a national level, the ADAM program discussed in this issue of the *Forum* cost 1.3 million dollars in 1999. Over the last two decades the money allocated by the federal government for drug control has grown over 1100 per cent. For FY 2000 the federal government will spend an estimated 18.5 billion dollars on its drug control efforts – about one per cent of the total federal budget. In FY 1981 the drug budget was 1.5 billion

Please see Drug Budget, page 4

Table 1. Federal Drug Control Spending by Goal and Function, FY 1999-2001

Budget authority in millions of dollars.

	FY 1999 actual		FY 2000 estimated		FY 2001 request		Change from FY 2000 to FY 2001	
	Amount	%	Amount	%	Amount	%	Amount	%
Drug goals								
Goal 1	2,028.8	11.5 %	2,166.4	11.7 %	2,234.8	11.6 %	68.3	3.2 %
Goal 2	7,574.5	42.8	7,568.8	41.0	8,233.8	42.9	665.0	8.8
Goal 3	3,300.6	18.6	3,539.2	19.2	3,741.6	19.5	202.4	5.7
Goal 4	2,724.9	15.4	2,243.4	12.2	2,500.3	13.0	256.8	11.4
Goal 5	2,082.5	11.8	1,982.6	10.7	2,185.9	11.4	203.3	10.3
Subtotal	**17,711.2**		**17,500.6**		**18,896.4**		**1,395.9**	**8.0 %**
Goal 5 (U.S. Support for Plan Colombia and the Andean Region)			954.4	5.2 %	318.1	1.7 %		
Total	**17,711.2**		**18,455.0**		**19,214.5**		**759.6**	**4.1 %**
Functions								
Criminal justice system	8,557.6	48.3 %	8,631.2	46.8 %	9,385.5	48.8 %	754.3	8.7 %
Drug treatment	2,949.0	16.7	3,147.0	17.1	3,382.0	17.6	234.9	7.5
Drug prevention	1,953.5	11.0	2,064.5	11.2	2,122.3	11.0	57.8	2.8
Interdiction	2,417.9	13.7	1,922.7	10.4	2,213.4	11.5	290.8	15.1
Research	781.3	4.4	856.2	4.6	898.3	4.7	42.1	4.9
Intelligence	277.3	1.6	289.9	1.6	305.3	1.6	15.4	5.3
International	774.7	4.4	589.0	3.2	589.6	3.1	0.6	0.1
Subtotal	**17,711.2**		**17,500.6**		**18,396.4**		**1,395.9**	**8.0 %**
International (U.S. Support for Plan Colombia and the Andean Region)			954.4	5.2 %	318.1	1.7 %		
Total	**17,711.2**		**18,455.0**		**19,214.5**		**759.6**	**4.1 %**
Functional areas								
Demand reduction	5,570.6	31.5 %	5,953.2	32.3 %	6,283.9	32.7 %	330.8	5.6 %
Domestic law enforcement	8,948.1	50.5	9,035.7	49.0	9,809.4	51.1	773.7	8.6
Interdiction	2,417.9	13.7	1,922.7	10.4	2,213.4	11.5	290.8	15.1
International	774.7	4.4	589.0	3.2	589.6	3.1	0.6	0.1
International (U.S. Support for Plan Colombia and the Andean Region)	–	0.0	954.4	5.2	318.1	1.7	–	–
Total	**17,711.2**		**18,455.0**		**19,214.5**		**759.6**	**4.1 %**

Source: *Office of National Drug Control Policy*

Drug Budget
(continued from page 3)

dollars, about .2 per cent of the national budget at that time.

The overall statement of national drug policy with its application to specific programs is presented in two documents entitled "National Drug Control Strategy" and "Strategic Goals and Objectives of 1999 National Drug Control Strategy." The documents, which are published by the Office of National Drug Control Policy (ONDCP), the executive agency bearing responsibility for coordinating the drug control effort within the federal government, present five goals as the underlying structure of the drug war and its appropriation of funds: to educate and enable America's youth to reject illegal drugs as well as alcohol and tobacco; to increase the safety of America's citizens by substantially reducing drug-related crime and violence; to reduce health and social costs to the public of illegal drug use; to shield America's air, land and sea frontiers from the drug threat; and to break foreign and domestic drug sources of supply. These goals subsume seven functions: criminal justice, drug treatment, prevention, interdiction, research, intelligence and international efforts. The tables accompanying this article detail the drug control budget in terms of these goals and functions.

As Tables 1 and 2 show, the criminal justice system receives the largest sub-portion of the money, with the Department of Justice by far the recipient of the greatest amount among the major federal departments, but it is important to recognize that major thrust of the drug control effort is, in essence, directed toward enforcement and almost all of the main federal departments administer some drug-related enforcement program. Considerably more funds go into policing, corrections, interdiction, intelligence and international control efforts than go into treatment and prevention.

For many federal agencies the percentage of the agency budget now devoted to the drug control effort is growing (Table 3). For some agencies, such as the Federal Bureau of Prisons, the U.S. Marshals Service and the National Institutes of Health, the portion of the budget which is drug related is now over fifty per cent.

Table 2. Federal Drug Spending by Department

In millions of dollars

	FY 1999 actual	FY 2000 estimated	FY 2001 request	Change FY 00-01 Amount	%
Defense	974.9	1,005.2	1,029.1	238.8	2.4 %
Education	663.2	698.1	750.9	52.8	7.6
Health and Human Services	2,866.1	3,078.9	3,264.8	185.9	6.0
Housing and Urban Development	310.0	310.0	315.0	5.0	1.6
Justice	7,398.5	7,443.2	8,236.9	793.7	10.7
Office of National Drug Control Policy	453.2	461.4	496.8	35.4	7.7
State	498.7	282.8	276.8	(6.0)	(2.1)
Transportation	871.1	631.0	684.9	53.8	8.5
Treasury	1,756.5	1,499.6	1,788.3	188.7	12.6
Veterans Affairs	1,041.7	1,111.4	1,155.5	44.1	4.0
All other	877.3	978.8	997.5	18.7	1.9
Subtotal	**17,711.2**	**17,500.6**	**18,896.4**	**1,395.9**	**8.0 %**
Plan Columbia and Andean Region		954.4	318.1		
Total	**1,771.2**	**18,455.0**	**19,214.5**	**759.6**	**4.1 %**

Source: *Office of National Drug Control Policy*

Table 3. Selected Federal Agencies: Percentages of Budget Related to Drug Control

	FY 1999 actual	FY 2000 estimated	FY 2001 request
Federal Bureau of Prisons	58.0 %	57.8 %	57.5 %
U.S. Marshals Service	52.6	52.6	52.4
Immigration and Naturalization Service	15.5	15.8	16.6
Bureau of Alcohol, Tobacco and Firearms	41.9	41.7	43.0
U.S. Customs	45.4	35.2	35.0
Office of Justice Programs	27.5	28.2	31.9
Federal Judiciary	18.7	18.7	18.7
U.S. Attorney	17.8	17.9	16.9
COPS	33.0	33.0	33.0
Department of Education	1.7	1.6	1.7
National Institutes of Health	74.6	74.5	74.2

Source: *Office of National Drug Control Policy*

Drug Cases in the Courts

The available figures for federal courts show a steady rise in the percentage of the caseload related to drug charges (Table 1) since the early 1980s. Between FY 1992 and FY 1999 the percentage of drug cases as part of the total caseload more than doubled, rising from 13.3 per cent to 29 per cent. The actual number of drug cases filed in U.S. District Courts nationwide more than quadrupled, from 4193 in FY 82 to 17,483 in FY 99. Figures for case filings for U.S. District in Alaska do not reflect this national rise; in 1982 the percentage of total caseload was already 25 per cent and in 1999, 22.5 per cent. It has ranged from a high of 34.5 per cent to a low of 10.4 per cent.

The percentage of total felony filings in the Alaska Court System which are drug cases has remained relatively stable since the early 1980s, neither rising nor falling significantly, although the actual number of felony drug cases being filed each year has risen steadily, with 342 filed in 1982 and 809 filed in 1999—a growth of 137 per cent. (The Alaska Court System felony drug case

Table 1. Federal Drug Cases Filed in U.S. District Courts–U.S. and Alaska

	United States			Alaska		
Fiscal year	Total criminal cases	Drug cases Number	Drug cases % of total	Total criminal cases	Drug cases Number	Drug cases % of total
1982	31,623	4,193	13.3 %	190	48	25.3 %
1987	42,156	8,869	21.0	221	23	10.4
1992	47,472	12,833	27.0	286	68	23.8
1997	50,363	13,656	27.1	220	76	34.5
1998	57,691	16,281	28.2	261	49	18.8
1999	59,923	17,483	29.2	227	51	22.5

Sources: *Sourcebook of Criminal Justice Statistics, 1983, 1988, 1993; Administrative Office of the U.S. Courts*

The Alaska Department of Corrections: The Drug Treatment Picture

Although some plans for general screening of inmates for drug and alcohol problems are now being considered, the Alaska Department of Corrections at present does not test inmates for drug or alcohol problems at the time they begin serving their sentences. As a result, no firm numbers are available on the extent of the drug problem among the inmate population. DOC does state that the available treatment programs are always full, with those ordered by the courts into treatment receiving priority for available spaces and others being treated on a voluntary, first-come, first-served basis. More inmates request treatment than there are spaces available. (Table 1 provides national data on the extent of prior drug use among prisoners.)

Table 1. Level of Prior Drug Use by State and Federal Prisoners by Type and Drug and Frequency of Use, 1991 and 1997

	Ever used in the past		Ever used drugs regularly[a]		Used drugs in the month prior to offense		Used drugs at the time of offense	
	1991	1997	1991	1997	1991	1997	1991	1997
State prisoners								
Marijuana/hashish	73.8 %	77.0 %	51.9 %	58.3 %	32.2 %	39.2 %	11.4 %	15.1 %
Cocaine/crack	49.4	19.2	31.9	33.6	25.2	25.0	14.5	14.8
Heroin/opiates	25.2	24.5	15.3	15.0	9.6	9.2	5.8	5.6
Depressants[b]	24.0	23.7	10.8	11.3	3.8	5.1	1.0	1.8
Stimulants[c]	29.7	28.3	16.6	16.3	7.4	9.0	2.9	4.2
Hallucinogens[d]	26.9	28.7	11.5	11.3	3.7	4.0	1.6	1.8
Inhalants	–	14.4	–	5.4	–	1.0	–	–
Any drug[e]	**79.4 %**	**83.0 %**	**62.2 %**	**69.6 %**	**49.9 %**	**56.5 %**	**31.0 %**	**32.6 %**
Federal prisoners								
Marijuana/hashish	52.8 %	65.2 %	32.2 %	46.6 %	19.2 %	30.4 %	3.9 %	10.8 %
Cocaine/crack	37.3	44.8	20.6	28.2	15.4	20.0	7.7	9.3
Heroin/opiates	14.1	16.1	9.3	8.9	5.5	5.4	3.7	3.0
Depressants[b]	13.1	16.5	5.3	8.0	1.4	3.2	0.3	1.0
Stimulants[c]	16.8	20.9	8.3	12.9	3.9	7.6	1.8	4.1
Hallucinogens[d]	14.8	19.0	4.8	6.4	1.2	1.7	0.5	0.8
Inhalants	–	7.7	–	2.6	–	0.5	–	–
Any drug[e]	**60.1 %**	**72.9 %**	**42.1 %**	**57.3 %**	**31.8 %**	**44.8 %**	**16.8 %**	**22.4 %**

Note. Details add to more than total because prisoners may have used more than one type of drug.

a. Used drugs once a week or more for at least a month

b. Includes barbiturates, tranquilizers, and Quaalude.

c. Includes amphetamine and methamphetamine

d. Includes LSD and PCP.

e. Other unspecified drugs are included in the totals.

Source: Sourcebook of Criminal Justice Statistics 1998

The annual budget for DOC substance abuse programs is just under one million dollars. It has not increased in eight years. The department contracts with state-approved substance abuse treatment providers in the community for all of its programs. The department itself has only one regular position in this area, the Substance Abuse Program Coordinator, who administers the DOC programs. Because funding available for the programs has not increased, the number of treatment providers willing to contract with DOC is declining.

The department offers an inmate substance abuse program in each facility, but those at the Ketchikan, Palmer, Yukon-Kuskokwim, and Anvil Mountain Correctional Centers are educational programs only. At Sixth Avenue and Mat-Su Pretrial, orientation programs are offered. At Cook Inlet Pre-Trial and Fairbanks Correction Center education programs with an introduction to treatment component are available. At Lemon Creek, Meadow Creek, Spring Creek, and Wildwood Correctional Centers and at the Point MacKenzie Rehabilitation Center, the programs offer a level of treatment comparable to that labeled as "outpatient treatment" in the general community. The only intensive residential treatment program is one for women at Hiland Mountain Correctional Center. Another intensive residential program, for men, which will be located at Wildwood, is in the planning stages. These intensive residential treatment programs are being primarily funded by federal monies, with some state matching funds required. (Federal funds are currently available only for residential

Please see ***Alaska DOC****, page 6*

figures also include cases related to the importation of alcohol.)

Because of changes in data systems it is impossible to assemble consistent regular figures on the specific charges associated with drug case filings in the Alaska Court System over the last two decades, but a cursory examination of data from 1997, 1998 and 1999 reveals that most felony drug cases are filed under AS 11.71.030 and .040—misconduct involving a controlled substance in the third and fourth degrees.

Alaska does not have a discrete drug court which solely handles drug cases. According to figures from the Bureau of Justice Statistics, at the end of FY 98, there were 430 such courts nationwide in operation or in the planning stages. The majority of those in operation had been so for less than two years. Plans to establish a drug court within the Alaska system have run into funding difficulties.

Table 2. Drug Cases Filed in the Alaska Court System

	Total criminal cases filed	Drug cases	
		Number	% of total
1982	1,607	342	21.3 %
1987	2,661	473	17.8
1992	2,763	519	18.8
1997	3,362	791	23.5
1998	3,588	836	23.3
1999	3,429	809	23.6

Note: Drug case totals include cases filed under statutes pertaining to contraband, controlled substances, drugs and the importation of alcohol.

Source: Alaska Court System annual reports

Alaska DOC
(continued from page 5)

programs.)

According to DOC figures, during FY 1999, 1583 inmates were admitted to the programs comprising the substance abuse educational component and 306 to the outpatient-level programs. Since the residential treatment program for women opened at Hiland Mountain, 94 inmates have been admitted. The Central Arizona Detention Center, the private correctional facility owned by Corrections Corporation of America in Florence, Arizona, which contracts with DOC, also offers a substance abuse day treatment program.

This Arizona facility, with close to 900 Alaska inmates, is, in effect, the state's largest institution. The rise in the number of inmates being sent to Arizona has an effect on the drug treatment situation within other Alaska facilities. The shifts among inmate populations which occur as an administrative consequence of the use of the out-of-state prison can undermine the establishment of stable treatment program environments.

In addition to providing the treatment programs under contract, DOC also facilitates the formation of twelve-step programs such as Narcotics Anonymous and Alcoholics Anonymous in its facilities.

Incarceration on Drug Offenses

The "war on drugs" has led to an enormous increase in both the numbers and percentages of inmates in the federal system incarcerated primarily for drug offenses (Table 1), but to less of a proportional increase in similar imprisonments in the Alaska state system.

The inmate population sentenced for drug offenses is now almost 60 per cent of the total federal inmate population. Between 1985 and 1998 the *number* of federal inmates sentenced for drug charges grew by nearly 500 per cent.

The Alaska Department of Corrections does not show such a precipitous rise in the numbers or percentages of inmates sentenced primarily for drug offenses.

In December 1985, out of the total inmate population of 2124 reported in the corrections data base, 105, or 5 per cent, were sentenced on a drug-related offense as the primary offense (Table 2). (Corrections became a separate state department in 1984; before then it was a division within Health and Human Services. The data base from which these figures were taken was put in place in late 1983.) By the end of 1999, the total DOC inmate population, including that in community residential centers, was 4077. Of these, 247—6.1 per cent— had a controlled substance charge as the primary charge. (These figures do not include those imprisoned on a parole or probation violation which was itself a drug offense, so they are undoubtedly somewhat low.) While the percentage of prisoners in the Alaska system on drug charges has grown only slightly, the actual number has increased by more than 135 per cent, paralleling the climb in the overall DOC population.

Table 1. Federal Prison Prisoners Sentenced for Drug Offenses, 1980-1998

	Total sentenced and unsentenced population	Sentenced population: Total	Drug offenses: Number	Drug offenses: Per cent of total
1980	24,252	19,023	4,749	25.0 %
1981	26,195	19,765	5,076	25.7
1982	28,133	20,938	5,518	26.4
1983	30,214	26,027	7,201	27.7
1984	32,317	27,623	8,152	29.5
1985	36,042	27,623	9,491	34.4
1986	40,505	31,831	12,119	38.1
1987	43,683	34,163	14,354	42.0
1988	43,401	34,680	15,526	44.8
1989	50,173	38,969	19,459	49.9
1990	57,331	47,847	25,037	52.3
1991	63,711	53,526	30,498	57.0
1992	70,346	61,026	36,349	59.6
1993	79,483	70,557	42,945	60.9
1994	85,290	76,186	46,743	61.4
1995	89,564	79,347	48,118	60.6
1996	94,215	83,515	50,754	60.8
1997	100,639	89,748	54,099	60.3
1998*	106,536	95,522	56,291	58.9

Note: These data represent inmates housed in Federal Bureau of Prison facilities; inmates housed in contract facilities are not included.

* 1998 data are preliminary and subject to revision.

Source: *Sourcebook of Criminal Justice Statistics 1998, based on data from the Federal Bureau of Prisons*

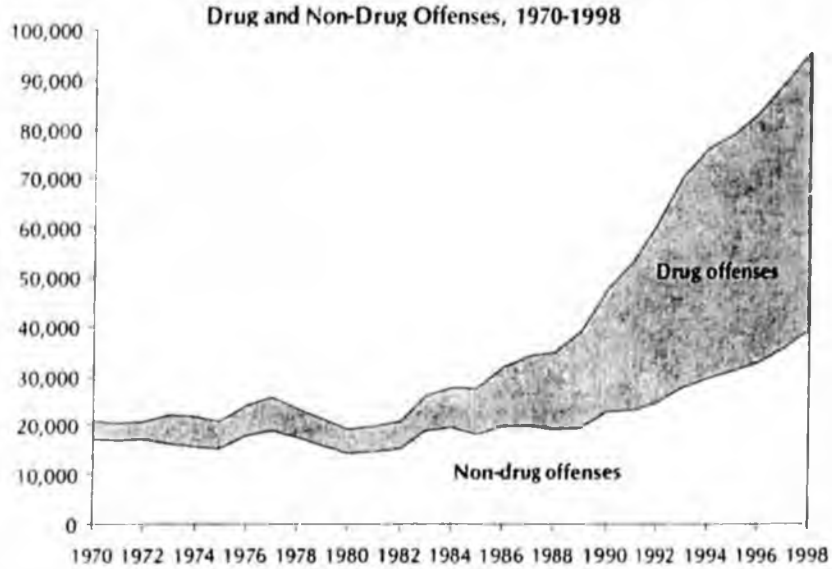
Table 2. Alaska Department of Corrections: Inmates with Drug Offense as Primary Offense

	Drug offenses: Male	Drug offenses: Female	Drug offenses: Number	Drug offenses: % of total population	Total prison population
1985	–	–	105	4.9 %	2,124
1986	–	–	115	5.1	2,245
1991	–	–	167	6.7	2,483
1995	–	–	240	6.8	3,520
1996	–	–	251	6.7	3,721
1997	–	–	298	7.2	4,164
1998	–	–	276	6.7	4,097
1999	202	45	247	6.1	4,077

Note: Includes inmates in community residential centers.

Source of data: *Alaska Department of Corrections*

Figure 1. Federal Prison Population Sentenced for Drug and Non-Drug Offenses, 1970-1998



Note: These data represent inmates housed in Federal Bureau of Prison facilities; inmates housed in contract facilities are not included. 1998 Data are preliminary and subject to revision.

Source of data: *Sourcebook of Criminal Justice Statistics 1998, based on data from the Federal Bureau of Prisons*

Table 2. Percentage of Arrestees Reporting Drug Use in the Past 30 Days, by Age and Sex, Anchorage, 1999

	Crack		Cocaine		Crack and cocaine		Marijuana and cocaine		Opiates and cocaine		Any two or more drugs	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
All ages	19.2 %	29.7 %	12.1 %	14.8 %	5.5 %	11.6 %	9.4 %	11.6 %	1.2 %	2.6 %	26.0 %	26.6 %
By age												
15-20	0.0 %	15.8	13.7 %	5.3 %	0.0 %	5.3 %	9.8 %	5.3 %	2.0 %	0.0 %	27.5 %	21.1 %
21-25	10.5	25.0	11.6	21.4	5.3	17.9	11.6	17.9	3.2	3.6	28.7	21.4
26-30	23.0	18.2	11.5	22.7	4.6	18.2	9.2	18.2	1.1	9.1	26.7	27.3
31-35	27.8	35.7	16.7	10.7	11.3	7.1	6.3	10.7	0.0	3.6	31.3	18.5
35+	21.9	36.8	10.4	14.0	4.7	10.5	9.9	8.8	0.9	0.0	22.1	33.3

Source of data: Arrestee Drug Abuse Monitoring Program, National Institute of Justice

Anchorage Arrestees
(continued from page 1)

educational background, desire for treatment, and demographics. The second part of the ADAM protocol involves the collection of a urine sample from the interviewee used to corroborate the information given in the interview. The specimen is shipped to a lab where it undergoes testing for the presence of ten different drugs.

Participation is strictly voluntary with the inmate having the right to refuse to answer any question asked or terminate the interview at any time. The urine sample is also voluntary and the interviewee may refuse to provide a specimen despite participating in the self-report interview. However, the sample is only collected if the inmate has completed the interview. All of the information obtained during the interview process is strictly confidential, and individual results cannot be made available to any law enforcement or prosecutorial agency. Strict measures are taken to ensure that the interviewer does not know the names of the persons being interviewed, and the survey instrument and urine sample are not marked in any way which could be traced back to the individual.

At the end of data collection the questionnaires are sent to Washington, D.C. for analysis; aggregate data are returned to each individual site for further study.

1999 Results

Though participation in the study is voluntary, the participation rate is relatively high. In 1999, 1,117 arrestees were approached; 76 per cent (n=844) contributed an interview. Of those who agreed to be interviewed, 85 per cent provided a urine specimen for testing (n=718). The results discussed below reflect findings from the participants that contributed both an interview and urine specimen.

In 1999, a total of 563 male and 155 female adult arrestees were surveyed. (Anchorage is not currently surveying juveniles.) The results are for those arrested for all offenses—not just on drug related charges. The data show that cocaine and marijuana were used most frequently by both male and female arrestees. Slightly more than half tested positive for any drug, while 25 per cent of the males and 36 per cent of the females tested positive for cocaine, and 37 per cent of males and 31 per cent of females were positive for marijuana. Less than five per cent of those arrested tested positive for opiates or methamphetamines. (See Table 1.)

The self-reported drug information shows that 31 per cent of males and 45 per cent of females admitted using either crack or powder cocaine within the last 30 days (Table 2).

Among those reporting the use of either crack or powder cocaine, males (n=108) used crack a mean 8.8 days and females (n=46), 12.7 days. The mean number of days for powder cocaine usage was 6.5 for males (n=68) and 8.6 for females (n=23). The number of days per month of reported use for marijuana was 11.2 for males (n=269) and 11.0 for females (n=69). (See Table 3.) As Table 4 shows, the data also underscore the fact that drug use is common among individuals arrested across the spectrum of crimes.

Since 1999 was the first full year of data for the Anchorage site, no statistical comparisons with previous years are possible. As data collection continues it will be possible to examine trends in drug use among Anchorage arrestees.

Applications of ADAM Data

In addition to providing a barometer of

Please see Anchorage Arrestees, page 8

Table 3. Mean Number of Days Arrestees Used Drugs in the Past 30 Days, Anchorage, 1999

	Male N=563		Female N=155	
	N	Mean number of days	N	Mean number of days
Crack	108	8.8 days	46	12.7 days
Cocaine	68	6.5	23	8.6
Marijuana	269	11.2	69	11.0
Opiates	15	5.9	5	11.0
Methamphetamines	13	6.5	4	8.1

Source: Arrestee Drug Abuse Monitoring Program, National Institute of Justice

Table 4. Percentage of Arrestees Found Positive for Any Drug, by Offense Category, Anchorage, 1999

	Male N=563		Female N=155	
Offense	N	% positive	N	% positive
Violent offense	**152**	**46.1 %**	**35**	**37.1 %**
Robbery	7	42.9	3	100.0
Assault	126	46.8	29	34.5
Weapons	12	66.7	1	100.0
Other violent offense	17	29.4	4	25.0
Property offense	**106**	**57.5 %**	**31**	**61.3 %**
Larceny/theft	46	67.4	23	65.2
Burglary	11	54.5	0	0.0
Stolen vehicle	10	80.0	2	100.0
Other property offense	43	47.2	10	50.0
Drug offense	**16**	**87.5 %**	**6**	**50.0 %**
Drug sales	1	100.0	0	0.0
Drug possession	15	86.7	6	50.0
Prostitution	**0**	**0.0 %**	**7**	**71.4 %**
Other offense	**369**	**57.5 %**	**97**	**60.8 %**

Note: Detail may not add to total because some arrestees may have been arrested for more than one offense.

Source: Arrestee Drug Abuse Monitoring Program, National Institute of Justice

Anchorage Arrestees (continued from page 7)

local drug use patterns among the arrested population. ADAM data have a variety of other uses. A brief overview of how the data are being used in other cities can suggest possibilities for use in Alaska.

Researchers in Philadelphia are using ADAM data to explore the impact of certain "gateway" drugs on subsequent escalation to harder drug use. In addition, the same researchers are attempting to develop a typology of drug users, which can potentially lead to varied interventions or treatment based on user type. Other researchers are examining the relationship between drugs and crime.

It should be noted, however, that the ADAM data collection effort is not limited only to information about drugs. Researchers maximize the amount of data that can be collected through ADAM by creating addenda to the survey instrument. For example, after being interviewed about their drug use patterns, arrestees in 11 ADAM sites were questioned about firearms, including their reasons for owning a firearm, method of obtaining guns, and attitudes toward firearms.

Future of the Program in Anchorage

In January 2000, the ADAM survey instrument was expanded to include more relevant data for both law enforcement and treatment professionals. It will be possible to cross-link results to other national databases such as the National Household Survey on Drug Abuse and the Treatment Episode Data Set. This, in turn, will provide even more specific information on drug use for local policymakers, treatment professionals and law enforcement. Furthermore, the Justice Center intends to supplement the new instrument with addenda specifically aimed at local issues such as alcohol use. The National Institute of Justice and the Institutional Review Board that oversees the project must first approve all addenda used.

In order to disseminate the aggregate data and enhance ADAM's utility to the Anchorage community, the Anchorage site will also assemble a Local Coordinating Council. It will include members of the community at-large as well as professionals in the areas of drug abuse treatment, the judiciary, and law enforcement. We anticipate the implementation of an outreach program that will collect one quarter's data from other areas of the state such as Fairbanks, Juneau, Barrow and Bethel.

The ADAM program is in its infancy in Alaska but has the potential to increase useful information available for professionals across the state.

Cassie Atwell and Matthew Giblin are research associates with the Justice Center.

Alaska Justice Forum

Editor: Antonia Moras

Editorial Board: Cassie Atwell, Allan Barnes, Robert Congdon, Richard Curtis, Matthew Giblin, Maurice Godwin, Pamela Kelley, Robert Langworthy, Deborah Periman, Lisa Rieger, John Riley, Nancy Schafer, Lawrence Trostle, Darryl Wood

Typesetting and Layout: Melissa Green

Justice Center, Robert Langworthy, Director

Alaska Justice Statistical Analysis Unit, N.E. Schafer, Director

Published quarterly by the Justice Center and the Alaska Justice Statistical Analysis Unit at the University of Alaska Anchorage, 3211 Providence Drive, Anchorage, AK 99508, (907) 786-1810, fax 786-7777, Internet address ayjust@uaa.alaska.edu; World Wide Web http://www.uaa.alaska.edu/just/

ISSN 0893-8903

Search for Historical Records

Dr. Lawrence Trostle of the Justice Center is compiling historical materials on Alaska Native policing from 1867 through 1959. He is interested in looking at any material—diaries, letters, government records, missionary or other church records, newspaper accounts—which relate to the contribution of Alaska Natives to law enforcement or to the general provision of justice services in the period after the purchase of Alaska from Russia through the enactment of statehood. He is also interested in speaking with anyone who may have personal reminiscences to recount. Trostle can be reached through the Justice Center at (907) 786-1815 or aflct@uaa.alaska.edu.

Alaska Justice Forum
Justice Center
University of Alaska Anchorage
3211 Providence Drive
Anchorage, AK 99508

Return service requested

Non-Profit Organization
U.S. Postage
PAID
Anchorage, Alaska
Permit No. 107

C

MARIJUANA AND BEHAVIORIAL HEALTH

I. **Children Of Parents Who Use Marijuana Frequently Are Much More Likely To Use The Drug Than Children In Homes Where Parents Do Not Use Marijuana.**

- A person's perception of the risk from starting to use marijuana influences their use of the drug. Alaska ranks in the top 20% for rates of use of marijuana and in the bottom 20% for the perception of risk from using marijuana. *Douglas Wright, State Estimates of Substance Use From the 2002 NSDUH, Figures 2.5 – 2.10.*
- A 1990 survey of 5,458 students in grades 7-12 from 27 school districts across Alaska found that children in homes where parents used marijuana frequently were 350% more likely (22.6% vs. 5%) to use marijuana themselves than children in homes where the parents did not use marijuana. (*The State of Adolescent Health in Alaska, May, 1990.*
- Nationally, among youth perceiving their parents would strongly disapprove of their trying marijuana once or twice, only 5.4% had used marijuana in the past month vs. 28.7% of youth in homes who perceived that their parents would only somewhat disapprove or neither approve or disapprove of their trying marijuana. *Overview of Findings from the 2003 National Survey on Drug Use and Health, Dept. Health and Human Services, SAMHSA, Office of Applied Studies, p.6, 23, .*

- "Recent studies have shown that prevalence of adolescent marijuana use is inversely proportional to the perceived risk associated with use" *Legalization of Marijuana, Potential Impact on Youth, American Academy of Pediatrics, June, 2004.*
- In 2003, (nationally) the percentage of youth reporting it would be easy to obtain marijuana was 53.6%. *Overview of Findings from the 2003 National Survey on Drug Use and Health, Dept. Health and Human Services, SAMHSA, Office of Applied Studies, p.6.*
- This is approximately 15% <u>lower</u> than the number (68%) of 4,129 Alaska youth grades 7-12 surveyed in 1988 who responded they had the <u>actual</u> opportunity to try marijuana. *Bernard Segal, Drug Taking Behavior Among School Aged Youth, The Alaska Experience and Comparisons with Lower 48 States, 1990, Figure 4.1.*

II. <u>High THC Content Levels May Cause Increased Rates Of Abuse And Dependence.</u>

- Average THC content in Alaska marijuana has increased from 1-2% to almost 14% in 2003. *Reports from the Mississippi Monitoring Project, Dr. Elsohly.*
- Nationally, among past year marijuana users, overall rates of past year abuse or dependence have increased while the approximate number of users has remained steady. This indicates that the increased potency of

marijuana may be to blame. *Compton, WM, et.al., JAMA, May 5, 2004.*

- In Alaska, there were approximately 59 treatment admissions for marijuana abuse in 1976. *Drug Taking Behavior Among School Aged Youth, Segal, B., 1990, p.9, citing, State Office of Drug Abuse, 1976, p.27)*
- There were an average of 434 marijuana treatment admissions in Alaska between 2000 and 2003. This represents a 600% increase since 1976. *SAMHSA, Substance Abuse Treatment Admissions, TEDS Data.*
- In 2003, approximately half of the marijuana admissions in Alaska were for youth aged 12-17. Over 1/3rd were Alaska natives. *Id.*
- More teens are in treatment each year for marijuana dependence than for alcohol and all other drugs combined. *U.S. Dept. of HHS, SAMHSA, Office of Applied Studies, TEDS Data, National Admissions to Substance Abuse Treatment Services, 1992-2001:39, table 5.1a, 5.1b, 156-157.*
- In Alaska natives, dependence on marijuana frequently shows up as a secondary or co-occurring disorder with alcohol dependence. (63% of Alaska Natives with alcohol dependence were also dependent on marijuana) *Alaska Natives Combatting Substance Abuse And Related Violence Through Self-Healing, Center for Alcohol and Addiction Studies, January, 1999.*

III. **Marijuana Can Increase The Incidence Of Psychotic Symptoms In Young People And Has An Even Stronger Effect On Those Youth Predisposed To Psychosis.**

- 2/3rds (approximately 4,000) of Alaska's new marijuana users are between the ages of 12 and 17. *Gfroerer, J., Initiation of Marijuana Use, Trends, Patterns, and Implications, SAMHSA, 2002.*
- Using marijuana during adolescence and young adulthood increases the risk of psychotic symptoms later in life, and smoking marijuana can lead to adverse psychiatric effects. *Os, J., et.al., Prospective Cohort Study of Cannabis Use, Predisposition for Psychosis, and Psychotic Symptoms in Young People, British Medical Journal; Zammit, S., et.al., Self Reported Cannabis Use as a Risk Factor for Schizophrenia in Swedish Conscripts of 1969; Johns, A., Psychiatric Effects of Cannabis, The British Journal of Psychiatry (2001)*
- Teens engaging in risk behaviors, such as use of drugs, including marijuana are at increased odds for depression, suicidal ideation, and suicide attempts. *Hallfors, D., et.al., Adolescent Depression and Suicide Risk, Am. J. Prev. Med., 2004; George C. Patton: Cannabis Use and Mental Health in Young People: Cohort Study, British Medical Journal, November, 2002.*
- Chronic marijuana use may be associated with cognitive deficits. *Cerebrovascular Perfusion In*

Marijuana Users During A Month Of Monitored Abstinence., Herning, R., et.al., Neurology, February, 2005.

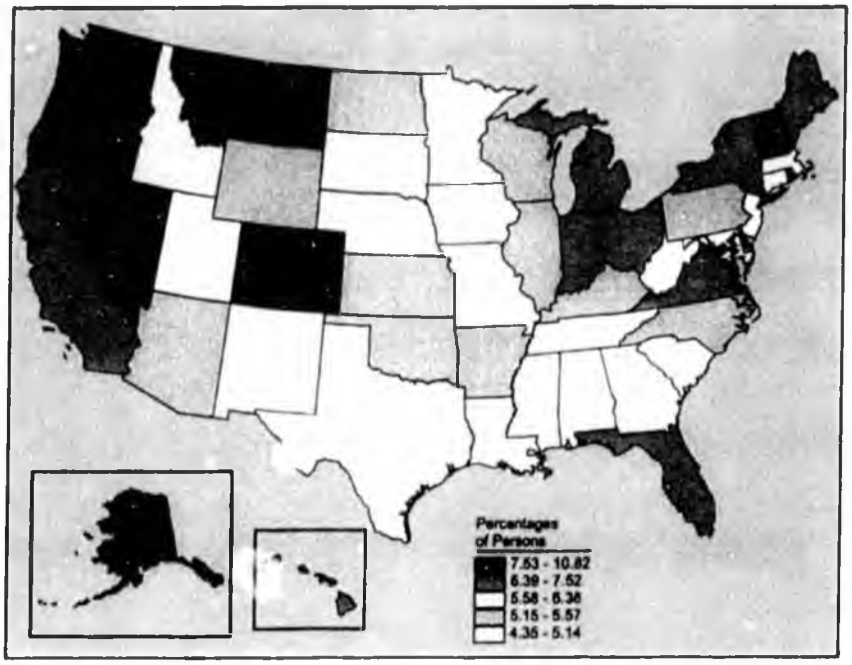
IV. <u>Marijuana As A Gateway Drug.</u>

- Use of Marijuana May Act As A Gateway To Other Drug Use. *Lynskey, M., et.al., Escalation of Drug Use In Eearly Onset Cannabis Users vs. Co-Twin Controls, JAMA, January 22, 2003; Gfroerer, J., Initiation of Marijuana Use, Trends, Patterns, and Implications, SAMHSA, 2002.*
- Youth who had ever used marijuana were more likely to have sold marijuana (24% vs. 1%) carried a handgun (21% vs. 7%) or been in a gang (14% vs. 2%) *Juvenile Offenders and Victims, 1999 National Report.*
- Youth who had ever sold marijuana were more likely to have sold hard drugs (cocaine or heroin) (40% vs. 1%) carried a handgun (35% vs. 8%) or been in a gang (24% vs. 4%) than youth who never sold marijuana. *Juvenile Offenders and Victims, 1999 National Report.*
- Initiation of marijuana use before age 15 was associated with a greater risk of using hard drugs such as heroin and cocaine. *Gfroerer, J., Initiation of Marijuana Use, Trends, Patterns, and Implications, SAMHSA, 2002.*
- Initiation of marijuana use before age 15 was associated with being 6 times as likely to be

dependent on an illegal drug. *Gfroerer, J., Initiation of Marijuana Use, Trends, Patterns, and Implications, SAMHSA, 2002.*

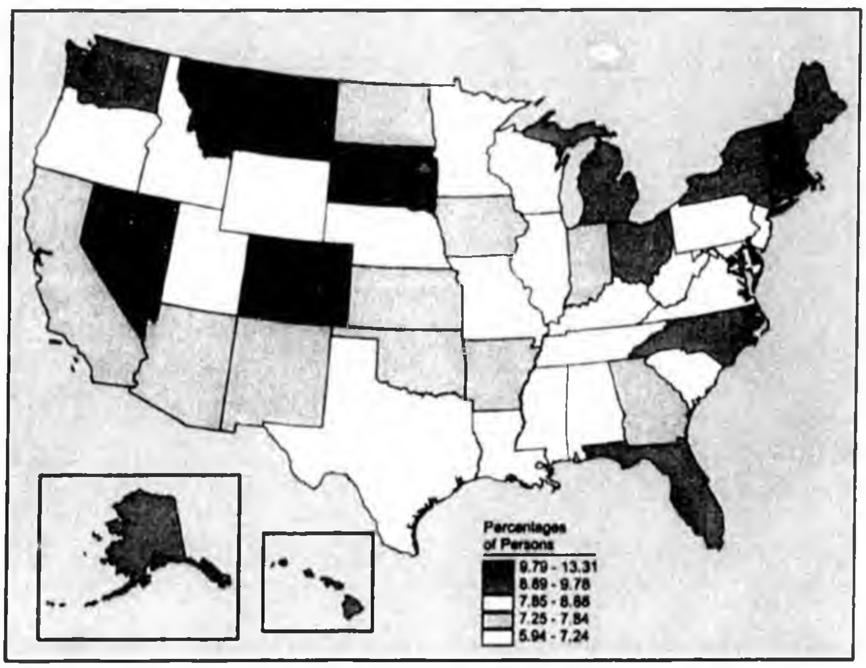
- Youths with an average grade of D or below were more than 4 times as likely to have used marijuana in the past year as you[illegible] who reported an average grade of A. *NHSDA Report, Marijuana Use Among Youths, July 19, 2002.*

Figure 2.5 Percentages Reporting Past Month Use of *Marijuana among Persons Aged 12 or Older*, by State: 2002



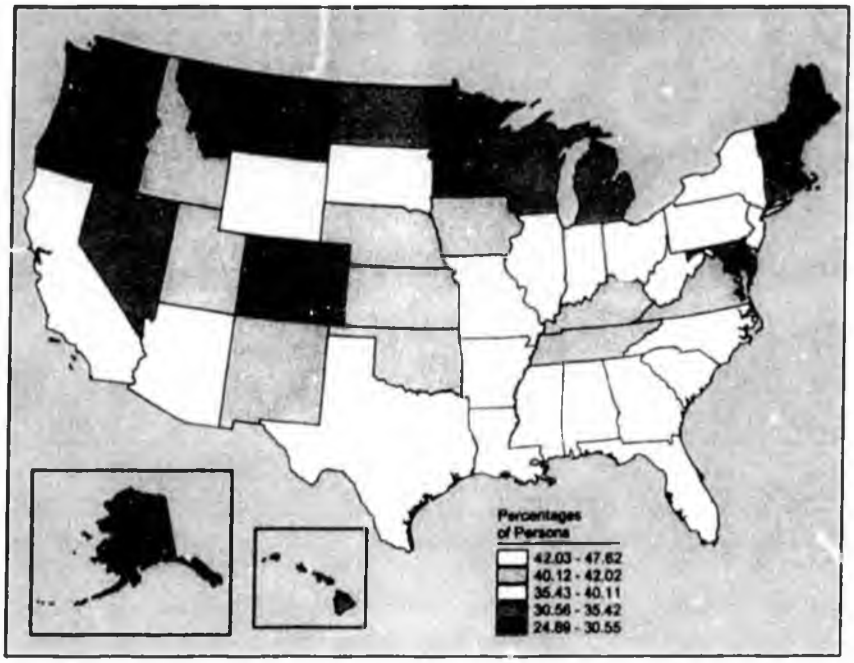
Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Figure 2.6 Percentages Reporting Past Month Use of *Marijuana among Youths Aged 12 to 17*, by State: 2002



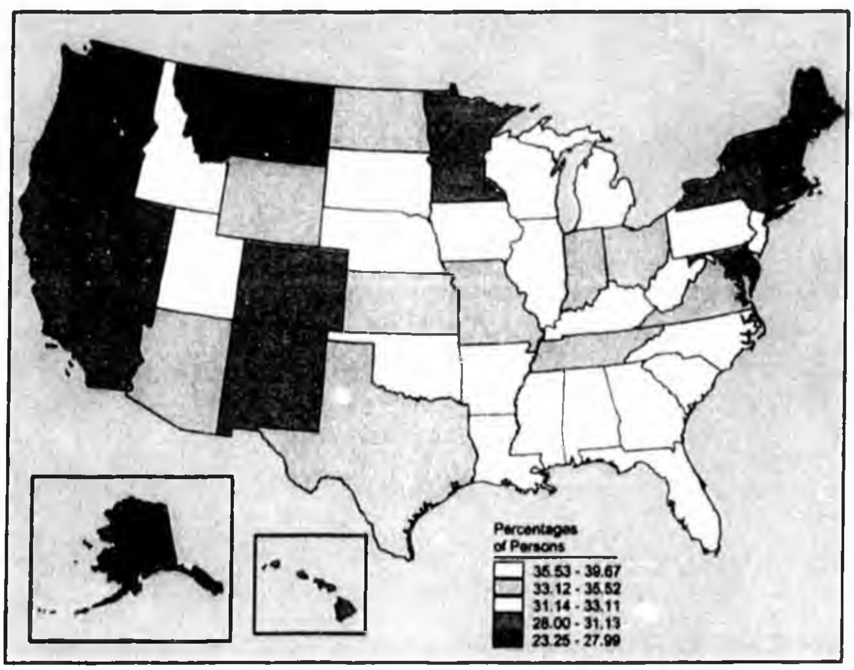
Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Figure 2.9 Percentages Reporting *Perceptions of Great Risk of Smoking Marijuana Once a Month among Persons Aged 12 or Older*, by State: 2002



Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

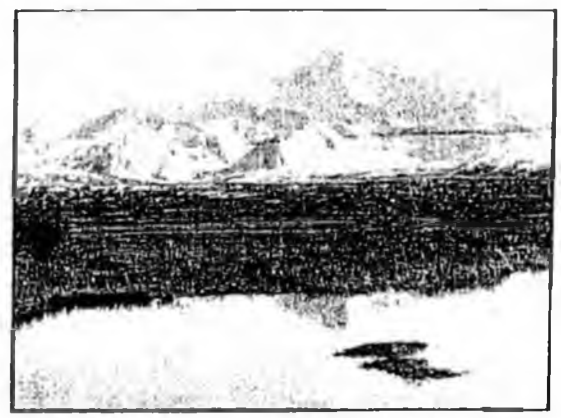
Figure 2.10 Percentages Reporting *Perceptions of Great Risk of Smoking Marijuana Once a Month among Youths Aged 12 to 17*, by State: 2002



Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

The State of Adolescent Health in Alaska

May 1990



Executive Summary

The Alaskan Adolescent Health Survey was undertaken in 1989 to draw a picture of the perceived health status and risk behaviors of youth in the state. It was intended to learn more about the health problems and concerns of youth from their perspective. The goal throughout has been to develop a statewide database which when coupled with morbidity and mortality data would provide information to those who plan and develop services at the state and local levels to better target those services.

While the entire state was invited to participate, the largest metropolitan areas declined, and as a consequence completed responses were received from 5,458 students in grades 7–12 representing rural areas, small towns, highway communities and regional centers from 27 school districts across Alaska. Seventy-seven percent of eligible students in participating districts completed the survey with the remaining students either having been absent the day of the survey (10%), having failed to bring the signed parental permission slip (10%), or having declined participation (3%).

The sample represents 13% of public school students in grades 7–12. While we cannot claim that the data are statistically generalizable to all rural and urban areas equally, we know this represents the largest study of youth health ever undertaken in Alaska.

Not only is it the largest study in terms of numbers of respondents, but it is the most comprehensive as well. The Alaskan Adolescent Health Survey contained 162 questions on a range of issues: health status; health-related behaviors; family life; feelings about school and school performance; behaviors and attitudes about foods and eating; use of alcohol, tobacco, and drugs; sexual behavior and contraception; and involvement in anti-social or deviant behaviors.

The results suggest that most youths surveyed see themselves to be healthy—at least physically healthy. On the other hand, because of their dietary or behavioral patterns 14 percent have risk factors which predispose to chronic illnesses later in life. These "predisposing factors" for illnesses such as cardiovascular disease and cancer appear to be more prevalent in smaller communities. In addition, compared with the nation, more Alaskan teens appear to be overweight.

Weight concerns are common among teens wherever they live; and Alaskan youths are no exception. For example, three out of ten females and 10% of males in this survey have a distorted body image; they see themselves as fat when they are not. Such distortions may lead to problem eating patterns of chronic dieting, binging and purging.

As is true for physical health, most teenagers in Alaska also see themselves as emotionally healthy. However, there is a significant minority of teenagers who report problems of grave concern. Over one-in-twenty describe themselves as severely stressed—a third of whom have been abused and half of whom have attempted suicide.

Overall, one-in-six Alaskan youths report they have attempted suicide—23% of females and 13% of males. Over half of these youths report having made multiple attempts. Over a third of all those who have made suicide attempts say they told no one. Many have family members or friends who have either attempted or completed suicide. As one would anticipate, there is a strong association between suicidal behavior and other risk factors (e.g., disordered eating, premature pregnancy) and especially abuse.

Physical and sexual abuse are relatively common among Alaskan youths with 23% of females and 8% of males reporting having been physically abused. A quarter of all girls and 3% of boys report sexual abuse. These figures especially for girls, are significantly higher than what many estimate to be the national prevalence. A total of 34% of girls surveyed report having been physically and/or sexually abused. Many youths who are abused tell no one.

When we turn to sexual activity we find that overall 43% of males and 38% of females in the survey report being sexually active. Upon closer examination, the patterns of sexual intercourse appear to parallel the nation as a whole with nearly three-quarters of females and two-thirds of males reporting being sexually active by the 12th grade.

Among those who have had intercourse, 15% of the girls report ever being pregnant; and 9% of sexually active males were aware that they had made someone pregnant. By the 12th grade, 21% of girls have been pregnant and, of those, more than one-in-four have been pregnant multiple times.

X

Other Characteristics and Related Problems

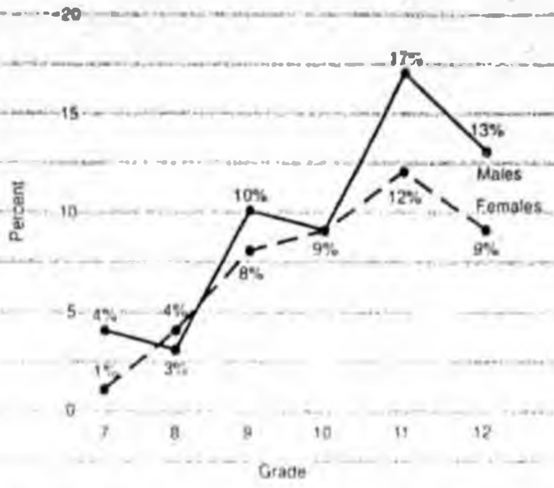
- Nearly three out of ten of those who do poorly in school are potential problem drinkers. About a tenth of those who do above average are potential problem drinkers.
- Those who have been abused are more likely to be potential problem drinkers (25%) compared to those who have not been abused (16%).
- 30% of potential problem drinkers have attempted suicide, compared to 13% of non-drinkers, and 22% of light drinkers.
- Compared with peers, potential problem drinkers are also engaged in more anti-social behavior, including vandalism, group fighting, and running away from home.

Marijuana

Students were asked about their use of marijuana:

- 22.2% of males and 20.5% of females in grades 7-9 had ever used marijuana.
- 45.9% of males and 45.8% of females in grades 10-12 had ever used marijuana (see Figure 25).
- While not dramatically so, marijuana, like tobacco, is somewhat more popular among youths from communities under 2,500 than youths from larger communities, with the greatest difference among 10-12th grade males who use marijuana weekly or daily (17% vs. 10%).

Figure 25: Percent Who Use Marijuana at Least Weekly*



*Weekly and daily use were combined to represent regular use

- A third of those who have ever used marijuana (34.8%) report they have used it in the past week—15% within the past day. A fifth of users have smoked marijuana in the past month (20.8%), and the remainder have smoked marijuana over a month ago (see Figure 27).
- A quarter of those who have used marijuana within the past year also report they have used it before or during school.
- More adolescents who report their parents use marijuana frequently use marijuana themselves (22.6%) compared with five percent of youths whose parents do not use marijuana.

Inhalants

Inhalants are a substance of abuse among younger children:

—7.7% of males and 7.0% of females in grades 7-9 have ever used inhalants.

—6.0% of males and 3.6% of females in grades 10-12 have ever used inhalants (see Figure 26).

- Less than 2% of all students use inhalants on a monthly or more frequent basis.
- While most youth who have ever tried inhalants have used them only once, or a long time ago, about fifteen percent of those who have ever tried them, report using within the past week (see Figure 27).
- About 16% of those who had used inhalants within the past year also reported they had used them before school, and half have used them during school.

Other Drugs of Abuse

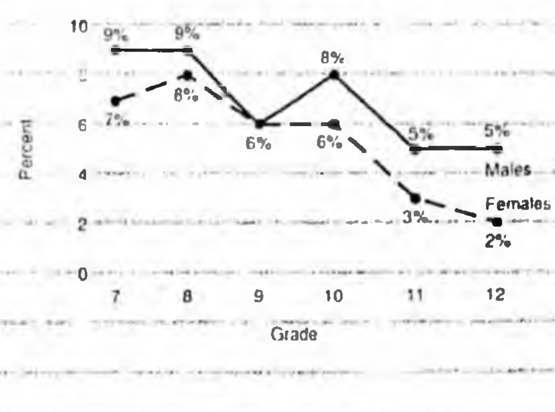
Speed* has been tried by 12.2% of 10-12th grade males, and 15.4% of females; yet few appear to use it with any frequency—2% of males, and 3% of females use it monthly or more often (see Table 32).

Cocaine has been tried by 9.2% of 10-12th grade males and 10.3% of females. Again, less than 2% of both gender groups use it monthly or more often.

Diet pills have been used by far more 10-12th grade females than males (19.3% vs. 3.2%). Nearly 7% of females report using diet pills monthly or more often, compared to less than one percent of males.

*Often teenagers report using speed when, in fact, they are using "look alike" drugs, drugs which appear to be amphetamines but are stimulants such as caffeine.

Figure 26: Percent Who Have Ever Used Inhalants



chemical health as a priority issue for teenagers in Alaska and to address those dynamics which predispose to drug use.

To meet this challenge, we must first acknowledge that the two primary substances of abuse are tobacco and alcohol. When daily cigarette and alcohol data are compared for 12th graders against national norms, what we we see is shown in Table 41.

by Gender				
	Alaska		Monitoring the Future	
Substance[2]	Males	Females	Males	Females
Cigarettes	18.0%	27.0%	17.4%	18.1%
Alcohol	2.1%	1.2%	7.0%	3.0%

[1]Bachman, J.G., Johnston, L.D., O'Malley, P.M. (1987). Monitoring the future: Questionnaire responses from the nations high school seniors. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan.

[2]Format for Alaska survey drug use questions were: Never, Over a year ago, Less than monthly, About monthly, About weekly, and Daily. In MTF, respondents are asked how many times in the past 30 days they have used each of the substances. The frequency options are 0, 1-2, 3-5, 6-9, 10-19, 20-39, 40 or more. In order to translate the MTF data to the Alaska continuum, the following equations were used: *Daily* = 20 or more times in the last 30 days

For daily cigarette use, there is a much higher rate among female 12th graders in Alaska compared with the nation; however, based on self-report, there is less daily drinking by Alaskan seniors than for the nation as a whole. Regular use of marijuana in Alaska among high school seniors (at least weekly) is nearly double that of the nation. Whether marijuana use has replaced alcohol as the preferred substance of regular use by Alaskan seniors remains a possibility. To look at these data in isolation from the other information collected in the Adolescent Health Survey is to ignore the dynamics which predispose to drug abuse. We know that those who do poorly in school are more likely to abuse substances; so, too, are those who are emotionally stressed. We know that those who are emotionally isolated are more likely to abuse drugs as are those who have been abused.

Simply stated, developing a substance abuse prevention program which does not address the predisposing factors and their interrelationships is most likely to fail. It is critical to understand the forces which predispose youth to abuse drugs if we are to assist them in developing chemical health.

CHALLENGE #8: To invest adequately in the youth of Alaska with the realization that they are the state's most valuable resource.

Clearly, this is the most difficult challenge of all. This report paints a portrait of youth in Alaska which suggests cause for concern in a number of areas. Yet, after the dust settles, will we say, "They'll grow out of it. We did?" Or, will we look at these data and ask, "Where should we invest our resources to help the largest numbers and most troubled of our adolescents?"

These are not easy questions which lend themselves to quick solutions. The meaning of these findings should be debated in our schools and in our legislature, in our churches, and in our communities. Only then may we develop a blueprint for action which will help all teenagers in Alaska achieve their maximum potential.

Overview of Findings from the 2003 National Survey on Drug Use and Health

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Substance Abuse and Mental Health Services Administration
Office of Applied Studies

1. Introduction

This report presents the first information from the 2003 National Survey on Drug Use and Health (NSDUH), an annual survey of the civilian, noninstitutionalized population of the United States aged 12 years old or older. Prior to 2002, the survey was called the National Household Survey on Drug Abuse (NHSDA). This brief Overview report provides a concise summary of the main results of the 2003 NSDUH. A more complete presentation of the initial results of the survey is given in the full report, *Results from the 2003 National Survey on Drug Use and Health: National Findings* (Office of Applied Studies [OAS], 2004). Both reports present national estimates of rates of use, numbers of users, and other measures related to illicit drugs, alcohol, and tobacco products. Measures related to mental health problems also are included. State-level estimates from NSDUH will be presented in a separate report.

A major focus of this report is changes in substance use between 2002 and 2003. Because of improvements to the survey in 2002, the 2002 data constitute a new baseline for tracking trends in substance use and other measures. Therefore, estimates from the 2002 and 2003 NSDUHs should not be compared with estimates from the 2001 and earlier NHSDAs to assess changes in substance use over time.

1.1. Summary of NSDUH

NSDUH is the primary source of statistical information on the use of illegal drugs by the U.S. population. Conducted by the Federal Government since 1971, the survey collects data by administering questionnaires to a representative sample of the population through face-to-face interviews at their places of residence. The survey is sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA) of the U.S. Department of Health and Human Services and is planned and managed by SAMHSA's Office of Applied Studies (OAS). Data collection is conducted under contract with RTI International, Research Triangle Park, North Carolina.[1] This section briefly describes the survey methodology; a more complete description is provided in Appendix A in the full "National Findings" report (OAS, 2004).

NSDUH collects information from residents of households, noninstitutional group quarters (e.g., shelters, rooming houses, dormitories), and civilians living on military bases. Persons excluded from the survey include homeless persons who do not use shelters, military personnel on active duty, and residents of institutional group quarters, such as jails and hospitals. Appendix D in the full report describes surveys that cover populations outside the NSDUH sampling frame.

Since 1999, the NSDUH interview has been carried out using computer-assisted interviewing (CAI). Most of the questions are administered with audio computer-assisted self-interviewing (ACASI). ACASI is designed to provide the respondent with a highly private and confidential means of responding to questions to increase the level of honest reporting of illicit drug use and other sensitive behaviors. Less sensitive items are administered by interviewers using computer-assisted personal interviewing (CAPI).

[1] RTI International is a trade name of Research Triangle Institute.

Consistent with the 2002 survey, the 2003 NSDUH employed a 50-State sample design with an independent, multistage area probability sample for each of the 50 States and the District of Columbia to facilitate State-level estimation. The design also oversampled youths and young adults, so that each State's sample was approximately equally distributed among three major age groups: 12 to 17 years, 18 to 25 years, and 26 years or older.

Nationally, 130,605 addresses were screened for the 2003 survey, and 67,784 completed interviews were obtained. The survey was conducted from January through December 2003. Weighted response rates for household screening and for interviewing were 90.72 and 77.39 percent, respectively.

1.2. Trend Measurement

Although the design of the 2002 and 2003 NSDUHs is similar to the design of the 1999 through 2001 surveys, there are important methodological differences that impact comparability of 2002 and 2003 estimates with estimates from prior surveys. In addition to the name change, each NSDUH respondent is now given an incentive payment of $30. These changes, both implemented in 2002 and continued in 2003, resulted in a substantial improvement in the survey response rate. The changes also affected respondents' reporting of many critical items that are the basis of prevalence measures reported by the survey each year. Comparability also could be affected by improved data collection quality control procedures that were introduced in the survey beginning in 2001, and by incorporating new population data from the 2000 decennial census into NSDUH sample weighting procedures. **Analyses of the effects of each of these factors on NSDUH estimates have shown that 2002 and 2003 data should not be compared with 2001 and earlier NHSDA data to assess changes over time. Therefore, this report presents data only from the 2002 and 2003 NSDUHs to examine trends.**

Limited trend assessment also can be done using information on prior substance use collected in the 2002 and 2003 NSDUHs. Specifically, questions on age at first use of substances, in conjunction with respondents' ages and interview dates, provide data that can be used to estimate the rates of first-time use (incidence) for years prior to 2002 and 2003. Trends for 1965 to 2002 in these incidence measures are discussed in Chapter 5 based on combined 2002 and 2003 data. Estimates of lifetime prevalence rates for years prior to 2002 were produced from 2002 NSDUH data on age at first use and included in the 2002 NSDUH full report (OAS, 2003). However, a recent evaluation assessing the validity of those estimates determined they were subject to significant bias (Gfroerer, Hughes, Chromy, Heller, & Packer, 2004). Therefore, these estimates of lifetime use are not included in this report. Further discussion of incidence estimates is given in Chapter 5 and Appendix B of the full report.

1.3. Purpose of This Report and Availability of Other Reports

This Overview report is intended to provide a concise summary of the key results from the 2003 NSDUH. It contains a subset of the results given in the full report, *Results from the 2003 National Survey on Drug Use and Health: National Findings* (OAS, 2004). Both reports present the results in separate chapters that discuss the national findings on seven topics: use of illicit drugs; use of alcohol; use of tobacco products; trends in initiation of substance use; prevention-related issues; substance dependence, abuse, and treatment; and mental health. The

Trends in Initiation of Substance Use (Incidence)

- There were an estimated 2.6 million new marijuana users in 2002. This means that each day an average of 7,000 Americans tried marijuana for the first time. About two thirds (69 percent) of these new marijuana users were under age 18, and about half (53 percent) were female.

- The annual number of marijuana initiates generally increased from 1965 until about 1973. From 1973 to 1978, the annual number of marijuana initiates remained level at over 3 million per year. After that, the number of initiates declined, reaching a low point in 1990, then rose again until 1995. From 1995 to 2002, there was no consistent trend, with estimates varying between 2.4 million and 2.9 million per year.

- Decreases in initiation of both LSD (from 631,000 to 272,000) and Ecstasy (from 1.8 million to 1.1 million) were evident between 2001 and 2002, coinciding with an overall drop in hallucinogen incidence from 1.6 million to 1.1 million.

- Pain reliever incidence increased from 1990 (573,000 initiates) to 2000 (2.5 million). In 2001 and 2002, the number also was 2.5 million.

- The number of new daily cigarette smokers decreased from 2.0 million in 1997 to 1.4 million in 2002. Among youths under 18, the number of new daily smokers decreased from 1.1 million per year between 1997 and 2000 to 734,000 in 2002. This corresponds to a decrease from about 3,000 to about 2,000 new youth smokers per day.

Youth Prevention-Related Measures

- The percentage of youths aged 12 to 17 indicating that smoking marijuana once a month was a great risk increased from 32.4 percent in 2002 to 34.9 percent in 2003. There were no changes between 2002 and 2003 in the percentages of youths perceiving a great risk associated with using cigarettes, alcohol, cocaine, heroin, and LSD.

- The percentage of youths reporting that it would be easy to obtain marijuana declined slightly between 2002 and 2003, from 55.0 to 53.6 percent. The percentage of youths reporting that LSD would be easy to obtain also decreased between 2002 and 2003, from 19.4 to 17.6 percent.

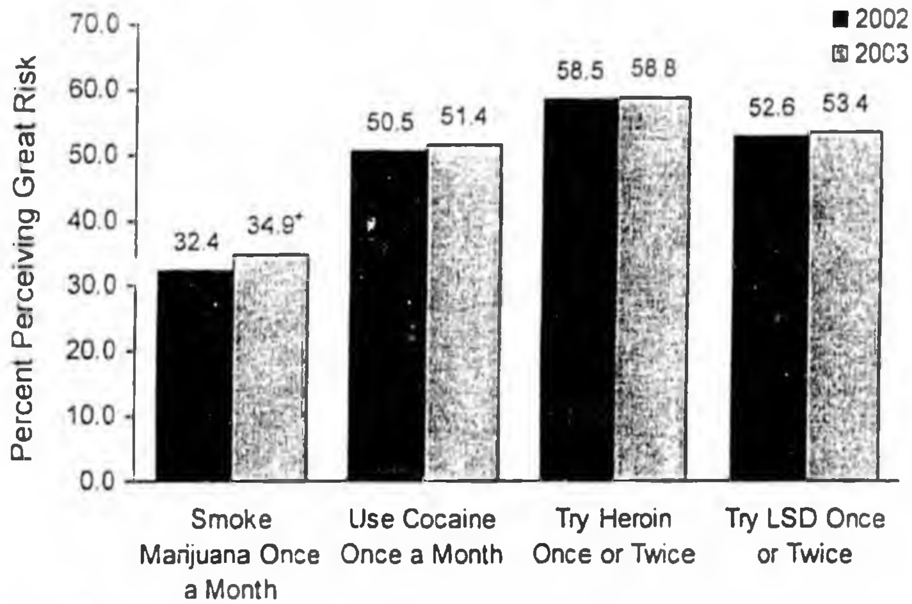
- Most youths (89.4 percent) reported that their parents would strongly disapprove of their trying marijuana once or twice. Among these youths, only 5.4 percent had used marijuana in the past month. However, among youths who perceived that their parents would only somewhat disapprove or neither approve nor disapprove of their trying marijuana, 28.7 percent used marijuana.

6. Youth Prevention-Related Measures

The National Survey on Drug Use and Health (NSDUH) includes an extensive set of questions about risk and protective factors directed at youths aged 12 to 17. Risk factors include those individual characteristics or social environments associated with an increased likelihood of substance use, while protective factors are related to a decreased likelihood of substance use. These factors derive from circumstances, influences, and perceptions at many levels, such as the individual, peer, family, school, and community levels (Hawkins, Catalano, & Miller, 1992).

Perceptions of Risk. Youths were asked how much they thought people risk harming themselves physically and in other ways when they use various substances. Response choices in the survey were "great risk," "moderate risk," "slight risk," or "no risk." The percentage of youths aged 12 to 17 indicating that smoking marijuana once a month was a great risk increased from 32.4 percent in 2002 to 34.9 percent in 2003. There were no statistically significant changes between 2002 and 2003 in the percentages of youths aged 12 to 17 perceiving a great risk in using cigarettes, alcohol, cocaine, heroin, and LSD (Figure 9).

Figure 9. Perceived Great Risk of Use of Selected Illicit Drugs among Youths Aged 12 to 17: 2002 and 2003



Note: Statistically significant differences (at 0.05 level) between 2002 and 2003 are denoted by " + ".

Availability. In 2003, approximately one in six youths (16.1 percent) reported that he or she had been approached by someone selling drugs in the past month. This was about the same percentage as in 2002 (16.7 percent). The percentage of youths reporting that it would be easy to obtain marijuana declined slightly between 2002 and 2003, from 55.0 to 53.6 percent. The percentage of youths reporting that LSD would be easy to obtain also decreased, from 19.4 to 17.6 percent.

Parental Disapproval of Substance Use. In 2003, youths who perceived that their parents would "strongly disapprove" of their use of substances were much less likely to use those substances than youths who perceived that their parents would only "somewhat disapprove" or "neither approve nor disapprove." Among youths in 2003 who perceived that their parents would strongly disapprove of their trying marijuana or hashish once or twice, 5.4 percent used marijuana in the past month, while among youths whose parents would not strongly disapprove, 28.7 percent used marijuana in the past month.

The majority of youths in 2003 indicated that their parents would strongly disapprove if they used marijuana once or twice (89.4 percent) or if they used marijuana once a month or more (92.2 percent). Most youths also indicated that their parents would strongly disapprove if they were to smoke one or more packs of cigarettes per day (89.8 percent) or have one or two alcohol drinks nearly every day (88.5 percent). These rates of perceived parental disapproval were all similar to the rates in 2002.

Delinquent Behavior. In 2003, youths were asked if they had engaged in the following delinquent behaviors during the past year: gotten into a serious fight at school or work, participated in a group-on-group fight, attacked someone with the intent to seriously hurt him or her, carried a handgun, sold illegal drugs, or stolen or tried to steal something worth $50 or more. Youths who had engaged in these behaviors were more likely to have used illicit drugs in the past month than other youths. Both the percentage of youths reporting that they had gotten into a serious fight at school or work and the percentage participating in a group-against-group fight in the past year increased between 2002 and 2003 from 20.6 to 23.8 percent and from 15.9 to 18.1 percent, respectively. The percentage selling illegal drugs in the past year decreased from 4.4 percent in 2002 to 3.6 percent in 2003. In 2003, 3.6 percent of youths indicated they had carried a handgun in the past year, 4.5 percent had stolen (or tried to steal) something worth more than $50, and 8.3 percent had attacked someone with the intent to seriously harm him or her; these percentages were similar to those in 2002.

Exposure to Prevention Messages. In 2003, over half of all youths aged 12 to 17 (58.9 percent) indicated that they had talked with at least one parent in the past year about the dangers of tobacco, alcohol, or drug use. A majority of youths (83.6 percent) reported having seen or heard alcohol or drug prevention messages outside of school in the past year, and 78.1 percent of youths enrolled in school during the past 12 months reported having seen or heard drug or alcohol prevention messages in school. These percentages were all similar to the percentages in 2002.

AMERICAN ACADEMY OF PEDIATRICS

POLICY STATEMENT
Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of All Children

Committee on Substance Abuse and Committee on Adolescence

Legalization of Marijuana: Potential Impact on Youth

ABSTRACT. **As experts in the health care of children and adolescents, pediatricians may be called on to advise legislators concerning the potential impact of changes in the legal status of marijuana on adolescents. Parents, too, may look to pediatricians for advice as they consider whether to support state-level initiatives that propose to legalize the use of marijuana for medical purposes or to decriminalize possession of small amounts of marijuana. This policy statement provides the position of the American Academy of Pediatrics on the issue of marijuana legalization, and the accompanying technical report (available online) reviews what is currently known about the relationship between adolescents' use of marijuana and its legal status to better understand how change might influence the degree of marijuana use by adolescents in the future.** ***Pediatrics*** **2004;113:1825–1826;** ***marijuana, legalization, substance abuse, decriminalization.***

INTRODUCTION

Substance abuse by adolescents is an ongoing concern of pediatricians. Marijuana is the illicit substance most commonly abused by adolescents.[1] Any change in the legal status of marijuana, even if limited to adults, could affect the prevalence of use among adolescents.[2] For example, tobacco and alcohol products, both legal for adults 18 and 21 years of age, respectively, are the psychoactive substances most widely abused by adolescents.

Marijuana currently is classified by the US Drug Enforcement Agency as a schedule I drug, which means that it has a high potential for abuse, has no currently accepted medical use in the United States, and lacks accepted safety for use under supervision by a physician. Rigorous scientific research to determine whether marijuana, especially cannabinoids, has any potential therapeutic effect is just beginning. In contrast, the significant neuropharmacologic, cognitive, behavioral, and somatic consequences of acute and long-term marijuana use are well known and include negative effects on short-term memory, concentration, attention span, motivation, and problem solving, which clearly interfere with learning; adverse effects on coordination, judgment, reaction time, and tracking ability, which contribute substantially to unintentional deaths and injuries among adolescents (especially those associated with motor vehicles); and negative health effects with repeated use similar to effects seen with smoking tobacco.[3]

More information, including historical perspectives on the legal status of marijuana as well as concerns surrounding medicinal use of marijuana, is available in the accompanying technical report (available online).[2]

RECOMMENDATIONS

1. The American Academy of Pediatrics opposes the legalization of marijuana.
2. The American Academy of Pediatrics supports rigorous scientific research regarding the use of cannabinoids for the relief of symptoms not currently ameliorated by existing legal drug formulations.

COMMITTEE ON SUBSTANCE ABUSE, 2001–2002
Edward A. Jacobs, MD, Chairperson
*Alain Joffe, MD, MPH
John R. Knight, MD
John Kulig, MD, MPH
Peter D. Rogers, MD, MPH
Janet F. Williams, MD

LIAISON
Deborah Simkin, MD
American Academy of Child and Adolescent Psychiatry

STAFF
Karen S. Smith

COMMITTEE ON ADOLESCENCE, 2001–2002
David W. Kaplan, MD, MPH, Chairperson
Angela Diaz, MD
Ronald A. Feinstein, MD
Martin M. Fisher, MD
Jonathan D. Klein, MD, MPH
Ellen S. Rome, MD, MPH
*W. Samuel Yancy, MD

LIAISONS
Ann J. Davis, MD
American College of Obstetricians and Gynecologists
Glen Pearson, MD
American Academy of Child and Adolescent Psychiatry
Jean-Yves Frappier, MD
Canadian Paediatric Society

STAFF
Karen S. Smith

**Lead authors*

REFERENCES

1. Schydlower M. Preface. In: Schydlower M, ed. *Substance Abuse: A Guide for Health Professionals*. 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2002:viii–x
2. American Academy of Pediatrics, Committee on Substance Abuse and Committee on Adolescence. Technical report: legalization of marijuana: potential impact on youth. *Pediatrics*. 2004;113(6). Available at: www.pediatrics.org/cgi/content/full/113/6/e632
3. American Academy of Pediatrics, Committee on Substance Abuse. Marijuana: a continuing concern for pediatricians. *Pediatrics*. 1999;104:982–985

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

PEDIATRICS

Legalization of Marijuana: Potential Impact on Youth

Alain Joffe, W. Samuel Yancy and the Committee on Substance Abuse and Committee on Adolescence

Pediatrics 2004;113;632-638
DOI: 10.1542/peds.113.6.e632

TECHNICAL REPORT

Alain Joffe, MD, MPH, and W. Samuel Yancy, MD, the Committee on Substance Abuse and Committee on Adolescence

Legalization of Marijuana: Potential Impact on Youth

ABSTRACT. This technical report provides historical perspectives and comparisons of various approaches to the legal status of marijuana to aid in forming public policy. Information on the impact that decriminalization and legalization of marijuana could have on adolescents, in addition to concerns surrounding medicinal use of marijuana, are also addressed in this report. Recommendations are included in the accompanying policy statement. *Pediatrics* **2004;113:e632–e638. URL: http://www.pediatrics.org/cgi/content/full/113/6/e632;** ***marijuana, legalization, substance abuse, decriminalization.***

ABBREVIATIONS. AAP, American Academy of Pediatrics; IOM, Institute of Medicine.

BACKGROUND

Over the last 40 years, the legal status of marijuana has been debated vigorously. Proponents of policies that would permit individual possession of small amounts of marijuana argue that it is a safe drug and that criminal sanctions against personal use and possession represent at worst excessively harsh and at best unnecessary penalties. Echoing these sentiments, editors of *The Lancet* have concluded that "cannabis per se is not a hazard to society but driving it further underground may well be."[1] Advocates for legalization also point out that the morbidity, mortality, and economic costs to society associated with alcohol and tobacco use in the United States dwarf those associated with marijuana use.

Those opposing liberalization of current laws counter that marijuana is not a benign drug, especially in light of new psychopharmacologic information demonstrating that marijuana shares many features with other illicit drugs. They also contend that legalization or decriminalization of personal use of marijuana likely would trigger a substantial increase in use, with foreseeable increases in the social, economic, and health costs.

Most recently, the debate has focused on the medical use of marijuana (that is, the use of smoked marijuana to treat a variety of medical conditions). Eight states (Alaska, Arizona, California, Colorado, Maine, Nevada, Oregon, and Washington) have passed ballot initiatives that provide for medical use of marijuana under certain circumstances; one other state (Hawaii) has enacted state legislation permitting medical marijuana use.[2] The federal government has opposed vigorously any efforts to permit physicians to prescribe marijuana for medical purposes, an approach characterized by the former editor of the *New England Journal of Medicine* as "misguided, heavy-handed, and inhumane."[3]

Controversy regarding marijuana is not limited to the United States. Australia has decriminalized the use of marijuana in some territories, and Canada[4] as well as Switzerland and other European countries[5] are reconsidering their approach to marijuana. However, the most widely publicized approach to regulation of marijuana is that of The Netherlands. Under a complex system of "law-on-the-books" and "law-in-action," Dutch law permits personal use of marijuana but outlaws possession.[6]

Pediatricians, too, are not of one mind in their views regarding the legal status of marijuana. In a periodic survey of fellows of the American Academy of Pediatrics (AAP) conducted in 1995,[7] only a minority (18%) favored legalization, and 26% believed that possession or sale should be a felony; 31% felt that marijuana should be available by prescription for medical purposes to a certain class of patients, and 24% believed that marijuana should remain illegal but penalties for personal possession should be reduced or eliminated.

Since the periodic survey was conducted, much more has been learned about the psychopharmacologic properties of marijuana. Scientists have demonstrated that the emotional stress caused by withdrawal from marijuana is linked to corticotropin-releasing factor, the same brain chemical that has been linked to anxiety and stress during opiate, alcohol, and cocaine withdrawal.[8] Others report that tetrahydrocannabinol, the active ingredient in marijuana, stimulates release of dopamine in the mesolimbic area of the brain, the same neurochemical process that reinforces dependence on other addictive drugs.[9] Current scientific information about marijuana has been summarized in the AAP policy statement "Marijuana: A Continuing Concern for Pediatricians."[10] Some of the significant neuropharmacologic, cognitive, behavioral, and somatic consequences of acute and long-term marijuana use are well known and include negative effects on short-

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

PEDIATRICS (ISSN 0031 4005).

term memory, concentration, attention span, motivation, and problem solving, which clearly interfere with learning; adverse effects on coordination, judgment, reaction time, and tracking ability, which contribute substantially to unintentional deaths and injuries among adolescents (especially those associated with motor vehicles); and negative health effects with repeated use similar to effects seen with smoking tobacco. Three recent studies[11-13] demonstrate an association between marijuana use and the subsequent development of mental health problems; however, a small study of 56 monozygotic cotwins discordant for marijuana use did not find any such associations.[14]

DEFINITION OF TERMS

There are 3 general policy perspectives concerning the status of marijuana in the United States: prohibition, decriminalization, and legalization. Prohibition describes current federal policy toward marijuana use, which seeks to minimize or prevent use of marijuana with strong legal sanctions and aggressive interdiction of supply routes. Decriminalization and depenalization (used interchangeably in this report) refer to the elimination, reduction, and/or nonenforcement of penalties for the sale, purchase, or possession of marijuana although such activities remain illegal. Under decriminalization, penalties for use or distribution are at least possible theoretically, and advertising would be banned. Legalization, one step beyond decriminalization, would fundamentally change the status of marijuana in society. It is an acknowledgment that the government has no fundamental interest in an individual's use of a drug, although it may still seek to regulate its sale, distribution, use, and advertisement to safeguard the public's health. Such is the case with alcohol and tobacco. Of the 3 approaches, only the prohibitionist approach has reducing or limiting drug use as its explicit goal.

HISTORICAL PERSPECTIVES ON DRUG POLICIES IN THE UNITED STATES

Important perspectives on how changing the status of marijuana could affect use by adolescents can be gleaned from an examination of this country's experience with drugs over the last 200 years. During the 19th century, opiate drugs were legal and widely available. Opium use was common, especially among middle-class white women.[15] Use of morphine also was extensive, and heroin was marketed as a "sedative for coughs." Cocaine, which routinely was added to patent medicines and beverages, also was legal; it was prized for its local anesthetic effect and its ability to counteract the effects of morphine. The national opiate addiction rate increased from 0.72 per 1000 in 1840 to 4.59 per 1000 in the 1890s, thereafter beginning a sustained decline.[16(p28)]

Another wave of drug use began in the mid-1960s as enforcement of marijuana laws by police became lax and adolescent and layperson perceptions of the risk of regular use declined. Officials from the US Drug Enforcement Agency expressed the view that the fight against marijuana detracted from the more important work of combating heroin use.[16(p174)] Drug incarcerations per 1000 arrests began to drop in 1960 and remained low through 1979. The Carter administration (1977–1981) proposed removing criminal sanctions for possessing small amounts of marijuana.[16(p175)] In 1975, 6% of high school seniors reported using marijuana daily during the previous 30 days. By 1978, the same year during which perceived risk of regular use of marijuana reached its lowest point ever, 10.7% of high school seniors reported using the drug daily.[17]

Drug use in America tends to follow cycles, often with one generation having to relearn the experiences of previous ones. Ninety years after the first cocaine epidemic, cocaine use began to increase in the 1970s and escalated substantially from 1980 to 1995. Because it had been so long since the previous epidemic, cocaine was perceived to be a safe drug. In a chapter on cocaine in the 1980 edition of a prominent textbook of psychiatry, the authors wrote: "If it is used no more than two or three times a week, cocaine creates no serious problems."[18] In 1977, 10% of 18- to 25-year-olds had used cocaine; that proportion doubled to 20% in 1979. By 1985, one third of 18- to 25-year-olds had used cocaine, as had 17.3% of 12th graders.[15] Only with subsequent widespread publicity about the health risks and addictive properties of cocaine and the epidemic of crack cocaine did cocaine use among young people begin to wane.

US AND INTERNATIONAL EXPERIENCES WITH MARIJUANA LEGALIZATION AND DEPENALIZATION

Because to our knowledge no country has completely legalized the sale, possession, and advertising of marijuana, there are no studies that examine the effect of legalization on marijuana use by young people. Hence, we examine data on adolescents' use of marijuana in states and countries that have, to a greater or lesser extent, decriminalized use and possession of this drug.

Analyzing data from the annual Monitoring the Future survey, Johnston et al[15] concluded that decriminalization of marijuana in a number of states from 1975 to 1980 apparently had no effect on high school students' beliefs and attitudes about marijuana or on their use of the drug during those years. In contrast, Chaloupka et al,[20] analyzing data from the 1992–1994 Monitoring the Future surveys, found that "youths living in decriminalized states are significantly more likely to report currently using marijuana and may consume more frequently."

There are several possible explanations for these disparate findings. Although the study by Johnston et al did not find any effect of decriminalization, baseline marijuana use was higher in states that changed their laws compared with states that did not, although the subsequent rate of increase in all states was the same. It is possible that the higher baseline rates of use in the states that decriminalized marijuana use may have reflected a more lax or tolerant approach to marijuana use before decriminalization. Hence, decriminalization would not have resulted in any significant lessening of enforcement, and the observed rate of increase would parallel but not exceed changes in the states that did not alter their laws. Also, because the Monitoring the Future survey is administered in schools, any effect of decriminalization on marijuana use by out-of-school youth (who typically have higher levels of drug use[21]) would not have been reflected.

An additional [illegible] is provided by a recent analysis of marijuana decriminalization laws in the United States by Pacula et al.[22] They found that some states that are viewed as having decriminalized marijuana use have in fact retained a first-time marijuana offense as a criminal offense. In addition, many states that are characterized as not having decriminalized laws pertaining to marijuana use specify first-time marijuana possession offenses as noncriminal. These same authors found that youth living in states that lowered offenses for marijuana possession to below the felony level were more likely to report use of marijuana in the past month.[22]

Several territories in Australia have decriminalized use of marijuana. Studies comparing use in these territories with use in those that did not reduce penalties found no appreciable differences in use.[23,24]

The most widely scrutinized large-scale change in the legal status of marijuana occurred in The Netherlands. Dutch policy regarding decriminalization is very complex. Use of illegal drugs per se is not punishable by law, but possession for use is; drug dealing also is considered a felony.[25] Theoretically, one can be imprisoned for up to 1 month for possession of 5 g or less of cannabis, and promotion of marijuana through advertisements is forbidden also.

From 1984 to 1996, the period during which Dutch prosecution of marijuana-related offenses became virtually nonexistent, marijuana use increased consistently and substantially until 1992 while decreasing or remaining stable in other countries.[26,27] Among 18- to 20-year-olds, the proportion who reported ever having used marijuana increased from 15% to 44%, and the proportion who reported using it within the previous 30 days increased from 8.5% to 18.5%. Use among adolescents in the United States decreased steadily from 1979 to 1992. In Norway, which also forbids the sale of marijuana, use remained constant until 1992 and then increased. Use remained steady or decreased in Catalunya (Spain), Stockholm, Hamburg, and Denmark during this period. These figures strongly suggest that marijuana use was influenced by changes in Dutch policy during this period. However, the United States and Norway (Oslo) also experienced increases in use of marijuana from 1992 to 1996, and thus it is difficult to attribute any change in use among Dutch youth after 1992 to the country's drug policies.

The 1999 European School Survey Project on Alcohol and Drugs, specifically developed to provide data on European drug use comparable with that obtained by the Monitoring the Future surveys, revealed that the proportion of adolescents in The Netherlands who reported ever having used marijuana (28%) was substantially lower than that of 10th graders in the United States (41%). However, the European survey also indicated that Dutch use was higher than any other European country except Ireland, the United Kingdom, France, and the Czech Republic.[28]

MEDICAL MARIJUANA

Considerable anecdotal evidence suggests that marijuana may be effective in treating a number of medical conditions. This perspective has been an important force behind efforts to change the legal status of marijuana. Marijuana has been touted as ameliorating chemotherapy-induced nausea, wasting and anorexia associated with AIDS, intraocular pressure in glaucoma, and muscle spasticity arising from such conditions as multiple sclerosis. Two comprehensive reviews evaluating the scientific basis for these claims, one conducted by the Institute of Medicine (IOM) and the other by the American Medical Association, have been published recently.[29,30] Both reports acknowledge the lack of rigorous data to support the use of smoked marijuana as medicine while calling for additional research into the medical use of cannabinoids, especially those that could be delivered rapidly in a smoke-free manner. The IOM report noted that marijuana smoke delivers "harmful substances" as well as tetrahydrocannabinol to the body and that marijuana "plants cannot be expected to provide a precisely defined drug effect." "For these reasons," the IOM report concluded, "there is very little future in smoked marijuana as a medically approved medication. If there is any future in cannabinoid development, it lies with agents of more certain, not less certain, composition."

POTENTIAL EFFECT OF DECRIMINALIZATION OR LEGALIZATION ON US ADOLESCENTS

Although efforts to legalize marijuana are focused solely on adults (no one is proposing that use or possession of marijuana by adolescents should be legalized), any change in its legal status could nonetheless have an effect on adolescents. Alcohol (illegal for those under 21 years of age) and tobacco products (illegal under 18 years of age) are nonetheless the psychoactive substances most widely abused by adolescents. During 2003, 47.5% of 12th graders reported using alcohol in the past 30 days and 24.4% reported smoking cigarettes in the past 30 days.[31]

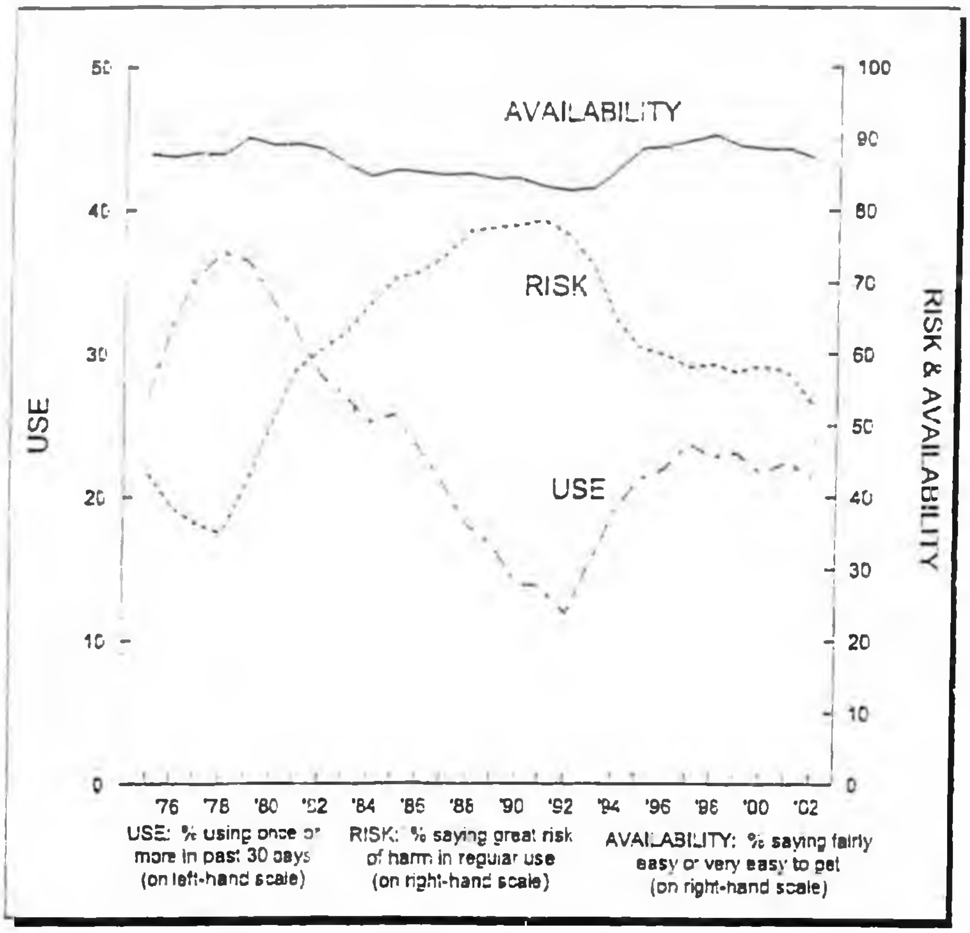
Legalization of marijuana could result in advertising campaigns for its use, some of which might be directed toward adolescents. Control measures to prevent advertising to young people, as recent experience demonstrates, may be difficult to implement. As revealed during the course of the Comprehensive Tobacco Settlement negotiations, tobacco companies systematically have marketed their products to young people even while disavowing any efforts to do so. Even after the Comprehensive Tobacco Settlement was implemented (which prohibited any youth-oriented advertising), tobacco companies continued marketing to young people. A recent study noted that cigarette advertising in youth-oriented magazines increased by $54 million after the Tobacco Master Settlement Agreement.[32] Another study showed that advertising of youth brands of cigarettes (defined as those smoked by >5% of 8th, 10th, and 12th graders in 1998) in youth-oriented magazines increased from 1995 to 2000, as did expenditures for adult brands in youth-oriented magazines.[33] The Supreme Court recently struck down several Massachusetts regulations aimed at protecting schoolchildren from tobacco advertising (including bans on tobacco ads within 1000 feet of a school or playground). "The state's interest in preventing underage tobacco use is substantial and even compelling, but it is no less true that the sale and use of tobacco by adults is a legal activity," wrote Justice Sandra Day O'Connor for the majority. She continued, "... tobacco retailers and manufacturers have an interest in conveying truthful information about their products to adults, and adults have a corresponding interest in receiving truthful information about tobacco products."[34] Presumably, these same interests in regard to advertising for marijuana products also would be protected.

DiFranza[35] has demonstrated that both the states and the federal government are poorly enforcing the Synar Amendment, which requires states to control the sale of tobacco products to those younger than 18 years. Legalization of marijuana for adults but not adolescents would necessitate additional law enforcement burdens on a system that currently is not meeting its regulatory obligations.

Similarly, the alcoholic-beverage industry continues to portray drinking in terms that clearly appeal to young people. Drinking is associated with being sexy, popular, and fun and as an ideal means to "break the ice" in social settings.[36] These portrayals are extremely enticing to adolescents, who are in the process of developing their own identities as well as refining their social skills. One can speculate that distributors of marijuana quickly would recognize the profitability of portraying marijuana in a similar manner (thereby maximizing sales), all the while protesting that their marketing attempts seek only to induce adults to change brands.

How adolescents would perceive a change in the legal status of marijuana, even if only for adults, also is difficult to determine. However, recent studies have shown that prevalence of adolescent marijuana use is inversely proportional to the perceived risk associated with use (Fig 1).[37] The proportion of 12th graders who reported using marijuana in the past 30 days peaked in 1978 and again in 1997, exactly the years in which the perceived risk of regular use was at its lowest.

Some research suggests that legal sanctions may



Source: Johnston LD, O'Malley PM, Bachman JG. Monitoring the Future: National Survey Results on Drug Use, 1975-2002. Vol I: Secondary School Students. Bethesda, MD: National Institute on Drug Abuse, 2003

Fig 1. Marijuana: trends in perceived availability, perceived risk of regular use, and prevalence of use in past 30 days for 12th graders influence the initial decision to use drugs and that this influence diminishes as drug use by individuals progresses.[38] If so, it is the youngest adolescents (those who have not yet tried marijuana or are in the experimentation phase) who would be affected most by changes in marijuana laws. Age at first use is, in turn, a risk factor for problem use in the future.[39]

Moral development in children and adolescents assumes a developmental trajectory. Early adolescents have a concrete approach to morality: laws are obeyed to avoid punishment. As such, young adolescents would be most susceptible to the deterrent effects of drug laws. This deterrent effect could disappear or lessen with legalization of marijuana. Once adolescents gain the ability to think abstractly, challenges to the apparent hypocrisy of "do as I say, not as I do" can be anticipated.

Parental drug use is an important influence on adolescents' drug use.[40] Recent data indicate that easy household access to illicit substances is associated with greater risk of marijuana use among both younger and older adolescents.[41] Some adults may choose not to use marijuana (however they may feel about the law), because the potential risk of criminal sanctions outweighs any perceived benefit from using the drug. With the demise of legal sanctions against use, some parents may choose to begin using marijuana, acting as an important new source of exposure for their adolescents. Parental use of marijuana in the last year is associated with their adolescent's use during the same period.[42]

Availability of marijuana, which might increase if the drug were legalized, clearly has been shown to affect adolescents' use. Adolescents who have been offered marijuana are 7 times more likely to use it than are those who have not been offered marijuana. Similarly, those who report that marijuana is easy to get are approximately 2.5 times more likely to use it than those who consider it hard to get.[43]

Marijuana is cheap and easy to produce; if it were legalized, its price likely would decrease below current levels. Work by Pacula et al[44] in the United States and Williams[45] in Australia demonstrates clearly that a decrease in the price of marijuana is associated with a significant increase in the prevalence of use among adolescents.

Some advocates for the legalization of marijuana argue that it is safer than alcohol. They suggest that increased use of marijuana by young people might have a positive effect if some adolescents switched from alcohol to marijuana (a substitution effect). This theory cannot be supported by recent studies on adolescent marijuana and alcohol use that incorporated the price of marijuana into the analysis. These studies conclude that an increase in use of marijuana by adolescents would result in an increased use of alcohol (ie, that the 2 drugs are economic complements).[46]

From a public health perspective, even a small increase in use, whether attributable to increased availability or decreased perception of risk, would have significant ramifications. For example, if only an additional 1% of 15- to 19-year-olds in the United States began using marijuana, there would be approximately 190 000 new users.[47]

COMPARISONS BETWEEN MARIJUANA, ALCOHOL, AND TOBACCO

Proponents of legalization of marijuana argue that in terms of costs to society, both financial and health-related, alcohol and tobacco cause far more harm than does marijuana. They argue that classifying a relatively benign drug (marijuana) as schedule I and vigorously prosecuting its sale and possession while permitting the legal use of substances that cause far more damage are inconsistent and illogical practices or policies. That alcohol and tobacco cause far more harm in our society than marijuana is undeniable, but it does not follow logically that yet a third addictive psychoactive drug (marijuana) should be legalized. Many of the harms associated with alcohol and tobacco use stem from the widespread acceptability, availability, and use of these substances. Still other harms result from lax enforcement of current laws regulating their use or sale, especially to underage youth. Rather than legalizing marijuana, an equally compelling approach would be vigorously enforcing current regulations regarding sale and use of alcohol and tobacco products to minimize health-related problems attributable to their consumption. Recent examples include lowering the blood alcohol concentration that defines whether an individual is driving while intoxicated to 0.08 mg/dL (0.02 mg/dL for youth), limiting or banning smoking in public places, and banning cigarette advertisements targeted toward young people.

SUMMARY

Several recent studies concerning American adolescents, the Dutch experience with decriminalization (from 1984 to 1992), and the relationship between cheaper marijuana and use by adolescents suggest that decriminalization increases marijuana use by adolescents. Because no country has legalized use of marijuana outright, there are no studies available to evaluate the potential effect of legalization in the United States. Legalization of marijuana could decrease adolescents' perceptions of the risk of use and increase their exposure to this drug. Furthermore, data concerning adolescents' use of the 2 drugs that are legal for adults (alcohol and tobacco) suggest strongly that legalization of marijuana would have a negative effect on youth. Alcohol and tobacco are the drugs most widely abused by adolescents, although their sale to adolescents (younger than 18 years for tobacco and younger than 21 years for alcohol) is illegal. Research demonstrates that manufacturers of alcohol and tobacco market their products to young people, and the recent Supreme Court decision and experience with the Synar Amendment suggest that, if marijuana were legalized, restrictions on the sale and advertising of the substance to young people would prove daunting. Finally, two in-depth reviews of medical marijuana conclude that future research should focus on the medical use of cannabinoids, not smoked marijuana.

Recommendations from the AAP are included in the accompanying policy statement.[48]

COMMITTEE ON SUBSTANCE ABUSE, 2001–2002
Edward A. Jacobs, MD, Chairperson
Alain Joffe, MD, MPH
John R. Knight, MD
John Kulig, MD, MPH
Peter D. Rogers, MD, MPH
Janet F. Williams, MD

LIAISON
Deborah Simkin, MD
American Academy of Child and Adolescent Psychiatry

STAFF
Karen S. Smith

COMMITTEE ON ADOLESCENCE, 2001–2002
David W. Kaplan, MD, MPH, Chairperson
Angela Diaz, MD
Ronald A. Feinstein, MD
Martin M. Fisher, MD
Jonathan D. Klein, MD, MPH
Ellen S. Rome, MD, MPH
W. Samuel Yancy, MD

LIAISONS
Ann J. Davis, MD
American College of Obstetricians and Gynecologists
Glen Pearson, MD
American Academy of Child and Adolescent Psychiatry
Jean-Yves Frappier, MD
Canadian Paediatric Society

STAFF
Karen S. Smith

REFERENCES

1. Deglamorising cannabis [editorial]. *Lancet*. 1995;346:1241
National Drug Intelligence Center. *Marijuana. National Drug Threat Assessment 2003*. Johnstown, PA: National Drug Intelligence Center; 2003. Available at: www.usdoj.gov/ndic/pubs3/3300/marijuan.htm. Accessed February 4, 2004
3. Kassirer JP. Federal foolishness and marijuana. *N Engl J Med*. 1997;336:366–367
4. Canada Senate. *Cannabis: Our Position for a Canadian Public Policy. Report of the Senate Special Committee on Illegal Drugs*. Available at: www.medicalmarihuana.ca/pdfiles/senatesummary.pdf. Accessed February 4, 2004
5. Katz G. Europe loosens its pot laws. *Roll Stone*. 2002;(899–900):55–57
6. Silvis J. Enforcing drug laws in The Netherlands. In: Leuw E, Marshall IH, eds. *Between Prohibition and Legalization. The Dutch Experiment in Drug Policy*. Amsterdam, The Netherlands: Kugler Publications; 1994: 41–58
7. American Academy of Pediatrics, Division of Child Health Research. *AAP Periodic Survey of Fellows No. 31: Issues Surrounding Drug Legalization*. Elk Grove Village, IL: American Academy of Pediatrics; 1995
8. Rodriguez de Fonseca F, Carrera MR, Navarro M, Koob GF, Weiss F. Activation of corticotropin-releasing factor in the limbic system during cannabinoid withdrawal. *Science*. 1997;276:2050–2054
9. Tanda G, Pontieri FE, Di Chiara G. Cannabinoid and heroin activation of mesolimbic dopamine transmission by a common μ_1 opioid receptor mechanism. *Science*. 1997;276:2048–2050
10. American Academy of Pediatrics, Committee on Substance Abuse. Marijuana: a continuing concern for pediatricians. *Pediatrics*. [illegible];104:982–985
11. Patton GC, Coffey C, Carlin JB, Degenhardt L, Lynskey M, Hall W. Cannabis use and mental health in young people: cohort study. *BMJ*. 2002;325:1195–1198
12. Zammit S, Allebeck P, Andreasson S, Lundberg I, Lewis G. Self reported cannabis use as a risk factor for schizophrenia in Swedish conscripts of 1969: historical cohort study. *BMJ*. 2002;325:1199–1203
13. Arseneault L, Cannon M, Poulton R, Murray R, Caspi A, Moffitt TE. Cannabis use in adolescence and risk for adult psychosis: longitudinal prospective study. *BMJ*. 2002;325:1212–1213
14. Eisen SA, Chantarujikapong S, Xian H, et al. Does marijuana use have residual effects on self-reported health measures, socio-demographics and quality of life? A monozygotic co-twin control study in men. *Addiction*. 2002;97:1137–1144
15. Jonnes J. *Hep-Cats, Narcs, and Pipe Dreams: A History of America's Romance With Illegal Drugs*. New York, NY: Scribner; 1996
16. Courtwright DT. *Dark Paradise: A History of Opiate Addiction in America*. Cambridge, MA: Harvard University Press; 2001
17. Johnston LD, O'Malley PM, Bachman JG. *Monitoring the Future National Survey Results on Drug Abuse, 1975–2002. Volume I: Secondary School Students*. Bethesda, MD: National Institute on Drug Abuse, Department of Health and Human Services; 2002. NIH Publication No. 02-5106. Available at: www.monitoringthefuture.org/pubs/monographs/vol1_2001.pdf. Accessed May 23, 2003
18. Grinspoon L, Bakalar JB. Drug dependence: nonnarcotic agents. In: Kaplan HI, Freedman AM, Sadock BJ, eds. *Comprehensive Textbook of Psychiatry*. 3rd ed. Baltimore, MD: Williams & Wilkins; 1980:1621
19. Johnston LD, O'Malley PM, Bachman JG. *Marijuana Decriminalization: The Impact on Youth 1975–1980*. Monitoring the Future Occasional Paper No. 13. Ann Arbor, MI: Institute for Social Research, University of Michigan; 1981
20. Chaloupka FJ, Pacula RL, Farrelly MC, Johnston LD, O'Malley PM. *Do Higher Cigarette Prices Encourage Youth to Use Marijuana?* NBER Working Paper No. w6939. Cambridge, MA: National Bureau of Economic Research; 1999. Available at: www.nber.org/papers/w6939. Accessed May 7, 2003
21. Swaim RC, Beauvais F, Chavez EL, Oetting ER. The effect of school dropout rates on estimates of adolescent substance abuse among three racial/ethnic groups. *Am J Public Health*. 1997;87:51–55
22. Pacula RL, Chriqui JF, King J. *Marijuana Decriminalization: What Does it Mean in the United States?* Available at: www.impacteen.org/generalarea_PDFs/midecriminal_paculaJuly2002.pdf. Accessed January 27, 2004
23. Donnelly N, Hall W, Christie P. The effects of partial decriminalisation on cannabis use in South Australia, 1985 to 1993. *Aust J Public Health*. 1995;19:281–287
24. McGeorge J, Aitken CK. Effects of cannabis decriminalization in the Australian Capital Territory on university students' pattern of use. *J Drug Issues*. 1997;27:785–793
25. Korf DJ. *Dutch Treat: Formal Control and Illicit Drug Use in The Netherlands*. Amsterdam, The Netherlands: Thesis Publishers; 1995
26. MacCoun R, Reuter P. Interpreting Dutch cannabis policy: reasoning by analogy in the legalization debate. *Science*. 1997;278:47–52
27. MacCoun R, Reuter P. Evaluating alternative cannabis regimes. *Br J Psychiatry*. 2001;178:123–128
28. State University of New York at Albany. Press Release February 20, 2001. Available at: http://monitoringthefuture.org/pubs/espad_pr.pdf. Accessed December 17, 2003
29. Institute of Medicine. Introduction. In: Joy JE, Watson SJ, Benson JA, eds. *Marijuana and Medicine: Assessing the Science Base*. Washington, DC: National Academies Press; 1999:13–31
30. American Medical Association. *Medical Marijuana*. Report of the Council on Scientific Affairs (A-01). Chicago, IL: American Medical Association; 2001. Available at: www.ama-assn.org/ama/pub/article/2036-4971.html. Accessed May 7, 2003
31. Johnston LD, O'Malley PM, Bachman JG. Table 2: Trends in annual and 30-day prevalence of use of various drugs for eighth, tenth, and twelfth graders. Available at: www.monitoringthefuture.org/data/03data/pr03t2.pdf. Accessed January 27, 2004
32. Center for Substance Abuse Research. Cigarette advertisements in youth magazines increased by $54 million after Tobacco Master Settlement Agreement. In: *CESAR Fax*. Vol. 9. College Park, MD: Center for Substance Abuse Research, University of Maryland; 2000. Available at: www.cesar.umd.edu/cesar/cesarfax/vol9/9-26.pdf. Accessed May 7, 2003
33. King C III, Siegel M. The Master Settlement Agreement with the tobacco industry and cigarette advertising in magazines. *N Engl J Med*. 2001;345:504–511
34. *Lorillard Tobacco Company v Reilly*. 218 F3d 30 (US Supreme Court 2001)
35. DiFranza JR. State and federal compliance with the Synar Amendment: federal fiscal year 1998. *Arch Pediatr Adolesc Med*. 2001;155:572–578

36. Austin SB, Rich M. Consumerism: its impact on the health of adolescents. *Adolesc Med*. 2001;12:389–409
37. Johnston LD, O'Malley PM, Bachman JG. *Monitoring the Future National Survey Results on Drug Use, 1975–2002. Volume I: Secondary School Students*. Bethesda, MD: National Institute on Drug Abuse; 2003. NIH Publication No. 03-5375
38. MacCoun RJ. Drugs and the law: a psychological analysis of drug prohibition. *Psychol Bull*. 1993;113:497–512
39. Hawkins JD. Risk and protective factors and their implications for preventive interventions for the health care professional. In: Schydlower M, ed. *Substance Abuse: A Guide for Health Professionals*. 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2002:1–19
40. Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention. *Psychol Bull*. 1992;112:64–105
41. Resnick MD, Bearman PS, Blum RW, et al. Protecting adolescents from harm. Findings from the National Longitudinal Study on Adolescent Health. *JAMA*. 1997;278:823–832
42. Kandel DB, Griesler PC, Lee G, Davies M, Schaffran C. *Parental Influences on Adolescent Marijuana Use and the Baby Boom Generation: Findings From the 1979–1996 Household Surveys on Drug Abuse*. Rockville, MD: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Department of Health and Human Services; 2001. Available at: www.SAMHSA.gov/OAS/NHSDA/BabyBoom/cover.htm. Accessed May 7, 2003
43. Lane J, Gerstein D, Huang L, Wright D. *Risk and Protective Factors for Adolescent Drug Use: Findings From the 1997 National Household Survey on Drug Abuse*. Rockville, MD: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Department of Health and Human Services; 2001. Available at: www.samhsa.gov/oas/NHSDA/NAC97/Table_of_Contents.htm. Accessed May 7, 2003
44. Pacula RL, Grossman M, Chaloupka FJ, O'Malley PM, Johnston LD, Farrelly MC. Marijuana and youth. In: Gruber J, ed. *Risky Behavior Among Youths: An Economic Analysis*. Chicago, IL: University of Chicago Press; 2001:271–326
45. Williams J. The effects of price and policy on marijuana use: what can be learned from the Australian experience? *Health Economics* [serial online]. Available at: www3.interscience.wiley.com/cgi-bin/abstract/103520930/START. Accessed May 13, 2003
46. Hall W, Pacula RL. *Cannabis Use and Dependence: Public Health and Public Policy*. Victoria, Australia: Cambridge University Press; 2003
47. Census 2000 supplementary survey profile for United States. Available at: www.census.gov/acs/www/Products/Profiles/Single/2002/ACS/Tabular/010/01000US1.htm. Accessed May 13, 2003
48. American Academy of Pediatrics, Committee on Substance Abuse and Committee on Adolescence. Policy statement: legalization of marijuana: potential impact on youth. *Pediatrics*. 2004;113:1825–1826

All technical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

Legalization of Marijuana: Potential Impact on Youth

Alain Joffe, W. Samuel Yancy and the Committee on Substance Abuse and Committee on Adolescence

Pediatrics 2004;113;632-638
DOI: 10.1542/peds.113.6.e632

This information is current as of February 2, 2005

Updated Information & Services	including high-resolution figures, can be found at: http://www.pediatrics.org/cgi/content/full/113/6/e632
References	This article cites 21 articles, 14 of which you can access for free at: http://www.pediatrics.org/cgi/content/full/113/6/e632#BIBL
Citations	This article has been cited by 1 HighWire-hosted articles: http://www.pediatrics.org/cgi/content/full/113/6/e632#otherarticles
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): **Therapeutics & Toxicology** http://www.pediatrics.org/cgi/collection/therapeutics_and_toxicology
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://www.pediatrics.org/misc/Permissions.shtml
Reprints	Information about ordering reprints can be found online: http://www.pediatrics.org/misc/reprints.shtml

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Prevalence of Marijuana Use Disorders in the United States

1991-1992 and 2001-2002

Wilson M. Compton, MD, MPE
Bridget F. Grant, PhD, PhD
James D. Colliver, PhD
Meyer D. Glantz, PhD
Frederick S. Stinson, PhD

Context Among illicit substance use disorders, marijuana use disorders are the most prevalent in the population. Yet, information about the prevalence of current *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) marijuana use disorders and how prevalence has changed is lacking.

Objective To examine changes in the prevalence of marijuana use, abuse, and dependence in the United States between 1991-1992 and 2001-2002.

Design, Setting, and Participants Face-to-face interviews were conducted in 2 large national surveys conducted 10 years apart: the 1991-1992 National Longitudinal Alcohol Epidemiologic Survey ([NLAES] n=42862) and the 2001-2002 National Epidemiologic Survey on Alcohol and Related Conditions ([NESARC] n=43093).

Main Outcome Measures Rates of past year marijuana use, abuse, and dependence.

Results Among the adult US population, the prevalence of marijuana use remained stable at about 4.0% over the past decade. In contrast, the prevalence of *DSM-IV* marijuana abuse or dependence significantly ($P=.01$) increased between 1991-1992 (1.2%) and 2001-2002 (1.5%), with the greatest increases observed among young black men and women ($P<.001$) and young Hispanic men ($P=.006$). Further, marijuana use disorders among marijuana users significantly increased ($P=.002$) in the absence of increased frequency and quantity of marijuana use, suggesting that the concomitant increase in potency of delta-9-tetrahydrocannabinol (Δ^9-THC) may have contributed to the rising rates.

Conclusions Despite the stability in the overall prevalence of marijuana use, more adults in the United States had a marijuana use disorder in 2001-2002 than in 1991-1992. Increases in the prevalence of marijuana use disorders were most notable among young black men and women and young Hispanic men. Although rates of marijuana abuse and dependence did not increase among young white men and women, their rates have remained high. The results of this study underscore the need to develop and implement new prevention and intervention programs targeted at youth, particularly minority youth.

JAMA. 2004;291:2114-2121 www.jama.com

Marijuana has been the most common illicit substance used in the United States for several decades.[1,2] Understanding changes in the use of marijuana over time is important for a number of reasons. Marijuana use is associated with impaired educational attainment,[3] reduced workplace productivity,[4] and increased risk of use of other substances.[5] Marijuana use plays a major role in motor vehicle crashes[6] and has adverse effects on the respiratory and cardiovascular systems.[7-10]

Marijuana use also is a necessary, although not a sufficient, condition for developing marijuana abuse and dependence as defined in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*), which are clear indicators of problems in and of themselves.[11] *Marijuana abuse* is defined in the *DSM-IV* as repeated instances of use under hazardous conditions, repeated, clinically meaningful impairment in social/occupational/educational functioning, or legal problems related to marijuana use. *Marijuana dependence* is defined in the *DSM-IV* as increased tolerance, compulsive use, impaired control, and continued use despite physical and psychological problems caused or exacerbated by use. Beyond the seriousness of these disorders in their own right, marijuana abuse and dependence increase the risk of other serious consequences, most significantly, major mood, anxiety, and personality psychopathology.[12-14]

Author Affiliations: Division of Epidemiology, Services and Prevention Research, National Institute on Drug Abuse, National Institutes of Health, Department of Health and Human Services (Drs Compton, Colliver, and Glantz), Laboratory of Epidemiology and Biometry, Division of Intramural Clinical and Biological Research, National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health, Department of Health and Human Services (Drs Grant and Stinson), Bethesda, Md.
Corresponding Author: Wilson M. Compton, MD, MPE, Division of Epidemiology, Services and Prevention Research, National Institute on Drug Abuse, 6001 Executive Blvd, MSC 9589, Bethesda, MD 20892-9589 (wcompton@nida.nih.gov)

Despite the seriousness of *DSM-IV* marijuana abuse and dependence, no long-term trend information is available about whether the prevalence of these disorders is increasing, decreasing, or remaining stable in the United States. Such information was recently added to the National Household Survey on Drug Abuse, but this has only been since 2000.[1] For public health efforts, accurate information on changes in potentially vulnerable groups may highlight the need for focused planning on both a national and local level and form the basis of rational, scientifically based prevention and intervention programs. The current study was designed, in part, to address this gap.

To assess changes in marijuana use, abuse, and dependence in the US population, we compared data from the 1991-1992 National Longitudinal Alcohol Epidemiologic Survey ([NLAES] n=42862) and the 2001-2002 National Epidemiologic Survey on Alcohol and Related Conditions ([NESARC] n=43093).[15,16] Both surveys were conducted by the National Institute on Alcohol Abuse and Alcoholism (NIAAA). Because changes in the prevalence of marijuana use may not reflect changes in the prevalence of marijuana use disorders, rates are presented separately for marijuana use and abuse or dependence in the total population. To assess the risk of marijuana abuse or dependence independent of these baseline rates, conditional rates of past-year marijuana abuse or dependence among users also are presented.

METHODS

Samples

Both the 1991-1992 NLAES and the 2001-2002 NESARC are nationally representative samples of the adult population of the United States and have been described in detail elsewhere.[15,16] The target population for each survey was the civilian noninstitutionalized population, 18 years and older, residing in the United States. The fieldwork for both studies was conducted by the US Census Bureau, under the direction of NIAAA staff. For the NESARC, the overall survey response rate was 81% and for the NLAES, 90%.

The NESARC's sample consisted of 655 primary sampling units (PSUs); however, in the final NESARC datafile, only 435 PSUs are shown because smaller PSUs were collapsed to minimize disclosure risks. The NLAES sample consisted of 198 PSUs. Oversampling of blacks and Hispanics in the NESARC and of blacks in the NLAES, completed at the design phase, increased the proportion of each of these groups in the total samples. In the final selection phase, 1 individual was randomly selected from a list of persons living in the household. At this stage of the survey, young adults (ages 18-24 years in the NESARC and ages 18-29 years in the NLAES) were oversampled at a rate of 2.25:1.00.

The complex sampling design necessitated weighting the data from both surveys to reflect the probability of the following: selection of a PSU within stratum, selection of housing units within the sample PSU, oversampling of young adults, and nonresponse at the household and person levels. The NESARC data were also adjusted to reduce the variance arising from selecting 2 PSUs to represent an entire stratum. The weighted data for both groups were then adjusted to be representative of the US population for a variety of socioeconomic variables including region, age, sex, and race/ethnicity using the Decennial Census of Population and Housing (1990 for the NLAES and 2000 for the NESARC). All potential NESARC respondents were informed in writing about the nature of the survey, the statistical uses of the survey data, the voluntary aspect of their participation, and the federal laws that rigorously provided for the strict confidentiality of the identifiable survey information. Those respondents consenting to participate after receiving this information were interviewed. The research protocol, including informed consent procedures, received full ethical review and approval from the US Census Bureau and US Office of Management and Budget.

Interviewers and Training

All interviews for both the NLAES and NESARC were conducted by professional interviewers from the US Census Bureau. On average, the 1000 NLAES and 1800 NESARC interviewers had 5 years of survey administration experience. All completed a 5-day self-study course followed by a 5-day in-person training session at one of the US Census Bureau's 12 regional offices.

Quality of interviewing was ensured by regional supervisors who recontacted a random 10% of all respondents by telephone and reasked a set of 30 questions from different parts of the interview to verify answers.

Diagnostic Assessment

All diagnoses in the NLAES and NESARC were made according to the criteria of the *DSM-IV* using the NIAAA *Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version* (*AUDADIS-IV*), a fully structured diagnostic interview designed for use by professional interviewers who are not clinicians.[17] Although the *DSM-IV* classification was not published until 1994, proposed diagnostic criteria for *DSM-IV* marijuana abuse and dependence were published by the American Psychiatric Association prior to the fieldwork for the NLAES and were incorporated into the *AUDADIS-IV* in their entirety.[18] What was not known at the time was which diagnostic criteria would be assigned to the abuse or dependence categories. However, since all proposed *DSM-IV* diagnostic criteria had been incorporated into the *AUDADIS-IV*, computer algorithms were able to produce diagnoses of abuse and dependence that accurately represented the placement of the criteria within abuse and dependence categories of the final *DSM-IV* revision.

The NLAES and NESARC included the same core questions to assess marijuana abuse and dependence. One minor difference is that, in the NLAES, duration associated with a particular criterion was assessed separately from the criterion itself. For example, if a respondent endorsed a particular criterion symptom for marijuana, the next question asked whether that criterion had happened more than once with marijuana. In the NESARC, duration associated with marijuana abuse and dependence criteria was embedded directly into the symptom questions. Another difference is that, in the NLAES, the *AUDADIS-IV* was administered using a paper-and-pencil instrument, while in the NESARC, the *AUDADIS-IV* was computerized and responses were entered directly into laptop computers. However, in both studies, all questions were asked by highly trained interviewers. Thus, the computerization did not change the way respondents were exposed to the questions.

In the *AUDADIS-IV*, symptom questions associated with *DSM-IV* abuse and dependence were asked separately for marijuana and each other substance. Consistent with *DSM-IV*, past-year diagnoses of marijuana abuse required a respondent to report at least 1 of the 4 criteria of marijuana abuse within the 12 months prior to the interview.[11] These included recurrent marijuana use resulting in failure to fulfill major role obligations, recurrent marijuana use in physically hazardous situations, recurrent marijuana-related legal problems, and continued marijuana use despite having persistent or recurrent social or interpersonal problems caused by or exacerbated by use. The diagnosis of marijuana dependence required that at least 3 criteria from a list of 6 during the preceding 12 months be met: (1) need for increased amounts of marijuana to achieve the desired effect or markedly diminished effect with continued use of the same amount of marijuana; (2) using marijuana in larger amounts or over a longer period than intended; (3) persistent desire or unsuccessful efforts to cut down or reduce marijuana use; (4) a great deal of time spent obtaining, using, or recovering from the effects of marijuana; (5) giving up important social, occupational, or recreational activities in favor of using marijuana; and (6) continued marijuana use despite persistent or recurrent physical or psychological problems caused or exacerbated by use.

Consistent with the *DSM-IV*, diagnoses of marijuana abuse and dependence were mutually exclusive. A marijuana dependence diagnosis preempts a diagnosis of marijuana abuse. Thus, respondents classified with marijuana abuse had marijuana abuse only, and respondents classified as dependent included those who were dependent with and without abuse. Because the *DSM-IV* does not include specific criteria for marijuana withdrawal, no criterion for marijuana withdrawal is included in the diagnosis and the typical list of 7 *DSM-IV* dependence criteria is reduced to 6 criteria for marijuana. While a number of studies have indicated that a withdrawal syndrome can be defined and assessed for marijuana,[19,20] this point has not yet been fully resolved. Our method of diagnosing marijuana dependence is therefore consistent with the *DSM-IV* in its current standard form.

The reliability and validity of the *AUDADIS-IV* are well documented in numerous national and international psychometric studies conducted in clinical, and particularly in general, population studies, the population for which it was designed.[21-32] The psychometric properties of the *AUDADIS-IV* alcohol and drug modules also were shown to be good in numerous countries in the World Health Organization/National Institutes of Health Joint Project on Reliability and Validity.[22,23,28-32]

Data Analysis

To account for the complex sample designs of both the NLAES and NESARC, SUDAAN software was used to estimate standard errors of all prevalence estimates in both studies across sex, age, and race-ethnic subgroups of the population.[33] Prevalence estimates and standard errors, derived separately for the NLAES and NESARC, were compared using *t* tests designed for independent samples. To take into account the sampling design, all standard errors of the prevalence estimates were calculated using SUDAAN, a software program that uses Taylor series linearization to make adjustments for weighted data. In all cases, results are not displayed when standard errors are greater than or equal to 50% of the weighted prevalence because these are too imprecise to be reliable.

RESULTS

Past-Year Marijuana Use

Past-year marijuana use was reported by 4.0% of the respondents in the 1991-1992 NLAES and 4.1% of the respondents in the 2001-2002 NESARC (TABLE 1). Marijuana use did not significantly increase in the full sample or among males or females, or among whites, blacks, or Hispanics overall. However, some subgroups did show significant increases and no subgroups showed significant decreases. Increased rates of marijuana use were observed among 18- to 29-year-old black and Hispanic women. The prevalence of marijuana use also increased significantly over the last decade among 45- to 64-year-old men and women overall and white men and black women in this age group.

Past-Year Marijuana Abuse and Dependence

In both the NLAES and NESARC, past-year marijuana abuse was more common than dependence. For the total population in 1991-1992 (the NLAES), past-year prevalence of marijuana abuse was 0.9% and dependence was 0.3%. Similarly, in 2001-2002 (the NESARC), past-year marijuana abuse was reported by 1.1% and dependence by 0.4%. This pattern of abuse, representing approximately 75% to 80% of the total marijuana use disorder cases, was consistent across age, sex, and race-ethnic subgroups, and all further results are described for combined abuse and dependence rates (TABLE 2). For instance, in the total population, past-year prevalence of marijuana abuse or dependence increased from 1.2% in 1991-1992 to 1.5% in 2001-2002 ($P = .01$). This can be translated into an increase from 2.2 million to 3.0 million, respectively, in terms of population estimates.

While most subgroups showed increases over the decade, these reached statistical significance for females, blacks, Hispanics, and those ages 18 to 29 years and 45 to 64 years overall, for 18- to 29-year-old women, for 45- to 64-year-old men, for black men and women overall, for 18- to-29-year-old black men and women, and for Hispanic men and Hispanics ages 18 to 29 years overall as well as 18- to-29-year-old Hispanic men.

Past-Year Marijuana Abuse and Dependence Among Past-Year Marijuana Users

Among past-year marijuana users, overall rates of past-year abuse or dependence increased from 30.2% in 1991-1992 to 35.6% in 2001-2002 ($P<.01$) (TABLE 3). Almost without exception, the conditional rates of abuse or dependence were larger in the more recent survey, although not all increases were significant. However, significant increases in the prevalence of marijuana abuse or dependence among users were found for both males (33.9% to 38.9%) and females (22.7% to 29.2%), and most notably among 18- to 29-year-old black men (21.8% to 43.0%), 18- to 29-year-old black women (19.1% to 47.2%), and 18- to 29-year-old Hispanic men (29.8% to 53.7%).

COMMENT

The results of this study show that marijuana use in the total adult population has remained substantially unchanged over the decade from 1991-1992 to 2001-2002. However, significant increases in use among some subgroups are important to note, for instance, young black and Hispanic women. In contrast to the results for use among the overall population, rates of abuse or dependence increased from 1991-1992 to 2001-2002. What is perhaps even more significant is that marijuana abuse or dependence increased among marijuana users by 18% from 30.2% in 1991-1992 to 35.6% in 2001-2002.

These results, taken together, suggest that factors affecting addiction potential are operating to produce the increase in prevalence in marijuana abuse or dependence. A number of factors could have led to increases in addiction potential, operating either independently or conjointly. The first is increased marijuana potency. The potency of delta-9-tetrahydrocannabinol

Table 1. Past-Year Prevalence of Marijuana Use, NLAES 1991-1992 and NESARC 2001-2002*

Sociodemographic Characteristic	Men		Women		Total	
	NLAES, % (SE)	NESARC, % (SE)	NLAES, % (SE)	NESARC, % (SE)	NLAES, % (SE)	NESARC, % (SE)
Total	5.5 (0.22)	5.6 (0.24)	2.5 (0.12)	2.6 (0.14)	4.0 (0.13)	4.1 (0.15)
Age group, y						
18-29	12.1 (0.68)	13.3 (0.72)	6.4 (0.37)	7.8 (0.50)†	9.3 (0.41)	10.5 (0.47)†
30-44	6.1 (0.35)	5.8 (0.42)	2.8 (0.20)	2.6 (0.22)	4.4 (0.20)	4.1 (0.24)
45-64	0.8 (0.15)	2.5 (0.26)‡	0.3 (0.07)	0.7 (0.10)‡	0.6 (0.08)	1.6 (0.14)‡
≥65	...	0.1 (0.04)	0.0 (0.00)	0.0 (0.00)	...	0.0 (0.00)
White						
Total	5.7 (0.25)	5.7 (0.29)	2.7 (0.14)	2.6 (0.17)	4.2 (0.15)	4.1 (0.17)
Age group, y						
18-29	13.9 (0.81)	15.1 (0.98)	7.7 (0.50)	8.6 (0.66)	10.8 (0.51)	11.8 (0.61)
30-44	6.5 (0.39)	6.2 (0.53)	3.1 (0.24)	2.9 (0.30)	4.8 (0.23)	4.5 (0.31)
45-64	0.8 (0.17)	2.5 (0.31)‡	0.3 (0.09)	0.6 (0.12)	0.5 (0.09)	1.6 (0.17)‡
≥65	...	...	0.0 (0.00)	0.0 (0.00)	...	...
Black						
Total	6.1 (0.66)	6.9 (0.73)	2.1 (0.26)	3.0 (0.32)†	3.9 (0.34)	4.7 ([illegible])
Age group, y						
18-29	10.4 (1.50)	14.2 (1.94)	3.4 (0.59)	6.8 (0.97)‡	6.6 (0.79)	10.1 (1.03)‡
30-44	6.8 (1.20)	6.4 (1.01)	3.0 (0.51)	3.0 (0.52)	4.7 (0.62)	4.5 (0.51)
45-64	1.8 (0.66)	3.0 (0.76)	0.3 (0.14)	1.1 (0.32)†	1.0 (0.31)	1.9 (0.37)†
≥65	0.0 (0.00)	...	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.2 (0.11)
Hispanic						
Total	3.9 (0.61)	4.6 (0.51)	1.3 (0.25)	2.1 (0.34)	2.6 (0.34)	3.3 (0.31)
Age group, y						
18-29	6.3 (1.22)	8.7 (1.03)	2.7 (0.63)	5.1 (0.90)†	4.5 (0.70)	7.1 (0.71)†
30-44	4.3 (1.13)	3.3 (0.63)	0.8 (0.30)	0.9 (0.30)	2.6 (0.63)	2.1 (0.35)
45-64	...	1.0 (0.32)	...	...	...	0.7 (0.19)
≥65	0.0 (0.0)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Total§	n = 982	n = 996	n = 640	n = 607	n = 1622	n = 1603

Abbreviations: NESARC, National Epidemiologic Survey on Alcohol and Related Conditions; NLAES, National Longitudinal Alcohol Epidemiologic Survey.
*Ellipses indicate that the estimate does not meet precision standard.
†$P<.05$, 1991-1992 compared with 2001-2002.
‡$P<.01$, 1991-1992 compared with 2001-2002.
§Unweighted number of past-year marijuana users in each group.

(Δ^9-THC) in confiscated marijuana from police seizures increased by 66% from 3.08% in 1992 to 5.11% in 2002.[34,35] Average potency of Δ^9-THC in these studies was consistently calculated as the simple arithmetic mean (ie, the sum of the Δ^9-THC concentrations divided by the number of seizures), which is more useful in discerning changes over time relative to normalized averages. This increase could have led to greater addiction potential for marijuana use disorders over the last decade. Moreover, there was no systematic change in the frequency of marijuana use between 1991-1992 and 2001-2002: use every day or nearly every day (18.7% and 21.7%); use 1 to 4 times per week (23.8% and 19.7%); use 1 to 3 times per month (22.6% and 20.2%); and 1 to 11 times per year (34.9% and 38.4%). Similarly, very little change in the usual quantity (ie, number of joints or joint equivalents) of marijuana used on smoking days was observed for each time period: 1 joint (65.6% and 63.7%), 2 to 3 joints (26.9% and 22.0%), 4 to 6 joints (4.0% and 8.1%), and 7 or more joints (3.5% and 6.2%). Increasing rates of marijuana use disorders among marijuana users in the absence of increased quantity and frequency of use strengthens the argument that the increasing rates may be attributable, in part, to increased potency of marijuana.

The increased prevalence of marijuana use disorders among marijuana users also may be due, in part, to increases in marijuana use among the youngest individuals observed in this and other studies (such as the Monitoring the Future and the National Survey of Drug Use and Health studies) during the past decade.[1,2] The early onset of drug use has been consistently associated with greater risk of the development of abuse and dependence.[5,36,37] Thus, the marked increase in marijuana use among the youngest age group may be linked to the increases in abuse and dependence. These factors, combined with factors increasing rates of marijuana use in certain subgroups, are all possible explanations of the increased prevalence in rates of marijuana abuse and dependence among marijuana users.

One of the most striking findings of this study was that the rates of marijuana use disorders did not increase among white young adults (ages 18-29 years), but did increase among young

Table 2. Past-Year Prevalence of *DSM-IV* Marijuana Abuse or Dependence, NLAES 1991-1992 and NESARC 2001-2002*

Sociodemographic Characteristic	Men		Women		Total	
	NLAES, % (SE)	NESARC, % (SE)	NLAES, % (SE)	NESARC, % (SE)	NLAES, % (SE)	NESARC, % (SE)
Total	1.9 (0.14)	2.2 (0.14)	0.6 (0.05)	0.8 (0.07)†	1.2 (0.07)	1.5 (0.08)†
Age group, y						
18-29	5.1 (0.46)	6.4 (0.51)	1.6 (0.18)	2.5 (0.27)‡	3.3 (0.26)	4.4 (0.30)‡
30-44	1.5 (0.16)	1.7 (0.19)	0.6 (0.09)	0.7 (0.11)	1.0 (0.09)	1.2 (0.12)
45-64	0.2 (0.08)	0.7 (0.15)‡		0.2 (0.06)	0.1 (0.04)	0.4 (0.08)‡
≥65	0.0 (0.00)		0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	
White						
Total	2.1 (0.17)	2.1 (0.17)	0.6 (0.06)	0.7 (0.08)	1.3 (0.09)	1.4 (0.10)
Age group, y						
18-29	6.3 (0.60)	7.2 (0.69)	2.0 (0.25)	2.7 (0.37)	4.2 (0.35)	4.9 (0.39)
30-44	1.6 (0.19)	1.7 (0.25)	0.6 (0.60)	0.7 (0.15)	1.1 (0.11)	1.2 (0.15)
45-64		0.7 (0.16)				0.4 (0.08)
≥65	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Black						
Total	1.3 (0.28)	2.6 (0.40)‡	0.4 (0.10)	1.2 (0.22)‡	0.8 (0.14)	1.8 (0.22)‡
Age group, y						
18-29	2.2 (0.71)	6.1 (1.19)‡	0.7 (0.21)	3.2 (0.66)‡	1.4 (0.34)	4.5 (0.67)‡
30-44	1.4 (0.48)	2.3 (0.56)	0.6 (0.23)	1.0 (0.34)	1.0 (0.26)	1.6 (0.30)
45-64						0.4 (0.17)
≥65	0.0 (0.00)		0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	
Hispanic						
Total	0.9 (0.26)	2.0 (0.30)‡	0.3 (0.10)	0.4 (0.10)	0.6 (0.14)	1.2 (0.17)‡
Age group, y						
18-29	1.9 (0.65)	4.7 (0.79)‡	0.6 (0.25)	0.9 (0.27)	1.2 (0.35)	2.9 (0.46)‡
30-44		0.9 (0.41)			0.4 (0.17)	0.5 (0.21)
45-64			0.0 (0.00)			
≥65	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)

Abbreviations: *DSM-IV*, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*; NESARC, National Epidemiologic Survey on Alcohol and Related Conditions; NLAES, National Longitudinal Alcohol Epidemiologic Survey.
*Ellipses indicate that estimate does not meet precision standard.
†$P<.05$, 1991-1992 compared with 2001-2002.
‡$P<.01$, 1991-1992 compared with 2001-2002.

adult black men and women and among young adult Hispanic men. It should also be noted that the prevalences of marijuana use disorders among white young adults have remained high, even though these rates have not significantly increased over the last decade.

The reasons for the rise in marijuana use disorders among these minority youth are not entirely known. Recently, researchers have highlighted the deleterious effects of acculturation on marijuana and other drug use disorders among the growing number of Hispanics faced with adapting to a new culture.[38,39] Lower educational and occupational expectations among minorities have also been implicated in this research. Alternatively, the growing number of minority youth attending college over the last decade might have been exposed to the risks of marijuana use commonly noted among college students, among whom the prevalence of past year marijuana use has increased from 23.0% to 30.0% over the last decade.[40,41]

What is clear is that no single environmental factor can explain the increases in marijuana use disorders observed in this study among certain minority subgroups of the population. Numerous environmental factors, including sociodemographic (increases in single-parent households, urbanicity), socioeconomic (education, income), individual lifestyle (grades, truancy, religious commitment), and economic factors, are all likely to serve as mediators of the observed changes.[42,43] A recent study also has demonstrated that decreases in the perceived risk of harmfulness and in disapproval of marijuana use can explain the recent historic changes in marijuana use among youth.[44] With regard to putative economic factors, recent studies have examined how changes in prices, taxes, and policies affecting tobacco and alcoholic beverages may have had an impact on the prevalence of marijuana use disorders.[44] For example, one study has shown that increases occurring over the past decade in the minimum drinking age had the unintended consequence of increasing marijuana use among high school seniors.[45] Further research on how prices and policies affecting tobacco and alcoholic beverages can affect marijuana use among important subgroups of the population defined in terms of race/ethnicity and other sociodemographic and socioeconomic characteristics is sorely needed and may help

Table 3. Past-Year Prevalence of *DSM-IV* Marijuana Abuse or Dependence Among Past-Year Marijuana Users, NLAES 1991-1992 and NESARC 2001-2002*

Sociodemographic Characteristic	Men		Women		Total	
	NLAES, % (SE)	NESARC, % (SE)	NLAES, % (SE)	NESARC, % (SE)	NLAES, % (SE)	NESARC, % (SE)
Total	33.9 (1.83)	38.9 (1.86)†	22.7 (1.92)	29.2 (2.03)‡	30.2 (1.35)	35.6 (1.37)‡
Age group, y						
18-29	41.6 (2.46)	47.8 (2.66)†	25.4 (2.59)	32.2 (2.78)†	36.0 (1.97)	42.1 (1.97)†
30-44	23.7 (2.22)	29.2 (3.25)	19.6 (2.94)	25.0 (3.81)	22.4 (1.79)	27.9 (2.63)†
45-64	22.1 (8.89)	27.0 (4.83)	...	21.7 (6.99)	16.9 (6.51)	25.8 (4.22)
≥65	0.0 (0.00)	...	...	...	0.0 (0.00)	...
White						
Total	36.7 (2.17)	37.6 (2.34)	22.1 (2.10)	27.9 (2.72)†	31.6 (1.63)	34.4 (1.81)
Age group, y						
18-29	45.7 (2.90)	47.4 (3.29)	25.5 (2.91)	30.8 (3.64)	38.6 (2.36)	41.3 (2.45)
30-44	25.2 (2.52)	27.8 (3.76)	18.2 (3.10)	25.3 (4.73)	22.9 (2.01)	27.0 (3.11)
45-64	19.0 (10.73)	26.1 (5.26)	...	...	...	24.0 (4.48)
≥65	0.0 (0.00)	0.0 (0.00)	...	...	0.0 (0.00)	0.0 (0.00)
Black						
Total	21.6 (4.29)	37.9 (4.76)‡	20.1 (4.27)	39.9 (5.28)‡	21.2 (3.28)	38.6 (3.64)‡
Age group, y						
18-29	21.8 (6.25)	43.0 (7.39)†	19.1 (5.87)	47.2 (6.41)‡	21.0 (4.80)	44.5 (5.16)‡
30-44	21.0 (6.36)	36.7 (6.53)†	21.0 (6.35)	33.5 (9.13)	21.0 (4.76)	35.5 (5.50)†
45-64	24.4 (15.64)	...	...	21.0 (12.88)	...	18.4 (7.74)
≥65	...	61.6 (23.77)	...	0.0 (0.00)	...	61.6 (23.77)
Hispanic						
Total	24.1 (6.22)	44.8 (4.05)‡	22.6 (7.63)	19.3 (4.56)	23.7 (5.11)	37.1 (3.45)†
Age group, y						
18-29	29.8 (8.75)	53.7 (6.77)†	20.5 (8.65)	18.3 (4.94)	27.1 (6.74)	41.8 (4.84)†
30-44	...	26.0 (11.02)	...	...	15.2 (6.41)	24.3 (9.10)
45-64	70.4 (29.45)	...	0.0 (0.00)	...	...	26.6 (11.91)
≥65	...	...	...	...	...	...

Abbreviations: *DSM-IV*, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*; NESARC, National Epidemiologic Survey on Alcohol and Related Conditions; NLAES, National Longitudinal Alcohol Epidemiologic Survey.

*Ellipses indicate that estimate does not meet precision standard.

†$P<.05$, 1991-1992 compared with 2001-2002.

‡$P<.01$, 1991-1992 compared with 2001-2002.

explain the increases observed among minority young adults.

Historical and cultural factors that shape the life history of various racial/ethnic minorities in the United States are potentially equally important in understanding the observed changes. Within this context, future research will need to more fully address the extraordinary heterogeneity within racial/ethnic groups in the search for the explanations of why rates of marijuana use disorders increased among some minority young adults as opposed to white young adults. For example, rates of marijuana use disorders are likely to differ among Mexican Americans, Cuban Americans, and Puerto Rican Americans. It is clear that achieving an understanding of changes in the prevalence of marijuana use disorders among minority young adults will require further research and is an important public health priority.

The results of this study indicate that the vast majority of individuals who use marijuana or have marijuana use disorders are young. Despite this generalization, this study is the first to report significant increases in marijuana use among 45- to 64-year-old men and women combined as well as a modest but significant increase in marijuana abuse or dependence among 45- to 64-year-old men. This indicates that the upper age limit for marijuana use, abuse, and dependence has shifted in a meaningful way. Such a shift is consistent with increased lifetime exposure to marijuana availability in the group who were adolescents in the late 1960s or early 1970s and were ages 45 to 64 years in 2001-2002. Given this shift, the extent to which marijuana use may be a contributing cause of illness in the aging population deserves further research attention.

The major findings from this study have significant research and public health implications. With regard to research, more periodic epidemiologic observational studies are needed to rapidly detect emerging epidemics in marijuana use disorders (and other drug use disorders) as revealed in this study. The apparent epidemic of marijuana use disorders among young adult minorities has possibly been occurring for many years and the failure to detect it sooner lies in the lack of epidemiologic monitoring data. Concerning public health implications, it is important to communicate that the increased potency of marijuana over the past decade may, in part, be responsible for increases in abuse and dependence among users. This is critical information for parents, teachers, peers, physicians, and other health professionals. From a broader public health perspective, the results of this study highlight the need to strengthen existing prevention and intervention efforts and to develop and implement widely new programs with the sex, racial/ethnic, and age differentials observed in this study in mind. Specifically, programs targeting young adults, especially black and Hispanic young adults, need to be designed and tested for their effectiveness as quickly as possible.

Author Contributions: Dr Grant, primary investigator on both the National Longitudinal Alcohol Epidemiologic Survey (NLAES) and the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), had full access to all of the data in this study and takes responsibility for integrity of the data and the accuracy of the data analysis.
Study concept and design: Grant.
Acquisition of data: Grant, Stinson.
Analysis and interpretation of data: Compton, Grant, Colliver, Glantz, Stinson.
Drafting of the manuscript: Compton, Grant.
Critical revision of the manuscript for important intellectual content: Compton, Grant, Colliver, Glantz, Stinson.
Statistical expertise: Grant, Colliver, Stinson.
Obtained funding: Compton, Grant.
Administrative, technical, or material support: Grant, Colliver, Stinson.
Supervision: Grant.
Funding/Support: The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) is funded by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) with supplemental support from the National Institute on Drug Abuse (NIDA).
Role of the Sponsor: All data collection was performed by the US Census Bureau under a contract from the NIAAA. Data analysis and manuscript preparation were completed by the authors of this article, who take responsibility for its content. Both NIAAA and NIDA leadership approval submission of the manuscript.
Disclaimer: The views and opinions expressed in this report are those of the authors and do not necessarily represent the views of the sponsoring agencies or the US government.

REFERENCES

1. Substance Abuse and Mental Health Services Administration. *Results From the 2001 National Household Survey on Drug Abuse. Volume I. Summary of National Findings.* Rockville, Md: Office of Applied Studies; 2002. NHSDA Series H-17, DHHS Publication SMA 02-3758.
2. Johnston LD, O'Malley PM, Bachman JG. *Monitoring the Future National Survey Results on Drug Use, 1975-2002.* Bethesda, Md: National Institute on Drug Abuse; 2003.
3. Lynskey M, Hall W. The effects of adolescent cannabis use on educational attainment: a review. *Addiction.* 2000;95:1621-1630.
4. Lehman WE, Simpson DD. Employee substance abuse and on-the-job behaviors. *J Appl Psychol.* 1992;77:309-321.
5. Lynskey MT, Health AC, Bucholz KK, et al. Escalation of drug use in early onset cannabis users vs co-twin controls. *JAMA.* 2003;289:427-433.
6. National Highway Traffic Safety Administration. *Traffic Safety Facts 2001.* Washington, DC: National Highway Traffic Safety Administration; 2001.
7. Mittleman MA, Lewis RA, Maclure M, Sherwood JB, Muller JE. Triggering myocardial infarction by marijuana. *Circulation.* 2001;103:2805-2809.
8. Polen MR, Sidney S, Tekawa IS, Sadler M, Friedman GD. Healthcare use by frequent marijuana smokers who do not smoke tobacco. *West J Med.* 1993;158:596-601.
9. Tashkin DP. Pulmonary complications of smoked substance abuse. *West J Med.* 1990;152:525-530.
10. Zhang ZF, Morgenstern H, Spitz MR, et al. Marijuana use and increased risk of squamous cell carcinoma of the head and neck. *Cancer Epidemiol Biomarkers Prev.* 1999;8:1071-1078.
11. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.* Washington, DC: American Psychiatric Association; 1994.
12. Brook JS, Cohen P, Brook DW. Longitudinal study of co-occurring psychiatric disorders and substance use. *J Am Acad Child Adolesc Psychiatry.* 1998;37:322-330.
13. Chen CY, Wagner F, Anthony J. Marijuana use and the risk of major depressive episode: epidemiological evidence from the United States National Comorbidity Survey. *Soc Psychiatry Psychiatr Epidemiol.* 2002;37:199-206.
14. Grant BF. Comorbidity between DSM-IV drug use disorders and major depression: results of a national survey of adults. *J Subst Abuse.* 1995;7:481-497.
15. Grant BF, Harford TC, Dawson DA, Chou SP, Dufour M, Pickering RP. Prevalence of DSM-IV alcohol abuse and dependence: United States, 1992. *Alcohol Health Res World.* 1992;18:243-248.
16. Grant, BF, Moore TC, Kaplan K. *Source and Accuracy Statement: Wave 1 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC).* Bethesda, Md: National Institute on Alcohol Abuse and Alcoholism; 2003.
17. Grant BF, Dawson DA, Hasin DS. *The Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version.* Bethesda, Md: National Institute on Alcohol Abuse and Alcoholism; 2001.
18. American Psychiatric Association. *DSM-IV Options Book.* Washington, DC: American Psychiatric Association; 1991.
19. Budney AJ, Hughes JR, Moor BA, Novy PL. Marijuana abstinence effects in marijuana smokers maintained in their home environment. *Arch Gen Psychiatry.* 2001;58:917-924.
20. Budney AJ, Novy P, Hughes JR. Marijuana withdrawal among adults seeking treatment for marijuana dependence. *Addiction.* 1999;94:1311-1322.
21. Canino GJ, Bravo M, Ramírez R, et al. The Spanish Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS): reliability and concordance with clinical diagnoses in a Hispanic population. *J Stud Alcohol.* 1999;60:790-799.
22. Chatterji S, Saunders JB, Vrasti R, Grant BF, Hasin DS, Mager D. The reliability of the Alcohol Use Dis-

orders and Associated Disabilities Interview Schedule-Alcohol/Drug-Revised (AUDADIS-ADR) in India, Romania and Australia. *Drug Alcohol Depend*. 1997;47:171-185.
23. Cottler LB, Grant BF, Blaine J, et al. Concordance of DSM-IV alcohol and drug use disorder criteria and diagnoses as measured by AUDADIS-ADR, CIDI and SCAN. *Drug Alcohol Depend*. 1997;47:195-205.
24. Grant BF. DSM-IV, DSM-III-R and ICD-10 alcohol and drug abuse/harmful use and dependence, United States, 1992: a nosological comparison. *Alcohol Clin Exp Res*. 1996;20:1481-1488.
25. Grant BF, Dawson DA, Stinson FS, Chou PS, Kay W, Pickering R. The Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV (AUDADIS-IV): reliability of alcohol consumption, tobacco use, family history of depression and psychiatric diagnostic modules in a general population sample. *Drug Alcohol Depend*. 2003;71:7-16.
26. Grant BF, Harford TC, Dawson [illegible], Chou PS, Pickering R. The Alcohol Use Disorder and Associated Disabilities Schedule (AUDADIS): reliability of alcohol and drug modules in a g[illegible]eral population sample. *Drug Alcohol Depend*. 19[illegible];39:37-44.
27. Hasin D, Carpenter KM, McCloud S, Smith M, Grant BF. The Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS): reliability of alcohol and drug modules in a clinical sample. *Drug Alcohol Depend*. 1997;44:133-141.
28. Hasin D, Grant BF, Cottler L, Blaine J, Towle L, Ustun B, Sartorius N. Nosological comparisons of alcohol and drug diagnoses: a multisite, multi-instrument international study. *Drug Alcohol Depend*. 1997;47:217-226.
29. Nelson CB, Rehm J, Usten B, Grant BF, Chatterji S. Factor structure for DSM-IV substance disorder criteria endorsed by alcohol, cannabis, cocaine and opiate users: results from the World Health Organization Reliability and Validity Study. *Addiction*. 1999;94:843-855.
30. Pull CB, Saunders JB, Mavreas V, et al. Concordance between ICD-10 alcohol and drug use disorder criteria and diagnoses as measured by the AUDADIS-ADR, CIDI, and SCAN: results of a cross-national study. *Drug Alcohol Depend*. 1997;47:207-216.
31. Ustun B, Compton W, Mager D, et al. WHO study on the reliability and validity of the alcohol and drug use disorder instruments: overview of methods and results. *Drug Alcohol Depend*. 1997;47:161-170.
32. Vrasti R, Grant BF, Chatterji S, et al. Reliability of the Romanian version of the alcohol module of the WHO Alcohol Use Disorder and Associated Disabilities Interview Schedule—Alcohol/Drug-Revised. *Eur Addict Res*. 1998;4:144-149.
33. Research Triangle Institute. *Software for Survey Data Analysis (SUDAAN), Version 8.0*. Research Triangle Park, NC: Research Triangle Institute; 2002.
34. ElSohly MA, Ross SA, Mehmedic Z, Arafat RS, Yi B, Banahan BF. Potency trends of Δ^9-THC and other cannabinoids in confiscated marijuana from 1980-1997. *J Forensic Sci*. 2000;45:24-30.
35. National Center for the Development of Natural Products. *Quarterly Report Potency Monitoring Project, May 9, 2003-August 8, 2003. NIDA Marijuana Project*. University, Miss: Research Institute of Pharmaceutical Sciences, School of Pharmacy, University of Mississippi; 2003.
36. Anthony JC, Petronis KR. Early-onset drug use and risk of later drug problems. *Drug Alcohol Depend*. 1995;40:9-15.
37. Grant BF, Dawson DA. Age of onset of drug use and its association with DSM-IV drug abuse and dependence. *J Subst Abuse*. 1998;10:163-173.
38. Ortega AN, Rosenheck R, Alegria M, Desai RA. Acculturation and the lifetime risk of psychiatric and substance use disorders among Hispanics. *J Nerv Ment Dis*. 2000;188:728-735.
39. Vega WA, Kolody B, Aguilar-Gaxiola S, Alderete E, Catalano R, Caraveo-Anduaga J. Lifetime prevalence of DSM-III-R psychiatric disorders among urban and rural Mexican Americans in California. *Arch Gen Psychiatry*. 1998;55:771-778.
40. US Department of Education. *2001 Fall Enrollment in Colleges and Universities*. Washington, DC: US Dept of Education; 2001.
41. Gledhill-Hoyt J, Lee H, Strote J, Wechsler H. Increased use of marijuana and other illicit drugs at US colleges in the 1990s: results of three national surveys. *Addiction*. 2000;95:1655-1667.
42. Grant BF. Prevalence and correlates of drug use and DSM-IV drug dependence in the United States: results of the National Longitudinal Alcohol Epidemiologic Survey. *J Subst Abuse*. 1996;8:195-210.
43. Brooks JS, Adams RE, Balka EB, Johnson E. Early adolescent marijuana use: risks for transition to young adulthood. *Psychol Med*. 2002;32:79-91.
44. Bachman JG, Johnston LD, O'Malley PM. Explaining recent increases in students' marijuana use: impacts of perceived risks and disapproval, 1976 through 1996. *Am J Public Health*. 1998;88:887-892.
45. DiNardo J, Lemieux T. Alcohol, marijuana, and American youth: the unintended consequences of government regulation. *J Health Econ*. 2001;20:991-1010.

If length of days be thy portion, make it not thy expectation. Reckon not upon a long life: think every day the last, and live always beyond thy account. He that so often surviveth his expectations lives many lives.
—Sir Thomas Browne (1605-1682)

FY 77

ALASKA STATE PLAN

FOR

DRUG ABUSE PREVENTION

Second Revision

CHART S-II-8

[illegible]y Drug of Abuse of Clients Reporting Through the CODAP System

PRIMARY DRUG OF ABUSE	PERCENT OF TOTAL (# of clients)	
	FY 75	FY 76
Heroin	31% (150)	55% (141)
Illegal Methadone	0% (0)	0% (1)
Other Opiates and Synthetics	0% (0)	1% (3)
Alcohol Abuse	31% (153)	12% (31)
Barbiturates	3% (17)	2% (4)
Other Seditives or Hypnotics Tranquilizers	4% (18)	1% (2)
Amphetamines	10% (51)	7% (19)
Cocaine	2% (12)	3% (7)
Marijuana/Hashish	12% (57)	6% (15)
Hallucinogens	4% (21)	2% (5)
Inhalants	1% (4)	0% (0)
Over the Counter	1% (3)	0% (1)
Other	1% (5)	
None		11% (29)
TOTAL	100% (49[illegible])	100% (258)

population areas, and their treatment is geared to hard drug users. This data also reflects the rising occurrence of cocaine in Alaska. As indicated previously, caution should be used in interpreting this data; it reflects those persons in some type of treatment program, which might reflect supply of services and not the in-need population.

TABLE 2.8

PRIMARY DRUG OF ABUSE OF CLIENTS REPORTING THROUGH THE CODAP SYSTEM - FY 1975-1977

	FY 75		FY 76		To Date FY 77	
Number of clients reporting	524		365		199	
Heroin	150	(.29)	209	(.57)	109	(.59)
Alcohol	153	(.29)	38	(.10)	18	(.09)
Barbiturates	17	(.03)	8	(.02)	5	(.02)
Other Sedatives or Hypnotics, Tranquilizers	18	(.03)	3	(.01)		
Amphetamines	51	(.10)	27	(.07)	5	(.02)
Cocaine	12	(.02)	9	(.02)	23	(.12)
Marijuana/Hashish	57	(.11)	26	(.07)	18	(.09)
Hallucinogens	21	(.04)	5	(.01)	2	(.01)
Inhalants	4	(.01)				
Over the Counter	3	(.01)	1	(.01)		
Other	5	(.01)	1	(.01)		
None	33	(.06)	38	(.10)	19	(.10)

Table 2.9 summarizes the admissions and discharges across all drug agencies, and provides an indication of utilization by environment.

Of those persons discharged from the Alaska Psychiatric Institute with a primary diagnosis of "drug abuse", 23 (88.5%) were male and 3 (11.5%) were female. Seventy-three percent of drug-related discharges in Fiscal Year 1977 were Caucasian; Alaska Natives constituted 23% of the drug-related discharges, and all other minorities (including Black, Oriental and Hispanic persons) constituted 4% of drug-related discharges. These figures are roughly consistent with the proportions of these racial/ethnic groups in the general population of Alaska, i.e., Caucasian - 79%, Indian and Alaska Native - 17%, and other - 4%, with the exception that the Alaska Native group appears to be over-represented in the Alaska Psychiatric Institute's drug-related discharges.

Sex differences can be noted among the drug-related discharges. For Caucasians and Alaska Natives, males constituted a substantially greater number of "drug abuse" discharges than did females: 89.5% of Caucasian drug-related were male, and 100.0% of Alaska Native discharges that were drug-related were male. On the other hand, 100.0% of the Other Minority drug-related discharges were female.

These data are consistent with data from other therapeutic agencies, that is, CODAP treatment data, for calendar years 1977 and 1978, in two important respects:

(1) Males in general are over-represented in the client populations compared to their proportion of the general population; and

(2) Among female admissions, white women constitute, by far, the greatest proportions, but minority race women are over-represented compared to their proportion of the general population.

The Alaska Psychiatric Institute data are inconsistent with CODAP treatment data in that Blacks consituted 10% and 12% of total CODAP admissions in 1977 and 1978 respectively, while, at most, they constituted 4% of drug-related discharges from the Alaska Psychiatric Institute.

CODAP TREATMENT DATA

Among therepeutic agencies, e.g., state mental hospitals, private physicians, community mental health organizations and drug treatment programs, the latter, drug treatment programs, are the most important source of incidence data, since they usually provide the largest and most pertinent collections of data pertaining to drug(s) of abuse and the history of their use by clients.

The Client Oriented Data Acquisition Process (CODAP) is a data collection system developed by the National Institute on Drug Abuse for federally funded drug abuse treatment programs. The function of CODAP is to provide routine, e.g., monthly-quarterly-annual, current information about clients in treatment at these programs.

Currently, six programs in Alaska report to the CODAP system on a regular basis (and have so reported for approximately 4-5 years). According to CODAP reports, 131 persons were admitted to treatment in calendar year 1977, and 188 clients were admitted in calendar year 1978.

In 1977 and 1978, as in previous years, the majority of persons admitted to treatment indicated narcotics (heroin, and other opiates and synthetic opiates) as their primary drug problem. Admissions with a primary problem of narcotics accounted for 55.7% of total admissions in 1977. Narcotic drug admissions during 1978 constituted 47.3% of total admissions. These figures represent a decrease from 1976 when 58.9%, or 163 (N=277), clients were admitted to treatment for narcotic drug problem. See Table 31.

Table 31. Admissions by Primary Drug of Abuse, All Programs, 1977-1978.

	1978		1977	
	N	% of Total	N	% of Total
None	15	7.98	3	2.29
Opiates/Synthetic Opiates	89	47.34	73	55.73
Alcohol	18	9.57	15	11.45
Barbiturates/Sedatives & Hypnotics	7	3.72	7	5.34
Amphetamines/Cocaine	24	12.77	12	9.16
Cannabis (Marijuana/Hashish)	19	10.11	12	9.16
Hallucinogens	7	3.72	1	0.76
Tranquilizers	4	2.13	1	0.76
Other (Unspecified)	1	0.53	2	1.53
Not Stated	4	2.13	5	3.82
TOTAL	188	100.0	131	100.0

Source: Therapeutic Agency Data Sources: 3.

Drug types which showed increases in the proportions of admissions during 1977 and 1978 were cocaine; barbiturates, and other sedatives and hypnotics; and marijuana/hashish. In 1976, cocaine was reported as the primary drug of abuse in 6.1% of admissions; this percentage rose to 9.6% in 1978. Marijuana as a primary drug of abuse risen from 8.3% of admissions in 1976 to 10.1% of admissions in 1978. The percentage of barbiturate and other sedatives/hypnotics admissions has doubled during this period: from 2.2% of admissions in 1976 to 5.3% in 1977 and 3.7% in 1978.

Alcohol admissions have remained fairly stable during the years 1976-1978, staying in the 9.5% - 11.5% range.

Females constituted 33.6% of all treatment admissions in 1977; and, 28.2% of all treatment admissions in 1978. See Table 32. It appears from the 1976-1978 data that the 2-to-1 male-female ratio of 1976-1977 is changing to roughly a 3-to-1 relationship at the current time. In contrast to the data on drug related mortality, females who were admitted to treatment in 1977-1978 were largely narcotics users: 73% of females admitted in 1977 reported narcotics as the primary drug of abuse and 60%, in 1978. Although females did not comprise the largest numerical segment of problem users of any of the major drug types, i.e., narcotics, alcohol, amphetamines/cocaine and marijuana females did account for a majority of admissions for barbiturates, sedatives/hypnotics in 1978 and tranquilizers in 1977. The percentages of females admitted for a primary problem with these drugs (combined total) was 11.3% in 1978 and 9.1% in 1977.

Males were also most likely to be admitted for primary problems with narcotics (47% and 42% in 1977 and 1978, respectively), followed by cocaine, alcohol and cannabis.

In 1978, 78% of persons admitted to drug abuse treatment programs were Caucasian; 10% were Black; a total of approximately 11% belonged to the American Indian (2.1%) and Alaska Native (8.5%) sub-classes; and 1% were Hispanic, i.e., Spanish-surnamed. See Table 33. As in CODAP admission data for the period 1976-1977, the 1978 data show that Blacks were admitted to treatment in a proportion much larger than their corresponding proportion of the general population, which is approximately 3%; while Alaska Natives and American Indians are admitted in proportions somewhat smaller than their corresponding proportions of the general population, which are 9.3% and 5.4%, respectively. People of Oriental and other racial/ethnic background constituted approximately 1.3% of Alaska's general population. As there were no Oriental admissions to treatment, it may be inferred that Spanish-surnamed people were slightly over-represented in the treatment population.

Table 33. Client Admissions, by Race/Ethnicity, 1977-1978.

	1978		1977	
	N	%	N	%
White	147	78.2	93	71.0
Black	19	10.1	16	12.2
American Indian	4	2.1	2	1.5
Alaska Native	16	8.5	18	13.7
Hispanic	2	1.1	2	1.5
Total	188	100.0	131	100.0

Source: Therapeutic Agencies Data Sources: 3.

As depicted in Tables 34 and 35, in 1978, narcotics were the leading drug of abuse for clients of all races, with the exception of American Indians; and for all races in 1977, with the exception of Alaska Natives, who had the same number of admissions for primary problems with alcohol as for primary problems with narcotics. Narcotics are the leading drug of abuse for Black clients in particular, e.g., 69% in 1977 and 53% in 1978. As indicated by CODAP data, the second most important drug of abuse for Blacks is cocaine. After narcotics, Caucasian clients are most likely to be admitted for alcohol, cocaine and marijuana. The same pattern of use appears for the American Indian/Alaska Native subclass. All admissions of Spanish-surnamed individuals during 1977-1978 were for narcotics.

Table 34. Primary Drug of Abuse, by Race/Ethnicity, 1978.

	WHITE		BLACK		AMERICAN INDIAN		ALASKA NATIVE		HISPANIC		TOTAL
	N	%	N	%	N	%	N	%	N	%	N
None	13	8.8	1	5.3	1	25.0					15
Opiates	56	38.1	9	47.4			3	18.8	2	100.0	70
Other Opiates/ Synthetics	17	11.6	1	5.3			1	6.3			19
Alcohol	14	9.5	1	5.3	1	25.0	2	12.5			18
Barbituates	3	2.0									3
Other Sedatives/ Hypnotics	4	2.7									4
Amphetamines	5	3.4					1	6.3			6
Cocaine	9	6.3	7	36.8	1	25.0	1	6.3			18
Cannabis	16	10.9			1	25.0	2	12.5			19
Hallucinogens	5	3.4					2	12.5			7
Tranquilizers	4	2.7									4
Other							1	6.3			1
Not Stated	1	0.6					3	18.8			4
Total	147	100.0	19	100.0	4	100.0	16	100.0	2	100.0	188

Source: Therapeutic Agencies Data Sources: 3.

Table 35. Primary Drug of Abuse, by Race/Ethnicity, 1977.

	WHITE		BLACK		AMERICAN INDIAN		ALASKA NATIVE		HISPANIC		TOTAL
	N	%	N	%	N	%	N	%	N	%	N
None	3	3.2									3
Opiates	52	55.9	11	68.8	1	50.0	7	38.9	2	100.0	73
Other Opiates/ Synthetics											0
Alcohol	6	6.5	1	6.3	1	50.0	7	38.9			15
Barbituates	1	1.1									1
Other Sedatives/ Hypnotics	5	5.4	1	6.3							6
Amphetamines	1	1.1					1	5.6			2
Cocaine	6	6.5	2	12.5			2	11.1			10
Cannabis	11	11.8					1	5.6			12
Hallucinogens	1	1.1									1
Tranquilizers	1	1.1									1
Other	1	1.1	1	6.3							2
Not Stated	5	5.4									5
Total	93	100.0	16	100.0	2	100.0	18	100.0	2	100.0	131

Source: Therapeutic Data Sources: 3.

the basis of 1977-1978 data, youngsters fourteen years of age and under and who were admitted to drug abuse treatment programs were most likely to report a primary drug problem with marijuana or stimulants, i.e., amphetamines/cocaine. Those between the ages of fifteen and nineteen were most likely to be admitted for marijuana (44% and 52% in 1977 and 1978, respectively); the next most likely drug of abuse for this age group was the opiates/synthetic opiates class of drugs (31% and 13% in 1977 and 1978, respectively). During the period 1977-1978, persons twenty years and older were admitted for a primary problem of narcotics almost uniformly in every age group, with three exceptions. These three exceptions occurred in the older age groups, as follows:

(1) in the 40-49 year old age group, in 1978, alcohol admissions exceeded narcotics admissions;

(2) in the 35-39 year old age group, in 1977, alcohol admissions exceeded narcotics admissions; and

(3) in the 50-59 year old age group, in 1977, barbiturate/other sedatives and hypnotics admissions exceeded narcotics admissions. See Tables 36 and 37.

Table 36. Primary Drug of Abuse, by Age Group, Percent Distribution, 1978.

	AGE								
DRUG TYPE	0-14	15-19	20-24	25-29	30-34	35-39	40-49	50-59	60+
None		4.3	7.9	10.2	9.5			33.3	
Opiates/Synthetic Opiates		13.0	46.0	52.5	76.2	54.5	33.3	66.7	
Alcohol		4.3	9.5	10.2	9.5		50.0		
Barbiturates/Sedatives & Hypnotics		8.7	3.2	3.4			16.7		
Amphetamines/Cocaine			19.0	15.3		27.3			
Cannabis	100.0	52.2	6.3	1.7					100.0
Hallucinogens		8.7	4.8	1.7		9.1			
Tranquilizers		4.3	1.6	3.4					
Other						9.1			
Not Stated			1.6	1.7	4.8				
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Therapeutic Agencies Data Sources: 3.

Table 37. Primary Drug of Abuse, by Age Group, Percent Distribution, 1977.

	AGE								
DRUG TYPE	0-14	15-19	20-24	25-29	30-34	35-39	40-49	50-59	60+
None			2.2	4.1					
Opiates/Synthetic Opiates		31.3	54.3	63.3	80.0	25.0	100.0		
Alcohol		18.8	8.7	12.2		50.0			
Barbiturates/Sedatives & Hypnotics		6.3	4.3	6.1				100.0	
Amphetamines/Cocaine	100.0		19.6		10.0				
Cannabis		43.8	2.2	4.1	10.0	25.0			
Hallucinogens			2.2						
Tranquilizers				2.0					
Other			2.2	2.0					
Not Stated			4.3	6.1					
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0

Source: Therapeutic Data Sources: 3.

The largest proportion of admissions came from the 20-29 year old age group in 1977 and 1978; in 1977, 72.5% of all clients admitted, and in 1978, 64.9% of all clients admitted, were members of this age group. Twelve percent of admissions in both years were in the 15-19 year old age group. The third leading age category during the period 1977-1978 was the 30-34 year old age group, which accounted for 7.6% of admissions in 1977 and 11.2% of admissions in 1978. See Table 38.

Table 38. Admissions, by Age Group, Number and Percent Distribution, 1977-1978.

AGE	NUMBER	PERCENT	NUMBER	PERCENT
0-14	1	0.5	3	2.3
15-19	23	12.2	16	12.2
20-24	63	33.5	46	35.1
25-29	59	31.4	49	37.4
30-34	21	11.2	10	7.6
35-39	11	5.6	4	3.1
40-49	6	3.2	3	2.3
50-59	3	1.6	1	0.8
60+	1	0.5	0	-0-
TOTAL	188	100.0	131	100.0

Source: Therapeutic Agencies Data Sources: 3.

of-first-use analysis, i.e., that the incidence of heroin use is decreasing.

In the treatment population, heroin is the primary drug problem most frequently in the 25-34 year old age group and among white, black and hispanic admissions.

For the period 1968-1977, narcotics, as a single identifiable class, are not the major cause of death; however, when one includes in narcotics deaths the mixture-of-drugs deaths involving opiates and synthetic opiates, or opiates and other drugs, and alcohol-in-combination-with-drugs which are opiates/synthetic opiates, then narcotics become the second leading cause of death, following the alcohol-in-combination-with-drugs category. Deaths attributable to the single identifiable drug class, narcotics, are rising: in 1975, narcotics deaths constituted 8% of all drug-related deaths; this had risen to 15% in 1976 and to 12% in 1977. Narcotics have caused a more significant number of deaths among males than among females. During the period 1968-1977, 22% of all male deaths were narcotics-related; only 5% of female deaths showed narcotics as the cause of death. During the latest three years of death data, the ratio of male to female narcotics deaths has been 4 to 1.

Narcotics use, although apparently not spreading as rapidly as it once was, still continues to be a major drug problem in Alaska. Narcotics are responsible for the largest number of admissions to treatment related to a single drug type, and are responsible for a sizeable proportion of drug-related mortality.

LICIT DRUGS

In 1977 licit drugs (that is, prescription drugs and over-the-counter drugs) were a factor in approximately 82% of all drug-related deaths. In fact, in 1977, licit drugs, alcohol-in-combination-with-drugs, and narcotics (opiates/synthetic opiates) were the only drugs which caused drug deaths in Alaska.

Within the licit drug category, drugs-in-combination-with-alcohol was the leading cause of death. Sedative/hypnotic drugs, tranquilizers, analgesic/antipyretics (an over-the-counter drug type), and other analgesic drugs, were responsible for equal proportions of deaths, approximately 12% each.

Despite the large percentage of drug-related deaths resulting from licit drugs, admissions to treatment for these drugs were not substantial. In 1978, male admissions for licit drugs amounted to 6.7% of total male admissions. Licit drugs in the treatment context are barbiturates, other sedatives and hypnotics, amphetamines and tranquilizers. The largest share of these male licit drug admissions was for amphetamines.

In 1978, female admissions for licit drugs came to 15.2% of total female admissions. The four types of licit drugs mentioned above each accounted for the same percentage of admissions.

In 1977, admissions for licit drugs were 6.6% of all admissions for males and 11.4% of all admissions for females.

In 1978, the great majority of admissions for licit drugs occurred among persons 29 years old and younger; the same was true of 1977 admissions. Among CODAP admissions, the majority of licit drug abuse appears to occur among whites.

MARIJUANA

Marijuana continued as the leading drug involved in all arrests for drug violations, although, in 1977, the proportion of all drug arrests which were for marijuana (69%) was smaller than in 1976 (76%). Most of these marijuana arrests involved young people under the age of 19 years (63%).

Marijuana seizures have increased markedly in the last four years, going from 446 pounds seized in 1977 (December 1974-November 1974), to 2,615 pounds seized in 1977 (December 1976-November 1977), indicating the increasing availability of marijuana in Alaska, both homegrown and imported. NOTE: In certain areas, Alaska's climate is suitable for outdoor marijuana cultivation.

Marijuana was the third leading drug problem in CODAP treatment program admissions in 1978. Marijuana admissions to treatment programs are increasing, and in 1978 accounted for 10 percent of admissions; fifty-two percent of these 1978 admissions were teenagers between the ages of 15 and 19 years of age. The health indicators available for this needs assessment give no evidence of adverse health consequences from marijuana use.

HALLUCINOGENS

Hallucinogens accounted for a little less than four percent of all CODAP treatment admissions in 1978, and less than one percent in 1977. Persons admitted for hallucinogen problems during 1977 and 1978 were male, and in the 15-24 year old age group, primarily. While PCP use has been reported (in the mass media and elsewhere) to be on the increase among young people in the state, this has not been documented by treatment statistics.

Arrests for hallucinogens were proportionately the same for males and females during the cumulative period, June 1973 through November 1977: 3.7% for males and 3.6% for females. When marijuana arrests are excluded, 13% of male arrests and 10% of female arrests involved hallucinogens; hallucinogens comprise the smallest drug arrest category, ranking behind narcotics, pharmaceuticals (included in sub-class "other non-narcotic drugs") and cocaine.

No deaths due to hallucinogens have been reported during the past ten-year period (provisional data).

INHALANTS

Inhalants were not mentioned by any persons entering drug abuse treatment programs as the primary drug of abuse in 1977 or 1978. During the ten-year period for which drug-related mortality data are available (provisional data), inhalant-caused deaths have been negligible. Casual reports suggest that inhalants are a problem among youth in the rural areas of the state, primarily due to the fact that obtaining more preferred substances is often difficult in remote areas. If this is so, the extent of the inhalant problem is not reflected in statistical data currently available.

Substance Abuse Treatment Admissions by Primary Substance of Abuse, According to Sex, Age Group, Race, and Ethnicity

YEAR=2000

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	No.	5,563	2,695	1,787	194	147	524	31	64	3	53	4	8	9
	%	100.0	48.4	32.1	3.5	2.6	9.4	0.6	1.2	0.1	1.0	0.1	0.1	0.2
SEX														
Male	%	65.1	67.3	67.4	43.8	38.1	68.9	45.2	37.5	66.7	43.4	0.0	62.5	88.9
Female	%	34.9	32.7	32.6	56.2	61.9	31.1	54.8	62.5	33.3	56.6	100.0	37.5	11.1
[illegible]	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
AGE AT ADMISSION														
[illegible] years	%	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.2
[illegible]	%	8.5	3.5	9.6	1.5	2.7	35.3	3.2	0.0	33.3	5.7	0.0	0.0	44.4
[illegible]	%	5.6	4.9	6.3	2.6	1.4	9.9	0.0	3.1	33.3	9.4	0.0	0.0	0.0
[illegible]		9.5	7.9	10.7	8.8	10.2	11.5	12.9	15.6	0.0	11.3	0.0	0.0	22.2
[illegible]		11.3	9.6	12.3	19.6	22.4	9.0	16.1	9.4	33.3	17.0	0.0	37.5	0.0
[illegible] years	%	13.0	11.7	15.1	21.6	16.3	6.9	16.1	21.9	0.0	15.1	50.0	12.5	11.1
[illegible]	%	16.9	17.3	19.0	19.1	15.0	8.4	12.9	12.5	0.0	17.0	25.0	12.5	0.0
[illegible]	%	12.7	15.0	11.8	8.2	15.6	5.5	6.5	17.2	0.0	9.4	25.0	12.5	0.0

[redacted]	[redacted]	7.5	10.2	5.6	5.7	6.8	2.1	9.7	6.3	0.0	5.7	0.0	0.0	0.0
[redacted]	[redacted]	4.1	6.7	2.1	0.0	2.0	0.8	3.2	1.6	0.0	0.0	0.0	0.0	0.0
[redacted]	[redacted]	1.5	2.6	0.6	0.5	0.7	0.2	3.2	0.0	0.0	1.9	0.0	0.0	0.0
[redacted]	[redacted]	1.1	1.8	0.2	0.0	0.0	0.6	3.2	1.6	0.0	0.0	0.0	12.5	0.0
[redacted]	[redacted]	0.7	1.4	0.1	0.0	0.0	0.2	0.0	1.6	0.0	0.0	0.0	0.0	0.0
[redacted]	[redacted]	7.5	7.2	6.6	12.4	[illegible]	9.7	12.9	9.4	0.0	7.5	0.0	12.5	0.0
[redacted]	[redacted]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
[redacted]	[redacted]													
[redacted]	[redacted]	42.0	40.4	40.6	42.8	53.1	44.7	48.4	48.4	100.0	77.4	50.0	75.0	22.2
[redacted]	[redacted]	3.7	1.5	3.2	24.7	14.3	5.7	3.2	3.1	0.0	1.9	0.0	12.5	11.1
[redacted]	[redacted]	48.4	53.5	51.7	22.7	27.2	40.3	0.0	10.9	0.0	15.1	50.0	0.0	66.7
[redacted]	[redacted]	0.7	0.5	0.5	1.5	0.7	1.1	3.2	3.1	0.0	1.9	0.0	0.0	0.0
[redacted]	[redacted]	2.3	2.2	2.1	4.6	2.7	2.1	3.2	1.6	0.0	0.0	0.0	12.5	0.0
[redacted]	[redacted]	3.0	1.9	2.0	3.6	2.0	6.1	41.9	32.8	0.0	3.8	0.0	0.0	0.0
[redacted]	[redacted]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
[redacted]	[redacted]													
[redacted]	[redacted]													

[illegible]	[illegible]	3.0	3.2	2.4	4.6	4.8	3.2	3.2	1.6	0.0	0.0	0.0	0.0	0.0
[illegible]	[illegible]	93.8	93.8	94.7	93.3	91.2	90.3	96.8	95.3	100.0	98.1	100.0	100.0	100.0
[illegible]	[illegible]	3.3	3.0	2.9	2.1	4.1	6.5	0.0	3.1	0.0	1.9	0.0	0.0	0.0
[illegible]	[illegible]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Click here to view descriptions of drug categories

-- Quantity is zero

SOURCE: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS).
Based on administrative data reported by States to TEDS through January 5, 2005.

Substance Abuse Treatment Admissions by Primary Substance of Abuse, According to Sex, Age Group, Race, and Ethnicity

YEAR=2001

		3,986	1,896	1,269	150	99	391	17	54	4	50	2	7	12
		100.0	47.6	31.8	3.8	2.5	9.8	0.4	1.4	0.1	1.3	0.1	0.2	0.3
		63.7	66.8	63.8	42.0	46.5	69.8	47.1	35.2	50.0	52.0	0.0	28.6	33.3
		36.3	33.2	36.2	58.0	53.5	30.2	52.9	64.8	50.0	48.0	100.0	71.4	66.7
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		7.6	2.6	6.5	0.0	0.0	40.2	0.0	0.0	25.0	8.0	0.0	0.0	0.0
		4.2	3.1	4.7	2.0	1.0	8.2	0.0	1.9	50.0	10.0	0.0	0.0	16.7
		10.4	8.1	12.3	10.7	8.1	14.1	11.8	14.8	0.0	22.0	0.0	0.0	0.0
		11.2	9.1	13.6	17.3	19.2	9.0	17.6	14.8	0.0	12.0	0.0	42.9	0.0
		12.8	12.3	14.1	24.7	19.2	5.6	17.6	9.3	0.0	14.0	0.0	28.6	0.0
		16.5	18.5	15.4	21.3	21.2	6.1	17.6	11.1	25.0	24.0	100.0	14.3	41.7
		11.9	14.3	10.7	11.3	9.1	4.6	11.8	25.9	0.0	2.0	0.0	0.0	25.0
		6.9	9.6	5.9	0.0	4.0	2.6	0.0	1.9	0.0	4.0	0.0	0.0	8.3

[redacted]	4.2	6.1	3.1	1.3	3.0	0.8	5.9	3.7	0.0	0.0	0.0	0.0	0.0
[redacted]	2.4	4.2	0.9	0.7	2.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
[redacted]	1.3	2.1	0.6	0.7	2.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
[redacted]	0.9	1.6	0.3	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
[redacted]	9.9	8.6	11.8	10.0	11.1	8.7	17.6	13.0	0.0	4.0	0.0	14.3	8.3
[redacted]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
[redacted]													
[redacted]	44.6	39.9	44.4	46.0	61.6	53.5	64.7	64.8	25.0	80.0	100.0	85.7	83.3
[redacted]	3.4	1.7	2.9	20.0	15.2	5.1	0.0	1.9	0.0	0.0	0.0	0.0	0.0
[redacted]	48.5	55.6	49.7	28.7	20.2	34.8	23.5	20.4	75.0	18.0	0.0	14.3	16.7
[redacted]	0.9	0.7	0.6	2.7	0.0	2.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0
[redacted]	1.4	1.2	1.3	2.7	2.0	2.8	5.9	1.9	0.0	0.0	0.0	0.0	0.0
[redacted]	1.2	0.8	1.0	0.0	1.0	1.8	0.0	11.1	0.0	2.0	0.0	0.0	0.0
[redacted]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	10[illegible]	100.0	100.0	100.0	100.0	100.0
[redacted]	3.2	2.3	3.2	5.3	6.1	4.9	29.4	3.7	0.0	4.0	0.0	0.0	0.0

[redacted]	[redacted]	93.0	94.1	93.5	93.3	90.9	87.0	64.7	94.4	100.0	92.0	100.0	85.7	100.0
[redacted]	[redacted]	3.9	3.6	3.4	1.3	3.0	8.2	5.9	1.9	0.0	4.0	0.0	14.3	0.0
[redacted]	[redacted]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Click here to view descriptions of drug categories

-- Quantity is zero

***SOURCE:** Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS).*

Based on administrative data reported by States to TEDS through January 5, 2005.

Substance Abuse Treatment Admissions by Primary Substance of Abuse, According to Sex, Age Group, Race, and Ethnicity

YEAR=2003

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	No.	4,006	2,108	1,155	71	70	363	16	106	1	1	70	1	9
	%	100.0	52.6	28.8	1.8	1.7	9.1	0.4	2.6	0.0	0.0	1.7	0.0	0.2
SEX														
Male	%	64.2	63.5	66.8	52.1	45.7	79.3	37.5	38.7	100.0	100.0	40.0	100.0	44.4
Female	%	35.8	36.5	33.2	47.9	54.3	20.7	62.5	61.3	0.0	0.0	60.0	0.0	55.6
Total	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
AGE AT ADMISSION														
[illegible]	%	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
[illegible]	%	10.5	3.7	11.5	0.0	1.4	53.7	0.0	2.8	0.0	0.0	10.0	0.0	0.0
[illegible]	%	5.2	3.2	7.5	2.8	7.1	9.1	6.3	3.8	0.0	0.0	2.9	100.0	0.0
[illegible]	%	8.7	6.2	10.4	16.9	14.3	10.5	12.5	19.8	0.0	100.0	15.7	0.0	0.0
[illegible]	%	9.6	6.8	11.5	16.9	12.9	11.3	12.5	17.0	0.0	0.0	30.0	0.0	11.1
[illegible]	%	11.2	10.3	13.0	21.1	21.4	3.6	18.8	16.0	100.0	0.0	21.4	0.0	11.1
[illegible]	%	15.1	15.7	16.6	15.5	20.0	3.6	31.3	11.3	0.0	0.0	12.9	0.0	33.3
[illegible]	%	15.2	19.1	13.3	11.3	8.6	3.3	0.0	17.9	0.0	0.0	2.9	0.0	22.2

11.5	16.0	7.9	9.9	10.0	1.9	6.3	4.7	0.0	0.0	1.4	0.0	11.1
6.6	8.2	6.7	4.2	2.9	1.7	6.3	1.9	0.0	0.0	2.9	0.0	0.0
4.1	6.8	1.3	1.4	1.4	0.6	0.0	0.9	0.0	0.0	0.0	0.0	0.0
1.1	1.9	0.2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	11.1
1.0	1.7	0.1	0.0	0.0	0.3	6.3	1.9	0.0	0.0	0.0	0.0	0.0
0.2	0.2	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
45.2	40.7	44.8	42.3	62.9	56.7	81.3	55.7	0.0	100.0	75.7	0.0	44.4
2.3	1.0	2.4	21.1	14.3	3.3	0.0	0.9	100.0	0.0	2.9	0.0	0.0
49.2	56.5	49.9	28.2	18.6	34.2	0.0	19.8	0.0	0.0	15.7	100.0	55.6
0.8	0.4	1.1	2.8	0.0	1.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0
1.5	1.1	1.3	4.2	4.3	3.0	0.0	1.9	0.0	0.0	1.4	0.0	0.0
1.1	0.2	0.4	1.4	0.0	0.8	18.8	21.7	0.0	0.0	1.4	0.0	0.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Hispanic or Latino	%	2.5	2.1	2.4	11.3	5.7	2.8	0.0	2.8	0.0	0.0	7.1	0.0	0.0
Not Hispanic or Latino	%	96.0	96.7	96.2	87.3	94.3	95.3	100.0	91.5	100.0	100.0	92.9	0.0	88.9
Unknown	%	1.4	1.2	1.4	1.4	0.0	1.9	0.0	5.7	0.0	0.0	0.0	100.0	11.1
Total	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Click here to view descriptions of drug categories

-- Quantity is zero

SOURCE: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS).

Based on administrative data reported by States to TEDS through January 5, 2005.

Substance Abuse Treatment Admissions by Primary Substance of Abuse, According to Sex, Age Group, Race, and Ethnicity

YEAR=2003

[illegible]	No.	4,006	2,108	1,155	71	70	363	16	106	1	1	70	1	9
	%	100.0	52.6	28.8	1.8	1.7	9.1	0.4	2.6	0.0	0.0	1.7	0.0	0.2
[illegible]														
[illegible]	%	64.2	63.5	66.8	52.1	45.7	79.3	37.5	38.7	100.0	100.0	40.0	100.0	44.4
[illegible]	%	35.8	36.5	33.2	47.9	54.3	20.7	62.5	61.3	0.0	0.0	60.0	0.0	55.6
[illegible]	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
[illegible]														
[illegible]	%	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
[illegible]	%	10.5	3.7	11.5	0.0	1.4	53.7	0.0	2.8	0.0	0.0	10.0	0.0	0.0
[illegible]	%	5.2	3.2	7.5	2.8	7.1	9.1	6.3	3.8	0.0	0.0	2.9	100.0	0.0
[illegible]	%	8.7	6.2	10.4	16.9	14.3	10.5	12.5	19.8	0.0	100.0	15.7	0.0	0.0
[illegible]	%	9.6	6.8	11.5	16.9	12.9	11.3	12.5	17.0	0.0	0.0	30.0	0.0	11.1
[illegible]	%	11.2	10.3	13.0	21.1	21.4	3.6	18.8	16.0	100.0	0.0	21.4	0.0	11.1
[illegible]	%	15.1	15.7	16.6	15.5	20.0	3.6	31.3	11.3	0.0	0.0	12.9	0.0	33.3
[illegible]	%	15.2	19.1	13.3	11.3	8.6	3.3	0.0	17.9	0.0	0.0	2.9	0.0	22.2

11.5	16.0	7.9	9.9	10.0	1.9	6.3	4.7	0.0	0.0	1.4	0.0	11.1
6.6	8.2	6.7	4.2	2.9	1.7	6.3	1.9	0.0	0.0	2.9	0.0	0.0
4.1	6.8	1.3	1.4	1.4	0.6	0.0	0.9	0.0	0.0	0.0	0.0	0.0
1.1	1.9	0.2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	11.1
1.0	1.7	0.1	0.0	0.0	0.3	6.3	1.9	0.0	0.0	0.0	0.0	0.0
0.2	0.2	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
45.2	40.7	44.8	42.3	62.9	56.7	81.3	55.7	0.0	100.0	75.7	0.0	44.4
2.3	1.0	2.4	21.1	14.3	3.3	0.0	0.9	100.0	0.0	2.9	0.0	0.0
49.2	56.5	49.9	28.2	18.6	34.2	0.0	19.8	0.0	0.0	15.7	100.0	55.6
0.8	0.4	1.1	2.8	0.0	1.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0
1.5	1.1	1.3	4.2	4.3	3.0	0.0	1.9	0.0	0.0	1.4	0.0	0.0
1.1	0.2	0.4	1.4	0.0	0.8	18.8	21.7	0.0	0.0	1.4	0.0	0.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[illegible]	[illegible]	2.5	2.1	2.4	11.3	5.7	2.8	0.0	2.8	0.0	0.0	7.1	0.0	0.0
[illegible]	[illegible]	96.0	96.7	96.2	87.3	94.3	95.3	100.0	91.5	100.0	100.0	92.9	0.0	88.9
[illegible]	[illegible]	1.4	1.2	1.4	1.4	0.0	1.9	0.0	5.7	0.0	0.0	0.0	100.0	11.1
[illegible]	[illegible]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Click here to view descriptions of drug categories

-- Quantity is zero

SOURCE: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS).

Based on administrative data reported by States to TEDS through January 5, 2005.

Drug-Taking Behavior Among School Aged Youth

The Alaska Experience and Comparisons with Lower-48 States

Bernard Segal, PhD

figures the name of each substance has been abbreviated. The following is a list of the abbreviations to help interpret the data when the findings are presented graphically: MJ = Marijuana, CK = Cocaine, CR = Crack, ST = Stimulants, HL = Hallucinogens, DP = Depressants, HR = Heroin, IN = Inhalants, TQ = Tranquilizers, AL = Alcohol, and TB = Cigarettes.

A. PREVALENCE AND PATTERNS OF DRUG-TAKING BEHAVIOR

1. Opportunity to Try Drugs

Drugs cannot be experienced unless there is an opportunity to try them. Data addressing the opportunity to try drugs convey an indication of the availability of drugs, what trends in use may be present and, by extrapolation, information about the extent which those who have a chance to try a drug do so. Figure 4-1 describes how many adolescents in the sample indicated having had an opportunity to try any of the different chemical substances, except for alcohol and tobacco. Both weighted and unweighted results are provided in the table. The sample was weighted to adjust for differences in community representation.

A comparison of the actual (unweighted) and projected (weighted) findings shows that the differences between them tend to be small, suggesting that the actual sample is representative of the population sampled, except for sampling error. The following discussion is therefore based on the unweighted or actual sample results, as is the interpretation of other findings unless noted otherwise.

What can be observed from the data in Figure 4-1 is that opportunity to try different chemical substances is pervasive, but with some variations. Marijuana is the drug most in evidence (70.1 percent), followed by inhalants (44.9 percent). Just less than two-fifths (39.3 percent) of the sample reported an opportunity to try cocaine. Stimulants are next, with 36.4 percent of the sample having indicated an opportunity to try them. Reports on the opportunity to try the remaining substances are less extensive, but over a quarter of the sample had an opportunity to try hallucinogens (23.1 percent), and

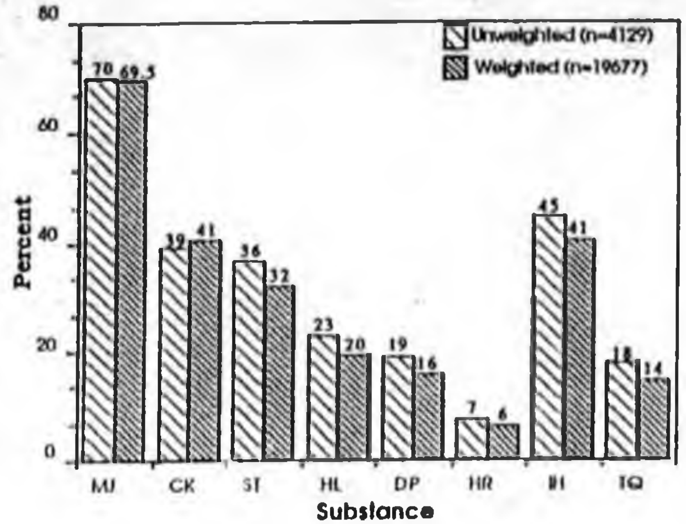


FIGURE 4-1. Opportunity to Try Chemical Substances Weighted and U weighted Comparison, Total Sample, 1988 (Figures are rounded to neare whole.)

less than a fifth indicated a chance to try depressants (18.6 percen or tranquilizers (17.6 percent). Last among the opportunity to t was heroin, with 7.4 percent of the sample noting an opportunity try it.

2. Opportunity to Try and Trying a Drug

An important piece of information related to the opportunity try a drug is the number of students who did try a substance wh the chance arose. Table 4-1 reports the percent of students wl indicated that they tried a substance when they had an opportunit As noted from the data, except for crack and heroin, over half tl students tried one of the substances when an opportunity occurre Consistent with its level of apparent availability, three-quarte (75.9 percent) of those who had an opportunity to try marijuana d so. Stimulants are the next highest tried substance, with two-thir (66 percent) of the sample showing that they tried it when a chan arose. Over half of those who had a chance to try cocaine (52 pe

Alaska Natives Combating Substance Abuse and Related Violence Through Self-Healing

Prepared For
The Alaska Federation of Natives

by

The Center for Alcohol and Addiction Studies
The Institute for Circumpolar Health Studies

ICHS

University of Alaska Anchorage
3211 Providence Drive
DPL-Suite 530
Anchorage, Alaska 99508

January 1999

physical or biological factors then the cure must also be of the spirit. (p. 1)

Alcoholism and Co-Existing (Co-Morbid) Disorders

Although the high level of drinking and alcohol-related problems among Alaska Natives has been well documented (see above), almost no research has been undertaken that described causal factors, clinical features, and behavioral correlates of alcohol dependence among members of this ethnic group. In order to learn more about how alcohol affects Alaska Natives, Segal and Hesselbrock (1997a) have been collecting data from clients entering three inpatient alcoholism treatment facilities in Anchorage. The information gained from this on-going study helps to further an understanding of some of the causes and of the course and consequences of alcohol dependence among Alaska Natives.

As of the fall of, 1997, a total of 261 Alaska Native clients were studied, of whom 54% were male, and 46% female. Their average age was 33.1 years (SD=8.5), ranging between 18 to 58 years. The mean age for males was 33.0 years (SD=8.4), and 33.2 (SD=8.6) for females; the age differences were not statistically significant.

The ethnic distribution was as follows: Aleut 23%, Yup'ik Eskimo, 19%, Tlingit Indian, 11%, Inupiat Eskimo, 17%, Athabascan Indian, 26%, Haida, 2%, Tsimshian, 1%, and mixed heritage, 1%. The relationship between gender and ethnicity was not statistically significant.

One of the most important findings, in addition to the severity of their drinking problems, was that a large proportion of men and women also presented other forms of drug dependence, as well as co-morbid or coexisting disorders. Forty-four percent of the cases, for example, were also dependent on cocaine, while 63% were also dependent on marijuana. Significantly more men (60%) than women (40%) exhibited marijuana dependence, while significantly more women (54%) than men (46%) manifested cocaine dependence.

Drug and Alcohol Services Information System

The DASIS Report

October 15, 2004

Adolescent Treatment Admissions: 1992 and 2002

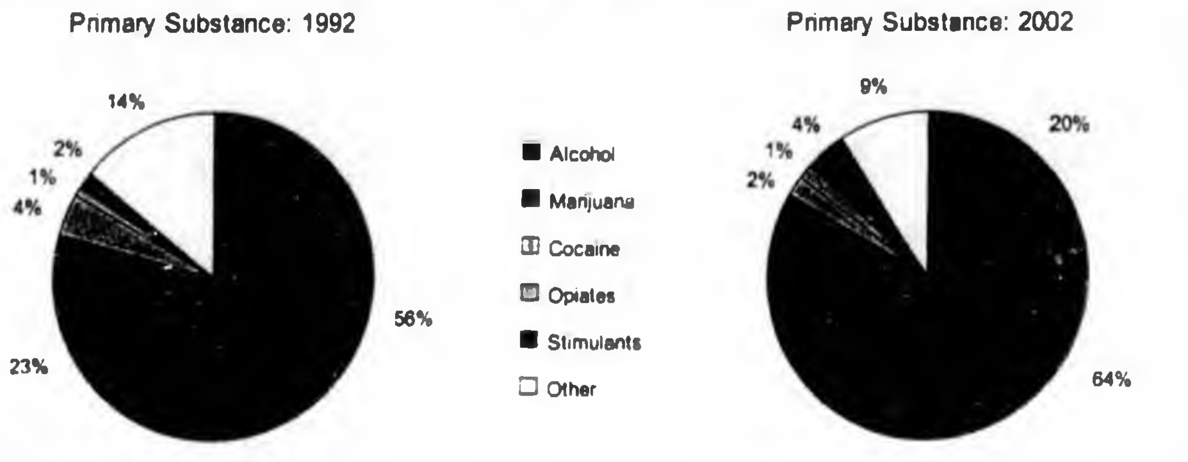
In Brief

- Between 1992 and 2002, the number of adolescent treatment admissions increased 65 percent, while all admissions increased 23 percent
- Between 1992 and 2002, adolescent admissions reporting marijuana as the primary substance increased from 23 to 64 percent, while admissions reporting alcohol as the primary substance decreased from 56 to 20 percent of all adolescent admissions
- In 2002, more than half (54 percent) of adolescent admissions were referred to treatment through the criminal justice system compared with 40 percent in 1992

This report looks at adolescent treatment admissions (aged 12 to 17) reported to the Treatment Episode Data Set (TEDS) in 1992 and 2002. TEDS is an annual compilation of data on the demographic characteristics and substance abuse problems of those admitted for substance abuse treatment. Between 1992 and 2002, the number of adolescent treatment admissions increased 65 percent (from 95,000 admissions in 1992 to 156,000 in 2002) and accounted for 8 percent of all admissions to TEDS in 2002, while all admissions increased 23 percent. TEDS data indicate that the overall increase in adolescent admissions for substance abuse treatment was attributable mainly to the increase in admissions where marijuana was reported as the primary substance of abuse.[1]

The DASIS Report is published periodically by the Office of Applied Studies, Substance Abuse and Mental Health Services Administration (SAMHSA). All material appearing in this report is in the public domain and may be reproduced or copied without permission from SAMHSA. Additional copies of this report or other reports from the Office of Applied Studies are available on-line: http://www.oas.samhsa.gov. Citation of the source is appreciated. For questions about this report please e-mail: shortreports@samhsa.hhs.gov.

Figure 1. Primary Substance of Abuse among Adolescent Treatment Admissions: 1992 and 2002



Source: 2002 SAMHSA Treatment Episode Data Set (TEDS)

Primary Substance

During the 10-year time period from 1992 to 2002, alcohol and marijuana were the two most frequently reported primary substances of abuse among adolescents. However, their relative proportions reversed over time. In 1992, 56 percent of adolescent admissions reported alcohol as their primary substance of abuse, and 23 percent reported marijuana (Figure 1). By 2002, the proportion of adolescents reporting alcohol as their primary substance of abuse had decreased to 20 percent while that reporting primary marijuana had increased to 64 percent. This increase of 41 percent was mainly due to an influx of adolescent admissions referred by the criminal justice system who reported marijuana as the primary substance.[2] In 1992, about 8,500 (or 9 percent) of all adolescent treatment admissions were referred by the criminal justice system and reported marijuana as their primary substance. By 2002, that number had increased to 52,700, representing about 34 percent of all adolescent admissions.

Demographic Characteristics

The proportion of adolescent admissions that were female decreased from 34 percent in 1992 to 30 percent in 2002. However, among all admissions, the proportion of females increased from 28 to 30 percent.

The racial/ethnic characteristics of adolescent admissions changed somewhat between 1992 and 2002 (Figure 2). Adolescent admissions in 1992 were about 68 percent White, 16 percent Black, and 11 percent Hispanic. By 2002, the percentage of adolescent admissions who were White had decreased to 60 percent, while the percentage of adolescent admissions who were Black and Hispanic had increased (Blacks 19 percent, Hispanics 15 percent).

Referral Source

In 2002, more than half (54 percent) of adolescent admissions were referred to treatment through the criminal justice system compared with 40 percent in 1992 (Figure 3).[3] The percentage of school referrals decreased from 18 percent in 1992 to 11 percent in 2002 and self/individual referrals remained stable around 18 percent for this 10-year period.

Type of Criminal Justice Referral

About one-third (16) of States and jurisdictions reporting to TEDS collected data on the type of criminal justice referral in both 1992 and 2002.[4] Among adolescent admissions referred by the criminal justice system, probation/parole referrals were the most common type of criminal justice system referral in both 1992 (48 percent) and 2002 (65 percent) (Figure 4). State/Federal court was the second largest type of criminal justice referral source among adolescent admissions (32 percent in 1992 and 18 percent in 2002).

Figure 2. Race/Ethnicity of Adolescent Treatment Admissions: 19[illegible] and 2002

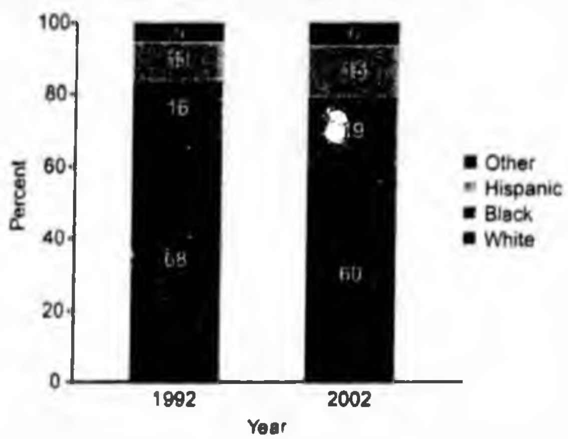
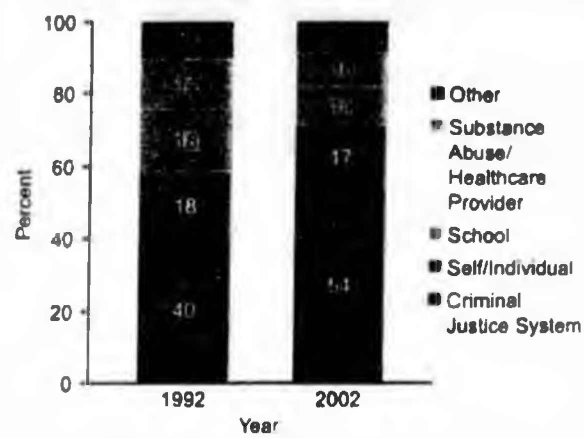


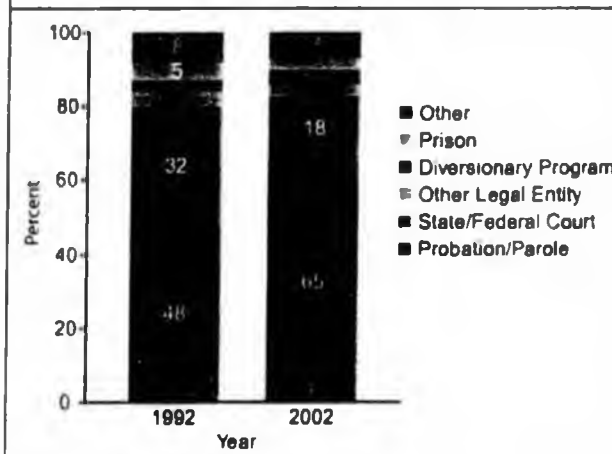
Figure 3. Referral Source for Adolescent Treatment Admissions: 1992 and 2002



Services

Among adolescent admissions, the percentage of admissions receiving ambulatory services[5] increased from 78 percent in 1992 to 83 percent in 2002. Admissions receiving rehabilitation/residential services decreased from 19 to 15 percent during this same time period. The percentage of admissions for detoxification services remained relatively constant at around 2 to 3 percent of total adolescent admissions.

Figure 4. Criminal Justice Referrals for Adolescents, by Type: 1992 and 2002



End Notes

[1] The primary substance of abuse is the main substance reported at the time of admission.

[2] For a more detailed report on treatment referral among adolescent marijuana users, see Substance Abuse and Mental Health Services Administration, Office of Applied Studies. *The DASIS report: Treatment referral sources for adolescent marijuana users.* Rockville, MD, March 29, 2002.

[3] For more detail regarding referrals by the criminal justice system, see Substance Abuse and Mental Health Services Administration, Office of Applied Studies. *The DASIS report: Substance abuse treatment admissions referred by the criminal justice system: 2002.* Rockville, MD, July 30, 2004.

[4] *Detailed criminal justice referral* is a Supplemental Data Set item reported with a 75 percent or higher response rate in 1992 and 2002 by 16 States including: CO, HI, KS, MA, MD, ND, NJ, NM, NV, NY, OH, OR, PA, RI, TX, and WV.

[5] Service settings are of three types: ambulatory, residential/rehabilitative, and detoxification. Ambulatory settings include intensive outpatient, non-intensive outpatient, and ambulatory detoxification. Residential/rehabilitative settings include hospital (other than detoxification), short-term (30 days or fewer), and long-term (more than 30 days). Detoxification includes 24-hour hospital inpatient and 24-hour free-standing residential.

The Drug and Alcohol Services Information System (DASIS) is an integrated data system maintained by the Office of Applied Studies, Substance Abuse and Mental Health Services Administration (SAMHSA). One component of DASIS is the Treatment Episode Data Set (TEDS). TEDS is a compilation of data on the demographic characteristics and substance abuse problems of those admitted for substance abuse treatment. The information comes primarily from facilities that receive some public funding. Information on treatment admissions is routinely collected by State administrative systems and then submitted to SAMHSA in a standard format. TEDS records represent admissions rather than individuals, as a person may be admitted to treatment more than once. State admission data are reported to TEDS by the Single State Agencies (SSAs) for substance abuse treatment. There are significant differences among State data collection systems. Sources of State variation include completeness of reporting, facilities reporting TEDS data, clients included, and treatment resources available. See the annual TEDS reports for details. Approximately 1.9 million records are included in TEDS each year.

The DASIS Report is prepared by the Office of Applied Studies, SAMHSA; Synectics for Management Decisions, Inc., Arlington, Virginia; and by RTI International in Research Triangle Park, North Carolina (RTI International is a trade name of Research Triangle Institute).

Information and data for this issue are based on data reported to TEDS through March 1, 2004.

Access the latest TEDS reports at: http://www.oas.samhsa.gov/dasis.htm
Access the latest TEDS public use files at: http://www.oas.samhsa.gov/SAMHDA.htm
Other substance abuse reports are available at: http://www.oas.samhsa.gov

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Substance Abuse and Mental Health Services Administration
Office of Applied Studies
www.samhsa.gov

National Survey on Drug Use and Health

The NSDUH Report

September 24, 2004

Risk and Protective Factors for Substance Use among American Indian or Alaska Native Youths

In Brief

- American Indian or Alaska Native youths were more likely to perceive moderate to no risk of substance use
- A larger percentage of American Indian or Alaska Native youths did not perceive strong parental disapproval of youth substance use than youths in other racial/ethnic groups
- American Indian or Alaska Native youths were more likely to believe that all or most of the students in their school get drunk at least once a week

Recent reports have shown higher rates of substance use among American Indians or Alaska Natives compared with persons from other racial/ethnic groups. Among American Indian or Alaska Native youths aged 12 to 17, the rates of past month cigarette use, binge drinking, and illicit drug use were higher than those from other racial/ethnic groups.[1,2] The National Survey on Drug Use and Health (NSDUH) collects data on a variety of risk and protective factors found to be associated with youth substance use. Risk factors for substance use typically are associated with an increased likelihood of substance use (e.g., drug availability), whereas protective factors are associated with a decreased likelihood of substance use (e.g., perceived parental disapproval of alcohol or drug use). Research has shown similar associations with risk and protective factors and substance use among American Indian or Alaska Native youths compared with youths in other racial/ethnic groups.[3,4]

The NSDUH Report (formerly **The NHSDA Report**) is published periodically by the Office of Applied Studies, Substance Abuse and Mental Health Services Administration (SAMHSA). All material appearing in this report is in the public domain and may be reproduced or copied without permission from SAMHSA. Additional copies of this report or other reports from the Office of Applied Studies are available on-line: http://www.oas.samhsa.gov. Citation of the source is appreciated.

Table 1. Percentages of Youths Aged 12 to 17 Reporting Individual and Peer Risk and Protective Factors, by Race/Ethnicity: 2002 and 2003 Annual Averages

Factor	American Indian or Alaska Native	Other Racial/ Ethnic Groups
Risk[4]		
Perceived Moderate to No Risk if		
Smoke 1 or More Packs of Cigarettes Per Day	46.7[b]	36.3
Smoke Marijuana Once or Twice a Week	57.5[b]	46.9
Have 4 or 5 Alcoholic Drinks Once or Twice a Week	67.8[a]	61.6
Peers Do Not Disapprove if		
Smoke 1 or More Packs of Cigarettes Per Day	20.0	15.0
Smoke Marijuana Once or Twice a Week	22.3	19.7
Have 1 or 2 Alcoholic Drinks Nearly Every Day	21.2	17.2
Protective[5]		
Participation in Youth Activities		
2 or more	73.8[b]	85.7
Religiosity		
Attended Religious Services 25 or More Times in the Past Year	18.4[b]	33.0
Religious Beliefs Are a Very Important Part of Life	71.8[a]	77.5
Religious Beliefs Influence How Youths Make Decisions	64.0	68.7
Important for Friends to Share Religious Beliefs	38.9	35.2

Table 2. Percentages of Youths Aged 12 to 17 Reporting Family Risk and Protective Factors, by Race/Ethnicity: 2002 and 2003 Annual Averages

Factor	American Indian or Alaska Native	Other Racial/ Ethnic Groups
Risk[4]		
Parents Do Not Strongly Disapprove if		
Smoke 1 or More Packs of Cigarettes Per Day	17.9[b]	10.3
Try Marijuana Once or Twice	15.7[a]	10.7
Have 1 or 2 Alcoholic Drinks Nearly Every Day	15.2[a]	11.2
Parental Monitoring		
Parents Seldom/Never Provided Help With Homework	22.6	18.8
Parents Seldom/Never Limited Amount of Time Out with Friends on School Nights	33.8	29.3
Parents Seldom/Never Made Youth Do Chores Around House	11.9	12.6
Parents Seldom/Never Limited Amount of Time Watching Television	64.6	62.8
Protective[5]		
Parent-Child Communication		
Talked to at Least 1 Parent about Dangers of Substance Use	54.6	58.5
Parental Encouragement		
Parents Let Youth Know They Had Done a Good Job	84.1	85.8
Parents Told Youth They Were Proud of Something They Had Done	84.5	85.3

This report looks at risk and protective factors for substance use among 46,310 respondents aged 12 to 17 (representing a national population of 25 million) comparing American Indian or Alaska Native youths with youths among all other racial/ethnic groups combined. The focus is on American Indian or Alaska Native youths and their higher levels of risk factors or lower levels of protective factors compared with youths of other races. Three categories of risk and protective factors were examined: individual/peers, family, and school. All estimates are annual averages based on combined 2002 and 2003 NSDUH data.

Individual and Peer Risk and Protective Factors

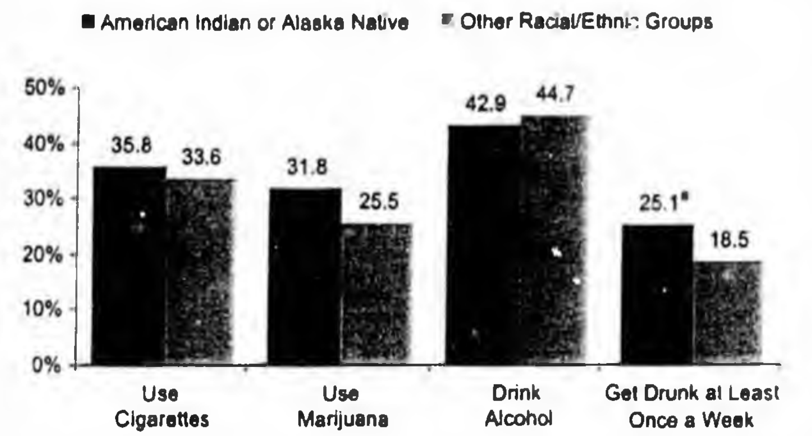
Individual and peer risk factors studied included low perceived risk in using substances and peer approval of substance use. A larger percentage of American Indian or Alaska Native youths perceived moderate to no risk of substance use compared with youths in other racial/ethnic groups (Table 1).[5] For example, 47 percent of American Indian or Alaska Native youths believed there was moderate to no risk in smoking one or more packs of cigarettes per day compared with only 36 percent of youths in other racial/ethnic groups. Although a larger percentage of American Indian or Alaska Native youths perceived their peers did not disapprove of smoking one or more packs of cigarettes per day, smoking marijuana once or twice a week, or having one or two alcoholic drinks nearly every day compared with youths in other racial/ethnic groups, the differences were not statistically significant.

Individual and peer protective factors studied were participation in youth activities and the importance of religious beliefs.[5] American Indian or Alaska Native youths were less likely to have participated in two or more youth activities than youths in other racial/ethnic groups. A smaller percentage of American Indian or Alaska Native youths attended religious services on a regular basis than youths in other racial/ethnic groups. Fewer American Indian or Alaska Native youths also agreed that religious beliefs are a very important part of their lives compared with youths in other racial/ethnic groups.

Family Risk and Protective Factors

A larger percentage of American Indian or Alaska Native youths did not perceive strong parental disapproval of youth substance use compared with youths in other racial/ethnic groups (Table 2).[5] For example, 18 percent of

Figure 1. Percentages of Youths Aged 12 to 17 Reporting Substance Use by All or Most of the Students In Their School,[a] by Race/Ethnicity: 2002 and 2003 Annual Averages



American Indian or Alaska Native youths felt their parents would not strongly disapprove if they were to smoke one or more packs of cigarettes per day compared with 10 percent of youths in other racial/ethnic groups. American Indian or Alaska Native youths were about as likely to have spoken with at least one of their parents about the dangers of substance use (55 percent) as youths from other racial/ethnic groups (59 percent).[5]

School Risk Factors

An important risk factor for youths is poor school performance. A similar proportion of American Indian or Alaska Native youths (9 percent) and youths in other racial/ethnic groups (6 percent) reported a D or lower average for the past semester or grading period.

Another risk factor for youths is the belief that the majority of their peers are using cigarettes, alcohol, or illicit drugs. American Indian or Alaska Native youths were equally as likely as youths in other racial/ethnic groups to report that most or all of the students in their school grade use cigarettes, use marijuana, or drink alcohol (Figure 1).[5] However, a greater percentage of American Indian or Alaska Native youths (25 percent) believed that all or most of the students in their school grade get drunk at least once a week than youths in other racial/ethnic groups (19 percent).

End Notes

1. Office of Applied Studies, Substance Abuse and Mental Health Services Administration (2003, May 16). Substance use among American Indians or Alaska Natives. *The NSDUH Report*. [Available at http://www.oas.samhsa.gov/facts.cfm]

2. Office of Applied Studies. (2004). *Results from the 2003 National Survey on Drug Use and Health: National findings* (DHHS Publication No. SMA 04-3964, NSDUH Series H-25). Rockville, MD: Substance Abuse and Mental Health Services Administration.

3. Moncher, M. S., Holden, G. W., & Trimble, J. E. (1990). Substance abuse among Native American youth. In G. A. Marlatt & G. R. VandenBos (Eds.), *Addictive behaviors: Readings on etiology, prevention, and treatment* (pp. 841-856). Washington, DC: American Psychological Association.

4. Lane, J., Gerstein, D., Huang, L., & Wright, D. (2001). *Risk and protective factors for adolescent drug use: Findings from the 1997 National Household Survey on Drug Abuse* (DHHS Publication No. SMA 01-3499, Analytic Series A-12). Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies. [Available at http://www.oas.samhsa.gov/analytic.htm]

5. Specific questions regarding youth risk and protective behaviors can be found in: Office of Applied Studies, Substance Abuse and Mental Health Services Administration. (2003, March). *2003 National Survey on Drug Use and Health: CAI specs for programming, English version* [PDF, March 2003], pgs. 154 and 234-240. Retrieved August 26, 2004, from http://www.oas.samhsa.gov/nhsda/methods.cfm#2k4

Figure and Table Notes

[a] Difference between American Indian or Alaska Native estimate and Other Racial/Ethnic Groups estimate is statistically significant at the 0.05 level.

[b] Difference between American Indian or Alaska Native estimate and Other Racial/Ethnic Groups estimate is statistically significant at the 0.01 level.

Source: SAMHSA, 2002 and 2003 NSDUH.

The National Survey on Drug Use and Health (NSDUH) is an annual survey sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA). Prior to 2002, this survey was called the National Household Survey on Drug Abuse (NHSDA). The 2002 and 2003 data are based on information obtained from 135,910 persons aged 12 or older, including 665 American Indian or Alaska Native youths aged 12 to 17. The survey collects data by administering questionnaires to a representative sample of the population through face-to-face interviews at their place of residence.

The NSDUH Report is prepared by the Office of Applied Studies (OAS), SAMHSA, and by RTI International in Research Triangle Park, North Carolina. (RTI International is a trade name of Research Triangle Institute.)

Information and data for this report are based on the following publications and statistics:

Office of Applied Studies. (2003). *Results from the 2002 National Survey on Drug Use and Health: National findings* (DHHS Publication No. SMA 03-3836, NSDUH Series H-22). Rockville, MD: Substance Abuse and Mental Health Services Administration.

Office of Applied Studies. (2004). *Results from the 2003 National Survey on Drug Use and Health: National findings* (DHHS Publication No. SMA 04-3964, NSDUH Series H-25). Rockville, MD: Substance Abuse and Mental Health Services Administration.

Also available online: http://www.oas.samhsa.gov

Because of improvements and modifications to the 2002 NSDUH, estimates from the 2002 and 2003 surveys should not be compared with estimates from the 2001 or earlier versions of the survey to examine changes over time.

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Substance Abuse & Mental Health Services Administration
Office of Applied Studies
www.samhsa.gov

Table 3.1b (continued)
Admissions by sex, race/ethnicity, and age at admission, according to primary substance of abuse: TEDS 2002
Percent distribution

[Based on administrative data reported to TEDS by all reporting States and jurisdictions. See Table 4.2.]

Sex, race/ethnicity, and age at admission	*No. of admissions*	*Primary substance at admission*															*Total*
		Alcohol		*Opiates*		*Cocaine*			*Stimulants*								
		Alcohol only	*With secondary drug*	*Heroin*	*Other opiates*	*Smoked cocaine*	*Other route*	*Marijuana/hashish*	*Methamphetamine/amphetamine*	*Other stimulants*	*Tranquilizers*	*Sedatives*	*Hallucinogens*	*PCP*	*Inhalants*	*Other/none specified*	
Age at admission																	
Under 15 years	30,467	5.7	10.0	0.3	0.3	0.4	0.5	55.4	2.0	0.1	0.2	0.1	0.3	*	0.7	23.8	100.0
15 to 19 years	205,202	9.0	15.9	3.8	0.9	1.5	1.8	54.8	5.6	0.1	0.3	0.2	0.5	0.2	0.2	5.4	100.0
15 to 17 years	128,930	6.8	14.4	1.1	0.5	0.8	1.3	63.4	4.2	0.1	0.3	0.2	0.5	0.1	0.2	6.3	100.0
18 to 19 years	76,272	12.8	18.5	8.3	1.7	2.6	2.6	40.1	8.0	0.1	0.4	0.2	0.5	0.3	0.1	3.9	100.0
20 to 24 years	242,486	15.5	18.5	14.7	2.7	4.4	3.3	25.6	10.2	0.1	0.4	0.2	0.3	0.4	0.1	3.7	100.0
25 to 29 years	211,963	18.1	18.5	17.2	3.1	8.1	4.1	15.2	10.6	0.1	0.4	0.2	0.2	0.4	*	3.7	100.0
30 to 34 years	258,007	19.5	20.8	17.2	2.8	13.2	4.6	8.6	9.0	0.1	0.4	0.2	0.1	0.2	*	3.3	100.0
35 to 39 years	303,074	23.4	22.5	16.5	2.3	14.8	4.5	5.5	6.6	0.1	0.4	0.2	*	0.2	*	2.9	100.0
40 to 44 years	280,746	28.7	22.1	16.8	2.5	13.3	3.9	4.0	4.9	0.1	0.4	0.3	0.1	0.1	*	2.8	100.0
45 to 49 years	185,365	35.4	19.4	19.2	2.8	10.1	2.9	3.1	3.2	0.1	0.5	0.3	*	0.1	*	2.9	100.0
50 to 54 years	92,147	42.8	16.8	19.8	2.7	7.4	2.2	2.4	1.9	*	0.5	0.3	*	*	*	3.1	100.0
55 to 59 years	39,152	55.3	13.3	14.8	2.1	5.2	1.8	1.7	1.4	*	0.5	0.2	*	*	*	3.6	100.0
60 to 64 years	16,340	66.3	9.3	10.8	1.8	4.0	1.2	1.1	0.6	*	0.7	0.2	*	*	*	3.9	100.0
65 years and over	11,054	72.0	7.9	7.4	2.0	2.2	0.7	1.1	0.7	0.1	1.0	0.4	*	*	*	4.4	100.0

* Less than 0.05 percent.

SOURCE: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS) - 3.01.04

Table 5.1a
Admissions aged 12-17 by primary substance of abuse: TEDS 1992-2002
Number

[Based on administrative data reported to TEDS by all reporting States and jurisdictions. See Table 4.2.]

Primary substance	*Number*										
	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Total	95,017	95,271	109,123	122,910	129,859	131,194	139,129	137,783	138,660	146,012	156,367
Alcohol	53,416	46,915	43,065	37,996	37,538	35,747	36,566	35,450	33,386	32,847	31,921
Alcohol only	26,379	21,275	17,926	14,096	12,768	11,537	11,489	11,115	10,519	10,814	10,407
Alcohol w/secondary drug	27,037	25,640	25,139	23,900	24,770	24,210	25,077	24,335	22,867	22,033	21,514
Cocaine	3,852	3,041	3,500	3,196	3,286	3,106	3,632	3,171	2,636	2,622	2,925
Smoked cocaine	1,861	1,600	2,026	1,623	1,469	1,296	1,627	1,369	1,121	1,044	1,119
Non-smoked cocaine	1,991	1,441	1,474	1,573	1,817	1,810	2,005	1,802	1,515	1,578	1,806
Opiates	834	874	1,161	1,273	1,440	1,995	2,141	2,115	1,992	2,060	2,222
Heroin	724	754	944	1,119	1,259	1,830	1,967	1,873	1,607	1,462	1,515
Other opiates/synthetics	110	120	217	154	181	165	174	242	385	598	707
Non-RX methadone	25	19	20	39	42	24	23	36	38	38	45
Other opiates/synthetics	85	101	197	115	139	141	151	206	347	560	662
Marijuana/hashish	21,899	30,742	46,572	63,403	72,601	74,639	81,650	82,797	85,888	91,022	98,499

Continued. See notes at end of table.

Table 5.1a (continued)
Admissions aged 12-17 by primary substance of abuse: TEDS 1992-2002
Number

[Based on administrative data reported to TEDS by all reporting States and jurisdictions. See Table 4.2.]

Primary substance	*Number*										
	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Stimulants	1,390	1,907	3,166	4,983	3,106	4,622	4,400	3,468	4,328	5,351	6,182
Methamphetamine	743	1,159	2,078	3,472	2,160	3,402	3,298	2,543	3,152	3,956	4,745
Other amphetamines	440	560	923	1,330	679	1,045	917	787	980	1,149	1,250
Other stimulants	207	188	165	181	267	175	185	138	196	246	187
Other drugs	4,484	3,986	3,933	4,069	3,427	3,167	3,709	4,696	4,578	4,722	3,360
Tranquilizers	81	75	79	97	93	131	148	225	274	418	413
Benzodiazepine	43	45	45	60	54	66	64	131	155	255	253
Other tranquilizers	38	30	34	37	39	65	84	94	119	163	160
Sedatives/hypnotics	110	92	80	96	95	115	116	120	167	220	268
Barbiturates	38	36	42	44	25	39	32	28	47	53	56
Other sedatives/hypnotics	72	56	38	52	70	76	84	92	120	167	212
Hallucinogens	1,645	1,208	1,116	1,430	1,269	1,059	892	1,107	1,015	880	684
PCP	247	255	301	299	235	179	133	180	169	161	192
Inhalants	1,812	1,734	1,566	1,298	983	895	745	615	534	475	456
Over-the-counter	104	94	153	127	95	101	86	89	88	174	173
Other	485	528	638	722	657	687	1,589	2,360	2,331	2,394	1,174
None reported	9,142	7,806	7,726	7,990	8,461	7,918	7,031	6,086	5,852	7,388	11,258

SOURCE: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS) - 3.01.04.

Table 5.1b
Admissions aged 12-17 by primary substance of abuse: TEDS 1992-2002
Percent distribution

[Based on administrative data reported to TEDS by all reporting States and jurisdictions. See Table 4.2.]

Primary substance	*Percent distribution*										
	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Alcohol	56.2	49.2	39.5	30.9	28.9	27.2	26.3	25.7	24.1	22.5	20.4
Alcohol only	27.8	22.3	16.4	11.5	9.8	8.8	8.3	8.1	7.6	7.4	6.7
Alcohol w/secondary drug	28.5	26.9	23.0	19.4	19.1	18.5	18.0	17.7	16.5	15.1	13.8
Cocaine	4.1	3.2	3.2	2.6	2.5	2.4	2.6	2.3	1.9	1.8	1.9
S ed cocaine	2.0	1.7	1.9	1.3	1.1	1.0	1.2	1.0	0.8	0.7	0.7
Non-smoked cocaine	2.1	1.5	1.4	1.3	1.4	1.4	1.4	1.3	1.1	1.1	1.2
Opiates	0.9	0.9	1.1	1.0	1.1	1.5	1.5	1.5	1.4	1.4	1.4
Heroin	0.8	0.8	0.9	0.9	1.0	1.4	1.4	1.4	1.2	1.0	1.0
Other opiates/synthetics	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5
Non-RX methadone	*	*	*	*	*	*	*	*	*	*	*
Other opiates/synthetics	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4
Marijuana/hashish	23.0	32.3	42.7	51.6	55.9	56.9	58.7	60.1	61.9	62.3	63.0

Continued. See notes at end of table.

Table 5.1b (continued)
Admissions aged 12-17 by primary substance of abuse: TEDS 1992-2002
Percent distribution

[Based on administrative data reported to TEDS by all reporting States and jurisdictions. See Table 4.2.]

Primary substance	*Percent distribution*										
	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Stimulants	1.5	2.0	2.9	4.1	2.4	3.5	3.2	2.5	3.1	3.7	4.0
Methamphetamine	0.8	1.2	1.9	2.8	1.7	2.6	2.4	1.8	2.3	2.7	3.0
Other amphetamines	0.5	0.6	0.8	1.1	0.5	0.8	0.7	0.6	0.7	0.8	0.8
Other stimulants	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1
Other drugs	4.7	4.2	3.6	3.3	2.6	2.4	2.7	3.4	3.3	3.2	2.1
Tranquilizers	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3
Benzodiazepine	*	*	*	*	*	0.1	*	0.1	0.1	0.2	0.2
Other tranquilizers	*	*	*	*	*	*	0.1	0.1	0.1	0.1	0.1
Sedatives/hypnotics	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Barbiturates	*	*	*	*	*	*	*	*	*	*	*
Other sedatives/hypnotics	0.1	0.1	*	*	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hallucinogens	1.7	1.3	1.0	1.2	1.0	0.8	0.6	0.8	0.7	0.6	0.4
PCP	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Inhalants	1.9	1.8	1.4	1.1	0.8	0.7	0.5	0.4	0.4	0.3	0.3
Over-the-counter	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other	0.5	0.6	0.6	0.6	0.5	0.5	1.1	1.7	1.7	1.6	0.8
None reported	9.6	8.2	7.1	6.5	6.5	6.0	5.1	4.4	4.2	5.1	7.2

* Less than 0.05 percent.

SOURCE: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, Treatment Episode Data Set (TEDS) - 3.01.04.

FY 77

ALASKA STATE PLAN

FOR

DRUG ABUSE PREVENTION

Second Revision

Table 3.1b
Admissions by sex, race/ethnicity, and age at admission, according to primary substance of abuse: TEDS 2002
Percent distribution

[Based on administrative data reported to TEDS by all reporting States and jurisdictions. See Table 4.2.]

Sex, race/ethnicity, and age at admission	No. of admissions	Primary substance at admission: Alcohol: Alcohol only	Alcohol: With secondary drug	Opiates: Heroin	Opiates: Other opiates	Cocaine: Smoked cocaine	Cocaine: Other route	Marijuana/ hashish	Stimulants: Methamphetamine/ amphetamine	Stimulants: Other stimulants	Tranquilizers	Sedatives	Hallucinogens	PCP	Inhalants	Other/ none specified	Total
Total	1,882,584	23.6	19.3	15.2	2.4	9.3	3.5	15.1	6.6	0.1	0.4	0.2	0.1	0.2	0.1	3.8	100.0
Sex																	
Male	1,315,587	25.8	20.4	14.9	1.9	7.9	3.4	16.3	5.3	0.1	0.3	0.2	0.2	0.2	0.1	3.4	100.0
Female	565,354	18.6	16.8	15.9	3.7	12.8	3.8	12.3	9.8	0.1	0.7	0.4	0.1	0.2	0.1	4.6	100.0
Race/ethnicity																	
White (non-Hispanic)	1,097,962	28.5	19.5	12.3	3.6	5.3	2.8	14.2	8.4	0.1	0.6	0.3	0	0.1	0.1	3.9	100.0
Black (non-Hispanic)	446,946	12.4	21.2	15.3	0.5	22.5	4.8	17.7	0.7	0.1	0.1	0.1	0.1	0.4	*	4.1	100.0
Hispanic origin	236,652	20.8	15.3	29.5	0.7	5.0	4.5	14.2	7.6	0.1	0.3	0.1	0.1	0.4	0.1	1.3	100.0
Mexican	97,407	28.6	12.1	18.8	0.5	4.0	3.8	15.9	14.5	0.1	0.2	0.1	0.1	0.5	0.2	0.6	100.0
Puerto Rican	81,782	9.3	18.8	48.8	0.7	4.8	4.5	10.7	0.6	*	0.4	0.2	0.1	0.2	*	1.0	100.0
Cuban	5,470	25.0	15.0	13.9	1.0	11.7	10.4	16.9	2.1	*	0.3	0.2	0.3	0.5	0.1	2.5	100.0
Other/not specified	51,993	24.1	15.8	20.9	0.8	6.5	5.1	16.2	6.5	0.2	0.2	0.1	0.1	0.5	0.1	2.8	100.0
Other	83,635	28.3	19.7	10.9	1.6	4.9	2.4	15.6	12.9	0.1	0.2	0.2	0.2	0.3	0.1	2.7	100.0
Alaska Native	5,139	40.4	22.7	17.9	2.8	3.0	1.7	7.6	2.7	0.1	0.2	0.1	0.1	0.2	*	0.6	100.0
American Indian	34,324	37.8	25.1	4.8	1.4	3.1	1.8	13.6	8.6	0.1	0.2	0.1	0.1	0.1	0.2	2.9	100.0
Asian/Pacific Islander	16,552	19.0	13.6	8.3	1.8	7.2	2.1	20.0	25.1	0.1	0.2	0.2	0.3	0.1	*	1.9	100.0
Other	27,620	19.9	16.0	18.6	1.4	6.2	3.5	16.9	12.7	0.1	0.3	0.2	0.2	0.5	*	3.5	100.0

Continued. See notes at end of table.

Alaska Natives Combating Substance Abuse and Related Violence Through Self-Healing

Prepared For
The Alaska Federation of Natives

by

The Center for Alcohol and Addiction Studies
The Institute for Circumpolar Health Studies

ICHS

University of Alaska Anchorage
3211 Providence Drive
DPL-Suite 530
Anchorage, Alaska 99508

January 1999

physical or biological factors then the cure must also be of the spirit. (p. 1)

Alcoholism and Co-Existing (Co-Morbid) Disorders

Although the high level of drinking and alcohol-related problems among Alaska Natives has been well documented (see above), almost no research has been undertaken that described causal factors, clinical features, and behavioral correlates of alcohol dependence among members of this ethnic group. In order to learn more about how alcohol affects Alaska Natives, Segal and Hesselbrock (1997a) have been collecting data from clients entering three inpatient alcoholism treatment facilities in Anchorage. The information gained from this on-going study helps to further an understanding of some of the causes and of the course and consequences of alcohol dependence among Alaska Natives.

As of the fall of, 1997, a total of 261 Alaska Native clients were studied, of whom 54% were male, and 46% female. Their average age was 33.1 years (SD=8.5), ranging between 18 to 58 years. The mean age for males was 33.0 years (SD=8.4), and 33.2 (SD=8.6) for females; the age differences were not statistically significant.

The ethnic distribution was as follows: Aleut 23%, Yup'ik Eskimo, 19%, Tlingit Indian, 11%, Inupiat Eskimo, 17%, Athabascan Indian, 26%, Haida, 2%, Tsimshian, 1%, and mixed heritage, 1%. The relationship between gender and ethnicity was not statistically significant.

One of the most important findings, in addition to the severity of their drinking problems, was that a large proportion of men and women also presented other forms of drug dependence, as well as co-morbid or coexisting disorders. Forty-four percent of the cases, for example, were also dependent on cocaine, while 63% were also dependent on marijuana. Significantly more men (60%) than women (40%) exhibited marijuana dependence, while significantly more women (54%) than men (46%) manifested cocaine dependence.

Initiation of Marijuana Use: Trends, Patterns, and Implications

Joseph C. Gfroerer
Li-Tzy Wu
Michael A. Penne

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Substance Abuse and Mental Health Services Administration
Office of Applied Studies

Highlights

Estimates of first-time drug use, referred to as incidence or initiation, provide an important measure of the Nation's drug use problem. They suggest emerging patterns of use and identify periods of heightened risk for an immediate focus on the prevention of substance use, particularly among children and youths. Incidence data also suggest the future burden on substance abuse treatment systems. This report contains an analysis of the initiation of marijuana use. Marijuana is the most widely used illicit drug in the United States and is, in most cases, the first illicit drug used by persons who have used an illicit drug. The analysis is based on data from the 1999 and 2000 National Household Surveys on Drug Abuse (NHSDAs). Selected findings are given below:

- An estimated 2.0 million Americans aged 12 or older used marijuana for the first time in 1999. This was fewer than the estimated number of new users in 1998 (approximately 2.5 million Americans), but still above the 1989 and 1990 levels (1.4 million each year).

- The rate of marijuana initiation increased during the late 1960s and early 1970s, with a peak in 1976 and 1977 (21.0 per 1,000 potential new users). After that period, the rate of new marijuana use decreased to 8.5 in 1990, followed by an increase to 16.8 in 1996, then a decrease to 13.6 in 1999.

- The trend in marijuana incidence since 1965 followed the same general pattern for males and females, although rates for females were consistently below rates for males. In 1999, the rates of new use per 1,000 potential new users were 15.5 for males and 12.1 for females.

- The rates of first marijuana use among American Indians/Alaska Natives were higher than for other racial/ethnic groups during the 1990s. Unlike the overall trend in rates, which showed a peak in 1996, the trend for American Indians/Alaska Natives indicated a continuing increase, reaching 46.5 per 1,000 potential new users in 1999.

- The mean age at first marijuana use was 19 years in the early 1970s and decreased to 17 years in the 1990s. The trends for males and females were parallel, with males initiating at an earlier age than females, on average. The average age of new marijuana users in 1999 was 16.4 years for males and 17.6 years for females.

- These average annual incidence rates varied slightly across different States and age groups. Colorado, Delaware, Massachusetts, New Hampshire, and Vermont were ranked in the top 10 for the overall age group (ages 12 or older), the youth age group (ages 12 to 17), and the young adult age group (ages 18 to 25). New Mexico had the highest rate for the overall and youth age groups. Minnesota had the highest rate for the overall and young adult age groups. By comparison, Louisiana had the lowest rate of recent new users for the overall, youth, and young adult age groups. Texas and Utah had the lowest rates of recent initiation among youths and young adults.

- Among recent initiates of marijuana (first use in 1998 or 1999), nearly three quarters had first used between the ages of 13 and 18. More than a quarter initiated use at age 14 or younger.

- Approximately 60 percent of recent initiates had used both alcohol and cigarettes prior to their first use of marijuana. About 9 percent had never used alcohol or cigarettes at the time of first marijuana use, and the remaining recent initiates had used either alcohol only (16.6 percent) or cigarettes only (14.8 percent).

- The average number of marijuana initiates per day during 1998 and 1999 was highest in June and July. For females, the months with the highest rates of initiation were January and July. On average during 1998 and 1999, there were 3,197 male initiates and 2,989 female initiates per day. Among males, the number of daily initiates increased to approximately 4,300 in June and July. Among females, the estimated initiates per day rose to 3,625 in July and 3,519 in January.

- Prior use of alcohol or cigarettes was highly correlated with becoming a new marijuana user. Among persons aged 12 to 25 who had never used marijuana, those who had smoked cigarettes were an estimated 6 times more likely than nonsmokers to initiate marijuana use within 1 year. Alcohol users were an estimated 7 to 9 times more likely than nonusers to start using marijuana within a year. Daily cigarette smoking was associated with a twofold increase in risk for marijuana initiation.

- Initiation of marijuana use before age 15 was associated with a greater risk of other drug use behaviors at age 26 or older. These behaviors include heroin use, cocaine use, nonmedical psychotherapeutic use, daily or almost daily marijuana use, and weekly use of illicit drugs other than marijuana.

- Initiation of marijuana use before age 15 was associated with a greater risk of illicit drug dependence or abuse at age 26 or older. Relative to adults who had initiated marijuana use at age 21 or older, adults who had first used before age 15 were 6 times as likely to be dependent on an illicit drug.

1. Introduction

1.1 Purpose of the Report

Estimates of first-time drug use, referred to as incidence or initiation, provide an important measure of the Nation's drug use problem. They suggest emerging patterns of use and identify periods of heightened risk for an immediate focus on the prevention of substance use, particularly among children and youths. Incidence data also suggest the future burden on substance abuse treatment systems.

This report contains an analysis of the initiation of marijuana use. Marijuana is the most widely used illicit drug in the United States and is in most cases the first illicit drug used by persons who have used an illicit drug. The analysis is based on data from the 1999 and 2000 National Household Surveys on Drug Abuse (NHSDAs). Overall estimates of the prevalence and rate of marijuana initiation based on combined 1999 and 2000 data were released in September 2001 (Office of Applied Studies [OAS], 2001b). Those results showed that, although there was a decrease in incidence from 2.6 million new users in 1996 to 2.0 million in 1999, these levels were still significantly higher than the levels in 1990 (1.4 million). The purpose of this report is to present more in-depth analyses of incidence rates among population subgroups, demographic characteristics and predictors of recent initiates, and consequences of early marijuana initiation. Specifically, this report has four objectives:

- estimate incidence rates and trends of marijuana use,
- provide State-specific incidence estimates,
- identify characteristics and predictors of recent marijuana initiates, and
- examine the relationship between early marijuana use and later drug use patterns.

The report is organized into seven chapters and two appendices. Chapter 2 describes the data source, measures of key study variables, and statistical methods. Chapter 3 presents incidence rates and trends of marijuana use based on the combined 1999 and 2000 computer-assisted interviewing (CAI) data. Chapter 4 summarizes incidence rates by State using small area estimation (SAE) methods. Chapter 5 examines social and demographic characteristics of recent marijuana initiates and predictors of initiation. This chapter also examines the relationship of marijuana initiation with school status, employment, and marital status among those aged 18 to 25 years. Chapter 6 addresses the relationship between early marijuana use and later drug use patterns, including lifetime and past year use of heroin, cocaine, and psychotherapeutics nonmedically; heavy marijuana use; heavy illicit drug use other than marijuana; abuse of and/or dependence on alcohol or other drugs; marijuana dependence; illicit drug dependence other than marijuana; illicit drug dependence; and alcohol dependence. Chapter 6 also reports findings on the relationship between the age at onset of marijuana use and past year drug dependence among lifetime marijuana users aged 26 or older who also used marijuana in the past year. Chapter 7 provides a summary of overall findings and conclusions and discusses some implications. Appendix A discusses the statistical methods used and the limitations of the NHSDA data, describes the statistical methods for calculating incidence rates and potential biases associated with incidence estimates, and discusses the change in NHSDA measures of substance use initiation and its impact on incidence rate calculation. Appendix B presents selected standard error tables for population estimates in the report. Appendix C provides selected questionnaire pages from the 1999 and 2000 NHSDAs on the demographic and marijuana questions.

1.2 Background on Marijuana Use and Initiation of Marijuana Use

1.2.1 Recent Trends in Use

Marijuana is the most widely used illicit drug in the United States (OAS, 2001b). According to the 2000 NHSDA, an estimated 14.0 million Americans were current (past month) marijuana users (OAS, 2001b). This represents 6.3 percent of people aged 12 or older and 76 percent of current illicit drug users. Of all current illicit drug users, approximately 59 percent used only marijuana, 17 percent used marijuana and another illicit drug, and the remaining 24 percent used only an illicit drug other than marijuana in the past month (OAS, 2001b).

The NHSDA and the Monitoring the Future (MTF) have shown generally similar long-term trends in the prevalence of substance use among youths, regardless of substantial differences in methodology between the two primary surveys of youth substance use. Between 1999 and 2000, both the NHSDA and MTF found no significant changes in lifetime, past year, and current use of marijuana (Johnston, O'Malley, & Bachman, 2001; OAS, 2001b).

The MTF found that marijuana use rose particularly sharply among 8^{th} graders in the 1990s, with annual prevalence tripling between 1991 and 1996 (i.e., from 6 to 18 percent) (Johnston et al., 2001). Starting a year later, marijuana use also rose significantly among 10^{th} and 12^{th} graders. Following the recent peak in 1996-1997, annual marijuana use declined somewhat in recent years (Johnston et al., 2001).

1.2.2 Prior Studies of Marijuana Initiation

Although the prevalence of marijuana use has been studied widely, relatively few incidence (first use) data are available. In the first published analysis of national incidence trends, Gfroerer and Brodsky (1992) estimated the number of new users of marijuana and other drugs based on combined data of 1985 to 1991 NHSDAs. They found that fewer than half a million people per year began using marijuana before 1966 and that new use of marijuana began increasing after 1966, reaching a peak in 1973 and declining thereafter. Johnson, Gerstein, Ghadialy, Choi, and Gfroerer (1996) studied the incidence of alcohol, cigarettes, and illicit drugs using data from the 1991 to 1993 NHSDAs. Their investigation found declining trends of marijuana initiation at all ages since at least the late 1970s. However, the mean age of marijuana initiates declined throughout most of the measurement period, from older than 19 years in the mid-1960s to younger than 18 years in the late 1980s and early 1990s. In addition, the rates of marijuana initiation at ages 12 to 17 (youths) and 18 to 25 (young adults) in the early 1990s were still much higher than corresponding rates in the early 1960s.

In recent years, youths aged 12 to 17 have constituted about two thirds of the new marijuana users, with young adults aged 18 to 25 constituting most of the remaining third (OAS, 2001b). Additionally, recent rates of new use among youths in 1996-1998 (averaging 86.4 initiates per 1,000 potential new users) were higher than they had ever been. Nonetheless, rates of new use for both youths and young adults decreased between 1998 and 1999. The average age of marijuana initiation has generally declined since 1965 and remained around 17 years after 1992 (OAS, 2001b).

1.2.3 Research on Seasonality of Substance Use

There are no known prior studies of seasonal patterns in the initiation of substance use. A few studies, however, have looked at seasonal patterns in use. Zingraff and Belyea (1983) suggested a possibility of increased rates of marijuana use during the summer months; other researchers have suggested that variations in activities during the different seasons may influence substance use (McKee, Sanderson, Chenet, Vassin, & Skolnikov, 1998). Kovalenko et al. (2000) studied the seasonality in symptoms of mental and substance use disorders among youths aged 9 to 17 and found a weak seasonality in the counts of symptoms of marijuana use, with estimated zeniths in August and September. The investigators suggested that the possible seasonality in marijuana use may be related to the cycles in school attendance.

On the other hand, one analysis found a lower prevalence of current marijuana during July to September. Using data from 1992-1996 NHSDAs, Huang, Schildhaus, and Wright (1999) examined the seasonality of past month substance use on a quarterly basis. In their logistic regression model controlling for survey year, age, gender, race/ethnicity, and region, current use of the following substances among youths aged 12 to 17 was observed to show seasonal differences: alcohol, an illicit drug except marijuana, marijuana only, an illicit drug, and heavy drinking. Youths were 1.3 times more likely to engage in current marijuana use only in Quarter 4 (October-December) than in Quarter 3 (July-September). Relative to Quarter 3, youths also were 1.2 times more likely to use an illicit drug in Quarter 1 (January-March). Further analyses found that, during Quarter 3, youths were significantly less likely to report being approached by drug dealers in the past month than in the other quarters.

1.2.4 Predictors of Initiation

Little research exists on the predictors of marijuana initiation. Van Etten and Anthony (1999) examined the initial opportunity to try marijuana and the transition from first opportunity to first marijuana use using data from the 1979 to 1994 NHSDAs. They found that an estimated 51 percent of U.S. residents had an opportunity to try marijuana. One striking finding is that 43 percent of those with an opportunity went on to first use marijuana within 1 year of the first opportunity (i.e., making a rapid transition). The study also found that males were more likely than females to have an opportunity to use marijuana, but were not more likely to eventually use marijuana once an opportunity was presented. Research has also shown that the risk of initiating marijuana use is associated with age and birth cohort. Chen and Kandel (1995) found that the major risk period for initiation into marijuana was mostly over by age 20. Gfroerer and Epstein (1999) also found that marijuana initiation was unlikely to occur after age 21. Rates of first marijuana use were higher among younger people and cohorts born after World War II than older people and cohorts born before World War II (Johnson et al., 1996; Johnson & Gerstein, 1998).

The onset of marijuana use also is influenced by a variety of personal, family, and community risk and protective factors, such as affiliation with drug-using peers, personality dimensions (e.g., unconventionality), and the parent-child bond (Brook et al., 1999a; Clayton, 1992).

1.2.5 Sequencing of Substance Use Initiation

Marijuana has been hypothesized to be a gateway drug for other illicit drug use. Studies by Kandel and other investigators have identified a developmental sequence of drug involvement among youths (Ellickson, Hays, & Bell, 1992; Kandel, Yamaguchi, & Chen, 1992; Yamaguchi & Kandel, 1984). Specifically, the initial use of alcohol and/or cigarettes typically precedes the use of marijuana, which then is followed by the involvement of other illicit drugs. By studying a sample of rural youths, Donnermeyer (1993) also found that early use of alcohol predicted early use of marijuana, which in turn was predictive of early use of other illicit drugs. Studies of age at initiation of drug use confirmed that initiation of alcohol or tobacco typically occurred before marijuana initiation (Costello, Erkanli, Federman, & Angold, 1999; Kosterman, Hawkins, Guo, Catalano, & Abbott, 2000).

1.2.6 Early Marijuana Use and Later Substance Use Problems

Not only does early marijuana use signal an increased risk for hard drug use by grade 10 (Ellickson & Morton, 1999), but it also is associated with drug use problems, dependency, and treatment need (Brook, Richter, Whiteman, & Cohen, 1999b; Clark, Kirisci, & Tarter, 1998; Gfroerer & Epstein, 1999). Among individuals with a history of marijuana dependence, the age at onset of marijuana dependence was younger in the adolescent-onset individuals compared with the adult-onset individuals, and the time from the first use to the onset of dependence also was shorter in the adolescent-onset individuals (Clark et al., 1998). Among middle school students, use of marijuana and other drugs before the age of 12 was found to be associated with engaging in greater numbers of health risk behaviors than among students whose age at onset was 12 years or older or the never users (DuRant, Smith, Kreiter, & Krowchuk, 1999). Early marijuana use is associated with later adolescent problems that limit the acquisition of skills necessary for employment and increased risk of contracting the human immunodeficiency virus (HIV) and using illicit drugs (Brook et al., 1999b). Gfroerer and Epstein (1999) used NHSDA data to examine the impact of marijuana initiation on future drug abuse treatment need and found age at first use of marijuana as the most significant predictor of treatment need in all four age groups (i.e., 12 to 17, 18 to 25, 26 to 34, and 35 or older).

The number of new marijuana users may have a significant impact on the future demand for substance abuse treatment as some new users continue into heavier marijuana use or other illicit drug taking. Consequently, delaying the onset of marijuana initiation could be important in preventing the progression into heavy drug involvement and other drug-related health risk behaviors, as well as in decreasing the social burdens of illicit drug use.

Taken together, studies of marijuana initiation provide vital information for focused prevention programs about the periods of heightened initiation risk, specify subgroups vulnerable to initial use, and generate estimates on treatment needs and future demand for substance abuse treatment.

6. Early Marijuana Use and Later Drug Use Patterns

6.1 Introduction

In addition to providing useful information for prevention planning, incidence data can be used to help policymakers anticipate future trends in the nature and extent of the need for substance abuse treatment services. Marijuana incidence data have been used to make projections of drug abuse treatment need in the year 2020 (Gfroerer & Epstein, 1999). That study and others have shown the importance of early marijuana use as a predictor of later substance use patterns and associated problems (Brook, Gordon, Brook, & Cohen, 1989; Brook, Cohen, & Brook, 1998b; Brook et al., 1999b; DeWit, Hance, Offord, & Ogborne, 2000; Grant & Dawson, 1998). Given the substantial increases in marijuana incidence rates during the 1990s and the continuing high rates as recently as 1999, data showing the relationship between early initiation and later substance use patterns are needed. This chapter provides such data, primarily focusing on age at first use of marijuana as a predictor.

The remainder of this chapter focuses on three topics. Section 6.2 discusses the estimated proportions of drug use patterns among adults aged 26 or older by age at first marijuana use and by age groups. Section 6.3 provides adjusted odds ratios (ORs) of illicit drug use, heavy illicit drug use, and substance dependence/abuse from the multiple logistic regression models. Each logistic regression model includes age of marijuana initiation, age group, gender, race/ethnicity, and educational level. Section 6.4 includes findings for a subset of the analysis focusing on past year marijuana users aged 26 or older. This subset examined the relationship between age at first marijuana use and past year drug dependence (e.g., marijuana dependence, illicit drug dependence other than marijuana, illicit drug dependence, alcohol dependence or abuse, and alcohol or illicit drug dependence/abuse).

Heavy marijuana use was defined as using marijuana on at least 300 days in the past year. Heavy illicit drug use other than marijuana was defined as using at least one of the following: cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically on at least 50 days in the past year, regardless of marijuana/hashish use. Marijuana/hashish users who also had used any of the other listed drugs on at least 50 days in the past year were counted as heavy users of illicit drugs other than marijuana. Because of changes in the measures of dependence and abuse in the 2000 survey, estimates for alcohol or illicit drug abuse and dependence were based only on data from the 2000 survey. In brief, the 2000 NHSDA includes a series of questions on dependence that assess health or emotional problems, attempts to cut down on use, tolerance, withdrawal, and other symptoms associated with substances used. The questions on abuse assess problems at work, home, and school; problems with family or friends; physical danger; and trouble with the law due to substances used. The changes in measures of abuse and dependence limit the comparisons between 2000's estimates and estimates from prior surveys.

6.2 Estimated Prevalence of Illicit Drug Use, Heavy Illicit Drug Use, Substance Abuse, and Dependence, by Age of Marijuana Initiation

6.2.1 Use of Heroin, Cocaine, and Psychotherapeutics Nonmedically

The prevalence of lifetime and past year use of heroin, cocaine, and nonmedical psychotherapeutics in relation to age at first marijuana use is presented in Table 6.1 and Figure 6.1. Among adults aged 26 or older, the highest prevalence of use of heroin, cocaine, and psychotherapeutics in the lifetime was noted among those who initiated marijuana before they were 15 years old (9.2, 62.0, and 53.9 percent, respectively, for heroin, cocaine, and psychotherapeutics). There was a tendency for the prevalence of lifetime illicit drug use to decrease with older age of first marijuana use. Among lifetime marijuana users reporting their onset after age 20, an estimated 1.1 percent used heroin, 16.4 percent used cocaine, and 20.6 percent used any psychotherapeutics nonmedically in their lifetime. Among persons who had never used marijuana, less than 1 percent had ever used cocaine or heroin, but 5.1 percent had used psychotherapeutics nonmedically.

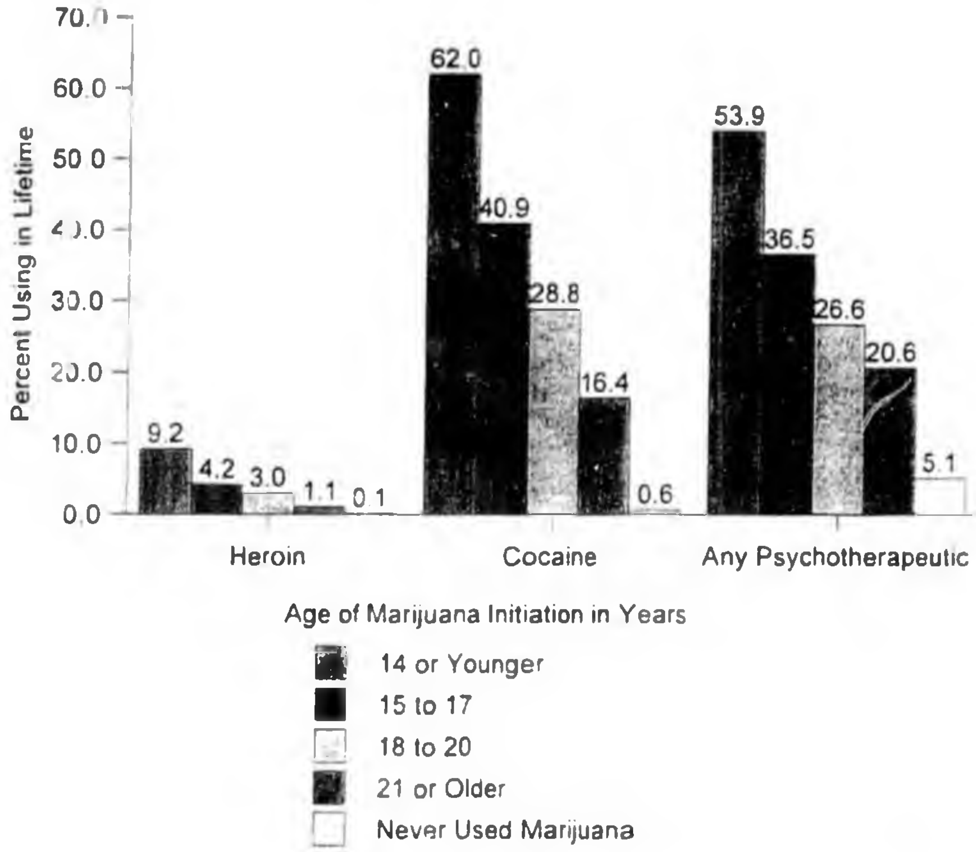
Similar patterns of past year use of these illicit drugs across the four groups of age at first marijuana use were observed. An estimated 6.9 percent of early-onset marijuana users (onset at age 14 or younger) used cocaine in the past year compared with only 0.8 percent of those initiating after age 20. An estimated 11.5 percent of early-onset marijuana users (onset at age 14 or younger) used any psychotherapeutics in the past year, while 2.9 percent of those initiating after age 20 did so.

For marijuana users aged 26 to 34 and those aged 35 to 49, rates of lifetime illicit drug use were generally higher among adolescence-onset marijuana users than among users initiating during adulthood. Because of a low prevalence of other illicit drug use among marijuana users aged 50 or older and very low proportions of past year heroin use across all three age groups (less than 1 percent), the relationship between the use of these illicit drugs and the onset age of marijuana use was less clear for them.

6.2.2 Heavy Illicit Drug Use

Among all lifetime marijuana users aged 26 or older, early-onset users not only had relatively higher proportions of recent (past year) heavy marijuana use than adult-onset users.

Figure 6.1 Prevalence of Lifetime Use of Heroin, Cocaine, and Psychotherapeutics among Adults Aged 26 or Older, by Age of Marijuana Initiation: 1999 and 2000

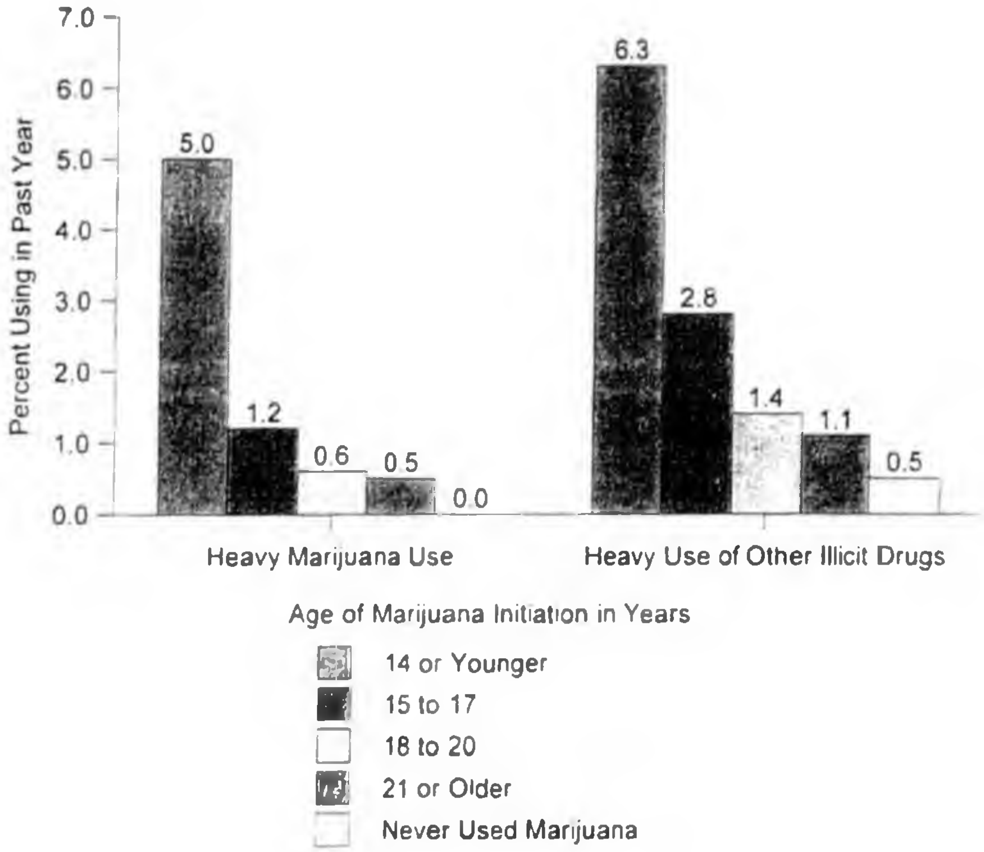


Note Nonmedical use of any prescription-type psychotherapeutic indicates using pain relievers, tranquilizers, stimulants, or sedatives at least once. Indicated use does not include over-the-counter drugs.

Source SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000.

but they also reported high proportions of heavy use of other illicit drugs (Table 6.2 and Figure 6.2). An estimated 5.0 percent of those initiating marijuana at age 14 or younger were recent heavy marijuana users compared with less than 1 percent of those with an onset age of 18 years or older. Likewise, 6.3 percent of those initiating marijuana at age 14 or younger were recent heavy users of other illicit drugs in comparison with about 1 percent of those with an onset age of 18 years or older. A similar pattern also was observed among two age groups of marijuana users (i.e., adults aged 26 to 34 and those aged 35 to 49). There was an insufficient number of heavy illicit drug users among the older age group (i.e., aged 50 or older) to allow for such a comparison. Less than 1 percent of adults who had never used marijuana reported heavy use of other illicit drugs.

Figure 6.2 Prevalence of Past Year Heavy Marijuana Use and Heavy Use of Other Illicit Drugs among Adults Aged 26 or Older, by Age of Marijuana Initiation: 1999 and 2000



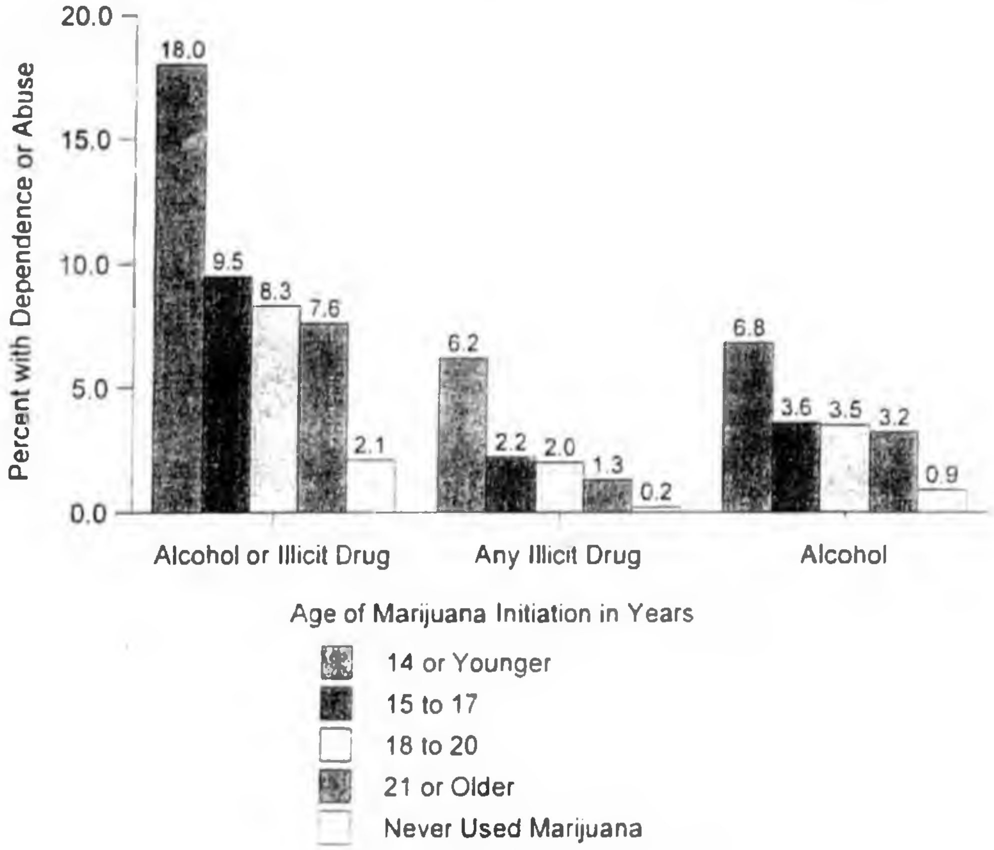
Note: Heavy marijuana use refers to using marijuana on 300 or more days in the past year. Heavy use of other illicit drugs refers to using cocaine, hallucinogens, inhalants, heroin, or any prescription-type psychotherapeutic used nonmedically (i.e., pain relievers, sedatives, tranquilizers, or stimulants) on at least 50 days in the past year.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000.

6.2.3 Substance Dependence and/or Abuse

The estimated past year prevalence of dependence on and abuse of alcohol or illicit drugs by age at first use of marijuana is summarized in Table 6.3 and Figure 6.3. Overall and among those aged 26 to 49, prevalence rates of dependence on or abuse of an illicit drug and prevalence rates of dependence on or abuse of either alcohol or an illicit drug were highest among those who started to use marijuana at age 14 or younger. An estimated 6.2 percent of those initiating marijuana before ge 15 abused or were dependent on an illicit drug in the past year compared with 1.3 percent of those initiating marijuana at age 21 or older. Similarly, 18.0 percent of early-onset (onset before age 15) marijuana users were classified with dependence on or abuse

Figure 6.3 Prevalence of Past Year Alcohol and/or Illicit Drug Dependence or Abuse among Adults Aged 26 or Older, by Age of Marijuana Initiation: 2000



Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. The alcohol-only data refer to just dependence on alcohol, not alcohol abuse. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) (APA, 1994).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

of either alcohol or an illicit drug in comparison with 7.6 percent of those who first used marijuana after age 20.

Even when the prevalence was restricted to dependence and was specific to alcohol, an illicit drug, marijuana, or an illicit drug other than marijuana, prevalence rates of dependence for each outcome were consistently found to be highest among marijuana users who started their first use at age 14 or younger.

Among adults who had never used marijuana, the prevalence of past year alcohol and/or illicit drug abuse or dependence was very low. Only about 0.2 percent of them were classified with dependence on or abuse of an illicit drug and 0.9 percent were dependent on alcohol. In addition, there was a tendency among those who had never used marijuana for the prevalence of illicit drug abuse or dependence to be higher among young adults aged 26 to 34 years (0.4 percent), but for the prevalence of alcohol dependence to be slightly higher among persons aged 35 to 49 (1.4 percent).

6.3 Multiple Logistic Regression Models

The estimated strength of associations of age at first marijuana use with the use of other illicit drugs and/or recent substance dependence and abuse was determined via multiple logistic regression procedures. Each logistic regression model also included age, gender, race/ethnicity, and educational level. Adjusted ORs, denoting the estimated association, that were derived from the multiple logistic regression procedures are discussed in this section.

6.3.1 Adjusted Odds Ratios of Use of Heroin, Cocaine, and Psychotherapeutics Nonmedically

Adjusted ORs for use of heroin, cocaine, and psychotherapeutics among lifetime marijuana users aged 26 or older are displayed in Table 6.4 (lifetime use) and Table 6.5 (past year use).

6.3.1.1 Heroin

With statistical adjustment for demographic characteristics, age at onset of marijuana use was significantly associated with lifetime heroin use (Table 6.4). In particular, onset before age 15 strongly predicted lifetime heroin use. Adjusted ORs of ever using heroin among lifetime marijuana users were 15.5 for those reporting first marijuana use at age 14 or younger, 6.1 for those initiating between the ages of 15 and 17, and 3.5 for those initiating between the ages of 18 and 20 as compared with those experiencing onset at age 21 or older. Among marijuana users, younger adults were significantly less likely to have ever used heroin than older adults aged 50 or older (OR = 0.2 for adults aged 26 to 34; OR = 0.5 for adults aged 35 to 49). Male marijuana users were an estimated 1.6 times more likely than female users to have ever used heroin. Relative to blacks, whites were at lower odds of using heroin in the lifetime. Educational level was not found to be associated with odds of lifetime heroin use. Age at first marijuana use was not associated with past year heroin use in the adjusted logistic regression model (Table 6.5).

6.3.1.2 Cocaine

Age at onset of marijuana use was highly associated with lifetime and recent cocaine use, particularly for those who initiated before age 15. These persons were 7 to 8 times more likely than those who initiated at age 21 or older to use cocaine (Tables 6.4 and 6.5). Lifetime marijuana users who were male and American Indian or Alaska Native (relative to black) also had increased rates of lifetime cocaine use. The analysis of recent cocaine use found that male gender and less than a high school education predicted increased odds of using cocaine in the past year (Table 6.5). In addition, white and Asian/Pacific Islander/Native Hawaiian lifetime marijuana users were less likely than black users to use cocaine recently.

6.3.1.3 Psychotherapeutics

Early onset of marijuana use also predicted increased odds of nonmedical use of any psychotherapeutic drug in the lifetime and past year (OR = 5.3 for lifetime use; OR = 3.4 for past year use). Younger adult marijuana users (aged 26 to 34) were less likely than older users (aged 50 or older) to report using psychotherapeutics in the lifetime, but they were significantly more likely to use them in the past year. Male marijuana users had decreased odds of using psychotherapeutics in the past year (OR = 0.8). Compared with black marijuana users, white, Hispanic, and American Indian/Alaska Native users had increased odds of recent psychotherapeutic use. Persons with less than high school schooling also had an increased likelihood of using psychotherapeutics in the past year.

6.3.2 Adjusted Odds Ratios of Heavy Illicit Drug Use

Adjusted ORs of past year (recent) heavy illicit drug use (marijuana and other illicit drugs) are summarized in Table 6.6. Early-onset of marijuana use (before age 15) was significantly associated with the increased odds of heavy use of marijuana (OR = 5.3) and other illicit drugs (OR = 4.5). Marijuana initiation between the ages of 15 and 17 also predicted heavy use of other illicit drugs (OR = 2.1). Male marijuana users were an estimated 2.1 times more likely than female users to report heavy marijuana in the past year. Lifetime marijuana users who did not attend college also were at increased odds of using an illicit drug heavily in the past year.

6.3.3 Adjusted Odds Ratios of Substance Dependence and/or Abuse

This section includes results of multiple logistic regression analyses of the following outcomes in relation to age at first use of marijuana among lifetime marijuana users aged 26 or older (Tables 6.7 to 6.9): (1) illicit drug dependence or abuse, (2) alcohol or illicit drug dependence or abuse, (3) alcohol dependence, (4) illicit drug dependence, (5) marijuana dependence, and (6) other illicit drug dependence.

Onset of marijuana use before age 15 significantly predicted increased odds of meeting the criteria for dependence on and/or abuse of either alcohol and/or an illicit drug in the past year (OR = 4.7 for an illicit drug; OR = 1.9 for alcohol or other illicit drugs). Black marijuana users had an increased likelihood of being dependent on or abusing an illicit drug than white and Asian/Pacific Islander/Native Hawaiian users. Less educated lifetime marijuana users (less than high school) were an estimated 1.8 times more likely to be classified with dependence on or abuse of an illicit drug recently, while age and gender were not associated with any odds of being dependent on or abusing illicit drugs (Table 6.7). Lifetime marijuana users who were aged 26 to 34, male, or had not attended college at the time of the survey had slightly increased odds of being dependent on or abusing alcohol or an illicit drug in the past year.

Adjusted ORs of alcohol dependence and illicit drug dependence among lifetime marijuana users are shown in Table 6.8. Age at marijuana initiation, age, and race/ethnicity were not found to predict recent alcohol dependence. In comparison, male and less educated marijuana users were at increased odds of being alcohol dependent in the past year. When the outcome of the logistic regression model was specific to illicit drug dependence, early-onset marijuana users (before age 15) were an estimated 6.2 times more likely than adult-onset users to be dependent on one or more illicit drugs in the past year. Relative to black marijuana users, white, Asian/Pacific Islander/Native Hawaiian, and American Indian or Alaska Native users had decreased odds of being classified with illicit drug dependence.

Table 6.9 further examines the estimated association between the onset age of marijuana use and recent illicit drug dependence. The multiple regression procedures revealed that the onset of marijuana use before age 15 was associated with recent dependence on both marijuana and other illicit drugs. In fact, onset before age 15 was associated with close to a tenfold excess in the odds of being classified with marijuana dependence than those who initiated marijuana in adulthood, independent of the influences of age, gender, race/ethnicity, and educational level. Marijuana users with less than a high school education were 3 times more likely than those who had attended college to be dependent on other illicit drugs recently.

6.4 Substance Dependence and/or Abuse Among Past Year Marijuana Users

This section focuses on dependence on and abuse of substances among lifetime marijuana users aged 26 or older who also used marijuana in the past year. The analyses presented in Section 6.3 demonstrate a high correlation between age at first marijuana use and subsequent patterns of substance use among adults aged 26 or older. Early-onset marijuana users are clearly more likely than adult-onset users to use drugs heavily and to have dependence and abuse problems later in life. However, these results do not indicate whether the higher rate of problematic use is simply because early-onset users are more likely to continue using illicit drugs as they age, making them more susceptible to problems, or whether their use of marijuana at a young age is a predictor of problematic use independent of their use history. Although it is not possible to fully explore this question with the limited data available in the NHSDA on drug use history, some indication of the independent effect of age at first use can be obtained by restricting analyses to persons who used marijuana in the past year.

6.4.1 Estimated Prevalence of Illicit Drug Dependence and/or Abuse, by Age of Marijuana Initiation

Table 6.10 displays past year prevalence of illicit drug dependence or abuse, alcohol or illicit drug dependence or abuse, and specific substance dependence among past year marijuana users aged 26 or older. These prevalence estimates are presented by age of marijuana initiation (14 or younger, 15 to 17 years, 18 to 20 years, and 21 or older).

The highest prevalence of illicit drug dependence or abuse, alcohol or illicit drug dependence or abuse, marijuana dependence, and other illicit drug dependence was found among those in the youngest group of age of first marijuana use. Among past year marijuana users, one fifth of those initiating marijuana before age 15 were classified with illicit drug dependence or abuse in the past year compared with approximately one tenth of those initiating marijuana after age 15. Similarly, about 40 percent of those with their onset of marijuana before age 14 met the criteria for dependence on or abuse of either alcohol or other illicit drugs compared with 16.7 percent of those with an onset after age 20.

With respect to alcohol dependence, approximately 10 percent of users with an onset of marijuana use before age 21 were dependent on alcohol in comparison with about 5 percent of those with an onset after age 20. The highest prevalence (15.2 percent) of illicit drug dependence was noted among those initiating use before age 15, while the lowest prevalence (3.4 percent) of illicit drug dependence was among those reporting their first use after age 20. Approximately 8 percent of those with an onset between ages 15 and 20 were dependent on an illicit drug.

Only 2.1 percent of those with their onset of marijuana after age 20 were dependent on marijuana in the past year, while 8.8 percent of those within the 14 or younger group, 4.7 percent of those within the 15 to 17 onset group, and 7.1 percent of those within the 18 to 20 onset group were dependent on marijuana. The prevalence of other illicit drug dependence decreased with increased age strata of first marijuana use. An estimated 8.6 percent of those with an onset before age 15 and 4.2 percent of those with an onset between the ages of 15 and 17 were dependent on other illicit drugs in the past year, while less than 3.0 percent of those with an onset at age 18 or older were classified with other illicit drug dependence.

6.4.2 Adjusted Odds Ratios of Substance Dependence and/or Abuse

The association between age at first use of marijuana and substance dependence and/or abuse among past year marijuana users aged 26 or older was examined using multiple logistic regression procedures. Adjusted ORs denote the estimated strength, holding constant the potential confounding influence of other demographic characteristics. Table 6.11 summarizes the logistic regression models for two dependence/abuse outcomes: (a) illicit drug dependence or abuse and (b) alcohol or illicit drug dependence or abuse. Models for alcohol dependence and illicit drug dependence are displayed in Table 6.12. Finally, models for marijuana dependence and other illicit drug dependence are shown in Table 6.13.

With statistical adjustment for demographic characteristics, onset of marijuana use before age 18 predicted increased odds of being classified with dependence on or abuse of either alcohol or other illicit drugs among adult marijuana users who reported the use in the past year (Table 6.11). Relative to an onset of marijuana use after age 20, an onset of use between the ages of 18 and 20 was not significant in predicting recent substance dependence or abuse. Compared with black marijuana users, white users were at decreased odds of meeting the criteria for illicit drug dependence or abuse in the past year (OR = 0.5). Recent marijuana users with a high school diploma had decreased odds of illicit drug dependence or abuse when compared with users who attended college.

Among recent marijuana users, age at onset of marijuana use was not found to be associated with alcohol dependence in the model (Table 6.12). In comparison, an onset of marijuana use before age 21 was associated with an increased likelihood of being classified with illicit drug dependence as compared with users with an onset at age 21 or older. Those with an onset before age 15 were an estimated 8.3 times more likely than those with an onset after age 20 to be dependent on one or more illicit drugs. Those with an onset between the ages of 15 and 20 were about 3 times more likely than those with an onset after age 20 to be dependent on one or more illicit drugs. As noted in the finding for illicit drug dependence or abuse, white recent marijuana users were less likely than black users to be dependent on an illicit drug (OR = 0.4).

Finally, multiple logistic regression showed that, among adult recent marijuana users, early-onset of marijuana use increased the likelihood of being dependent on both marijuana and other illicit drugs (Table 6.13). Relative to those with an onset of marijuana use after age 20, those reporting an onset before age 15 had an estimated OR of 5.1 for marijuana dependence and an OR of 17.0 for other illicit drug dependence. In addition, recent marijuana users aged 50 years old or older and black users were more likely to be classified with dependence on other illicit drugs than younger and white recent marijuana users.

Table 6.1 Percentages with *Lifetime and Past Year Use of Heroin, Cocaine, and Psychotherapeutics* among Adults Aged 26 or Older, by Age at First Marijuana Use and Age Groups: 1999 and 2000

Age in Years	Age of Marijuana Initiation in Years	Heroin		Cocaine		Any Psychotherapeutic	
		Lifetime	Past Year	Lifetime	Past Year	Lifetime	Past Year
Total	14 or younger	9.2	0.6	62.0	6.9	53.9	11.5
	15-17	4.2	0.2	40.9	3.5	36.5	5.6
	18-20	3.0	0.1	28.8	1.8	26.6	3.9
	21 or older	1.1	0.2	16.4	0.8	20.6	2.9
	Never used marijuana	0.1	0.0	0.6	0.1	5.1	1.2
26-34	14 or younger	5.1	0.1	57.5	8.9	48.6	12.3
	15-17	2.3	0.3	34.5	4.5	29.8	7.0
	18-20	1.2	0.1	19.4	2.4	19.4	5.1
	21 or older	0.5	0.0	14.9	1.5	17.4	5.0
	Never used marijuana	0.1	0.0	1.0	0.1	6.6	1.8
35-49	14 or younger	11.6	1.0	65.7	5.2	57.7	10.9
	15-17	4.8	0.2	44.3	3.0	39.8	5.1
	18-20	3.0	0.1	32.2	1.5	27.6	3.4
	21 or older	0.8	0.5	20.2	1.4	20.5	3.3
	Never used marijuana	0.1	0.0	1.2	0.1	6.2	6.2
50+	17 or younger	13.4	0.0	37.4	6.0	38.5	4.1
	18-20	5.8	0.2	29.6	2.0	33.2	4.0
	21 or older	1.5	0.0	14.1	0.2	21.5	2.1
	Never used marijuana	0.0	0.0	0.2	0.0	4.1	1.0

Note: Nonmedical use of any prescription-type psychotherapeutic indicates using pain relievers, tranquilizers, stimulants, or sedatives at least once. Indicated use does not include over-the-counter drugs.
Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000.

Table 6.2 Percentages with *Past Year Heavy Marijuana Use and Heavy Use of Other Illicit Drugs* among Adults Aged 26 or Older, by Age at First Marijuana Use and Age Groups: 1999 and 2000

Age in Years	Age of Marijuana Initiation in Years	Heavy Marijuana Use	Heavy Use of Other Illicit Drugs
Total	14 or younger	5.0	6.3
	15-17	1.2	2.8
	18-20	0.6	1.4
	21 or older	0.5	1.1
	Never used marijuana	0.0	0.5
26-34	14 or younger	7.3	7.0
	15-17	1.7	3.2
	18-20	1.3	1.3
	21 or older	0.5	1.8
	Never used marijuana	0.0	0.6
35-49	14 or younger	3.5	5.5
	15-17	1.0	2.6
	18-20	0.4	1.6
	21 or older	0.7	1.7
	Never used marijuana	0.0	0.6
50+	17 or younger	0.0	6.1
	18-20	0.2	0.9
	21 or older	0.4	0.5
	Never used marijuana	0.0	0.4

Note: Heavy marijuana use refers to using marijuana on 300 or more days in the past year. Heavy use of other illicit drugs refers to using cocaine, hallucinogens, inhalants, heroin, or any prescription-type psychotherapeutic used nonmedically (i.e., pain relievers, sedatives, tranquilizers, or stimulants) on at least 50 days in the past year.
Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000

Table 6.3 Percentages with *Past Year Alcohol and/or Illicit Drug Dependence or Abuse* among Adults Aged 26 or Older, by Age at First Marijuana Use and Age Groups: 2000

Age in Years	Age of Marijuana Initiation in Years	Illicit Drug Dependence or Abuse	Alcohol or Illicit Drug Dependence or Abuse	Alcohol Dependence	Illicit Drug Dependence	Marijuana Dependence	Other Illicit Drug Dependence
Total	14 or younger	6.2	18.0	6.8	4.5	2.5	2.7
	15-17	2.2	9.5	3.6	1.4	0.7	0.9
	18-20	2.0	8.3	3.5	1.7	0.8	1.2
	21 or older	1.3	7.6	3.2	0.7	0.2	0.5
	Never used marijuana	0.2	2.1	0.9	0.1	0.0	0.1
26-34	14 or younger	7.7	19.2	6.7	5.7	3.3	3.2
	15-17	2.9	13.1	4.1	1.7	0.8	1.1
	18-20	1.8	11.4	4.3	1.3	0.9	0.5
	21 or older	3.0	13.7	4.0	0.7	0.6	0.1
	Never used marijuana	0.4	3.4	1.0	0.2	0.0	0.2
35-49	14 or younger	5.0	17.3	6.5	3.4	2.0	2.0
	15-17	1.7	7.8	3.5	1.4	0.7	0.8
	18-20	1.8	7.5	3.2	1.7	0.8	1.1
	21 or older	1.7	8.0	3.8	1.2	0.0	1.2
	Never used marijuana	0.2	2.6	1.4	0.1	0.0	0.1
50+	17 or younger	8.2	9.8	4.6	3.6	0.0	3.6
	18-20	2.8	7.2	3.4	2.1	0.4	2.1
	21 or older	0.6	5.7	2.7	0.4	0.2	0.2
	Never used marijuana	0.1	1.4	0.6	0.1	0.0	0.1

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Other illicit drug dependence indicates meeting the dependence criteria of at least one of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.4 Adjusted Odds Ratios of *Lifetime Use of Heroin, Cocaine, and Psychotherapeutics* among Lifetime Marijuana Users Aged 26 or Older: 1999 and 2000

	Lifetime Heroin Use		Lifetime Cocaine Use		Lifetime Psychotherapeutic Use	
Variables	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age at First Marijuana Use in Years						
14 or younger vs. 21 or older	15.45	(7.56 - 31.55)	7.95	(6.53 - 9.68)	5.25	(4.37 - 6.31)
15-17 vs. 21 or older	6.10	(2.95 - 12.58)	3.27	(2.76 - 3.87)	2.47	(2.09 - 2.92)
18-20 vs. 21 or older	3.53	(1.73 - 7.20)	1.88	(1.57 - 2.25)	1.49	(1.24 - 1.78)
Age in Years						
26-34 vs. 50 or older	0.22	(0.13 - 0.38)	0.91	(0.73 - 1.12)	0.63	(0.51 - 0.77)
35-49 vs. 50 or older	0.53	(0.30 - 0.91)	1.41	(1.14 - 1.74)	0.93	(0.76 - 1.12)
Gender						
Male vs. female	1.61	(1.21 - 2.13)	1.33	(1.21 - 1.46)	1.04	(0.94 - 1.14)
Race/Ethnicity						
White vs. black	0.43	(0.29 - 0.64)	1.12	(0.93 - 1.34)	1.78	(1.48 - 2.13)
Hispanic vs. black	0.65	(0.38 - 1.12)	1.14	(0.88 - 1.48)	1.20	(0.92 - 1.58)
Other[1] vs. black	0.52	(0.23 - 1.16)	--	(-- - --)	--	(-- - --)
Asian/Pacific Islander/Native Hawaiian vs. black	--	(-- - --)	0.60	(0.38 - 0.95)	0.73	(0.45 - 1.19)
American Indian or Alaska Native vs. black	--	(-- - --)	1.82	(1.13 - 2.93)	2.85	(1.75 - 4.66)
More than one race vs. black	--	(-- - --)	1.19	(0.67 - 2.10)	1.57	(0.94 - 2.61)
Education						
Less than high school vs. at least some college	1.44	(0.96 - 2.17)	1.04	(0.88 - 1.21)	0.93	(0.79 - 1.10)
High school graduate vs. at least some college	1.03	(0.77 - 1.38)	0.90	(0.80 - 1.00)	0.91	(0.82 - 1.02)

-- Not available.

Note: Nonmedical use of any prescription-type psychotherapeutic indicates using pain relievers, tranquilizers, stimulants, or sedatives at least once. Indicated use does not include over-the-counter drugs.

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000

Table 6.5 Adjusted Odds Ratios of *Past Year Use of Heroin, Cocaine, and Psychotherapeutics* among Lifetime Marijuana Users Aged 26 or Older: 1999 and 2000

Variables	Past Year Heroin Use		Past Year Cocaine Use		Past Year Psychotherapeutic Use	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age at First Marijuana Use in Years						
14 or younger vs. 21 or older	2.46	(0.54 - 11.28)	7.01	(3.60 - 13.66)	3.44	(2.37 - 5.00)
15-17 vs. 21 or older	0.91	(0.21 - 3.96)	3.81	(1.99 - 7.31)	1.67	(1.19 - 2.34)
18-20 vs. 21 or older	0.56	0.10 - 3.09)	2.04	(1.02 - 4.09)	1.26	(0.85 - 1.87)
Age in Years						
26-34 vs. 50 or older	2.12	(0.23 - 19.96)	1.87	(0.83 - 4.23)	1.75	(1.04 - 2.93)
35-49 vs. 50 or older	6.04	(0.71 - 51.38)	1.19	(0.51 - 2.78)	1.33	(0.81 - 2.20)
Gender						
Male vs. female	0.60	(0.26 - 1.41)	1.35	(1.03 - 1.76)	0.76	(0.63 - 0.92)
Race/Ethnicity						
White vs. black	0.55	(0.20 - 1.52)	0.54	(0.39 - 0.76)	1.62	(1.18 - 2.24)
Hispanic vs. black	--	(-- - --)	0.74	(0.43 - 1.29)	1.86	(1.13 - 3.07)
Other[1] vs. black	1.51	(0.40 - 5.78)	--	(-- - --)	--	(-- - --)
Asian/Pacific Islander/Native Hawaiian vs. black	--	(-- - --)	0.23	(0.07 - 0.76)	0.65	(0.27 - 1.55)
American Indian or Alaska Native vs. black	--	(-- - --)	1.56	(0.57 - 4.27)	3.23	(1.25 - 8.34)
More than one race vs. black	--	(-- - --)	0.81	(0.32 - 2.06)	0.99	(0.42 - 2.29)
Education						
Less than high school vs. at least some college	1.74	(0.60 - 5.03)	2.29	(1.54 - 3.40)	1.78	(1.33 - 2.39)
High school graduate vs. at least some college	0.93	(0.36 - 2.35)	1.28	(1.00 - 1.64)	1.10	(0.90 - 1.35)

-- Not available.

Note: For past year heroin use, three racial/ethnic categories were used: white, black, and Hispanic, American Indian/Alaska Native, Asian/Pacific Islander/Native Hawaiian, and more than one race. Black was used as the reference group. Nonmedical use of any prescription-type psychotherapeutic indicates using pain relievers, tranquilizers, stimulants, or sedatives at least once. Indicated use does not include over-the-counter drugs.

[1] Hispanic, Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000.

Table 6.6 Adjusted Odds Ratios of *Past Year Heavy Marijuana Use and Heavy Use of Other Illicit Drugs* among Lifetime Marijuana Users Aged 26 or Older: 1999 and 2000

	Heavy Marijuana Use		Heavy Use of Other Illicit Drugs	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	5.30	(2.43 - 11.56)	4.49	(2.56 - 7.87)
15-17 vs. 21 or older	1.36	(0.63 - 2.95)	2.12	(1.24 - 3.64)
18-20 vs. 21 or older	0.82	(0.32 - 2.13)	1.15	(0.62 - 2.11)
Age in Years				
26-34 vs. 50 or older	4.73	(1.33 - 16.83)	1.72	(0.83 - 3.55)
35-49 vs. 50 or older	2.31	(0.64 - 8.29)	1.52	(0.75 - 3.08)
Gender				
Male vs. female	2.12	(1.47 - 3.05)	1.11	(0.86 - 1.42)
Race/Ethnicity				
White vs. black	1.25	(0.77 - 2.02)	0.62	(0.42 - 0.91)
Hispanic vs. black	1.01	(0.53 - 1.95)	1.23	(0.69 - 2.18)
Other[1] vs. black	1.17	(0.45 - 3.01)	--	(-- - --)
Asian/Pacific Islander/Native Hawaiian vs. black	--	(-- - --)	0.54	(0.21 - 1.40)
American Indian or Alaska Native vs. black	--	(-- - --)	2.63	(1.06 - 6.54)
More than one race vs. black	--	(-- - --)	0.77	(0.26 - 2.29)
Education				
Less than high school vs. at least some college	2.43	(1.47 - 3.99)	2.99	(2.02 - 4.41)
High school graduate vs. at least some college	2.74	(1.24 - 2.43)	1.57	(1.15 - 2.13)

-- Not available.

Note: For heavy marijuana use, four racial/ethnic categories were used: white; black; Hispanic; and American Indian/Alaska Native, Pacific Islander/Native Hawaiian, and more than one race. Black was used as the reference group. Heavy marijuana use refers to using marijuana on 300 or more days in the past year. Heavy use of other illicit drugs refers to using cocaine, hallucinogens, inhalants, heroin, or any prescription-type psychotherapeutic used nonmedically (i.e., pain relievers, sedatives, tranquilizers, or stimulants) on at least 50 days in the past year.

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000.

Table 6.7 Adjusted Odds Ratios of *Past Year Illicit Drug Dependence or Abuse and Alcohol or Illicit Drug Dependence or Abuse* among Lifetime Marijuana Users Aged 26 or Older: 2000

	Illicit Drug Dependence or Abuse		Alcohol or Illicit Drug Dependence or Abuse	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	4.74	(1.86 - 12.08)	1.90	(1.33 - 2.72)
15-17 vs. 21 or older	1.74	(0.69 - 4.36)	0.99	(0.71 - 1.37)
18-20 vs. 21 or older	1.51	(0.61 - 3.72)	0.94	(0.67 - 1.32)
Age in Years				
26-34 vs. 50 or older	1.31	(0.44 - 3.95)	2.20	(1.41 - 3.43)
35-49 vs. 50 or older	0.88	(0.31 - 2.52)	1.43	(0.92 - 2.22)
Gender				
Male vs. female	1.12	(0.72 - 1.74)	1.94	(1.56 - 2.42)
Race/Ethnicity				
White vs. black	0.52	(0.30 - 0.88)	0.93	(0.70 - 1.25)
Hispanic vs. black	0.89	(0.45 - 1.75)	0.95	(0.62 - 1.47)
Asian/Pacific Islander/Native Hawaiian vs. black	0.13	(0.03 - 0.63)	0.79	(0.27 - 2.28)
American Indian or Alaska Native vs. black	0.96	(0.26 - 3.46)	1.36	(0.59 - 3.13)
More than one race vs. black	3.01	(0.85 - 10.74)	1.59	(0.54 - 4.67)
Education				
Less than high school vs. at least some college	1.81	(1.05 - 3.13)	1.91	(1.42 - 2.56)
High school graduate vs. at least some college	0.75	(0.51 - 1.10)	1.32	(1.07 - 1.63)

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.8 Adjusted Odds Ratios of *Past Year Alcohol Dependence and Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older: 2000

Variables	Alcohol Dependence		Illicit Drug Dependence	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	1.64	(0.91 - 2.95)	6.19	(2.22 - 17.21)
15-17 vs. 21 or older	0.97	(0.57 - 1.65)	1.98	(0.74 - 5.27)
18-20 vs. 21 or older	1.02	(0.56 - 1.84)	2.29	(0.79 - 6.64)
Age in Years				
26-34 vs. 50 or older	1.51	(0.75 - 3.03)	1.20	(0.36 - 4.00)
35-49 vs. 50 or older	1.33	(0.67 - 2.64)	0.99	(0.30 - 3.30)
Gender				
Male vs. female	1.72	(1.23 - 2.41)	1.00	(0.61 - 1.64)
Race/Ethnicity				
White vs. black	0.83	(0.50 - 1.36)	0.49	(0.26 - 0.91)
Hispanic vs. black	0.67	(0.34 - 1.33)	0.57	(0.22 - 1.44)
Asian/Pacific Islander/Native Hawaiian vs. black	1.15	(0.23 - 5.64)	0.17	([illegible]03 - 0.87)
American Indian/Alaska Native vs. black	0.96	(0.23 - 3.99)	0.27	(0.08 - 0.95)
More than one race	0.81	(0.24 - 2.77)	1.09	(0.30 - 3.97)
Education				
Less than high school vs. at least some college	3.34	(2.21 - 5.07)	1.81	(0.90 - 3.62)
High school graduate vs. at least some college	1.62	(1.15 - 2.30)	0.69	(0.43 - 1.12)

Note: Illicit drug dependence indicates dependence on at least one of the following drugs: marijuana/hashish, cocaine (including cra[illegible] heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence is based on the definiti[illegible] found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.9 Adjusted Odds Ratios of *Past Year Marijuana Dependence and Other Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older: 2000

	Marijuana Dependence		Other Illicit Drug Dependence	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	9.77	(2.82 - 33.89)	5.67	(1.51 - 21.29)
15-17 vs. 21 or older	2.67	(0.76 - 9.38)	1.94	(0.56 - 6.74)
18-20 vs. 21 or older	2.98	(0.79 - 11.25)	2.52	(0.64 - 9.94)
Age in Years				
26-34 vs. 50 or older	2.47	(0.69 - 8.83)	0.76	(0.19 - 3.14)
35-49 vs. 50 or older	1.70	(0.46 - 6.27)	0.80	(0.19 - 3.33)
Gender				
Male vs. female	1.31	(0.71 - 2.40)	0.83	(0.44 - 1.56)
Race/Ethnicity				
White vs. black	0.52	(0.21 - 1.31)	0.53	(0.24 - 1.16)
Hispanic vs. black	--	(-- - --)	0.80	(0.27 - 2.35)
Other[1] vs. black	0.47	(0.12 - 1.77)	--	(-- - --)
Other[2] vs. black	--	(-- - --)	0.70	(0.20 - 2.50)
Education				
Less than high school vs. at least some college	0.95	(0.41 - 2.24)	2.98	(1.29 - 6.89)
High school graduate vs. at least some college	0.46	(0.23 - 0.92)	1.05	(0.59 - 1.88)

-- Not available.

Note: For marijuana dependence, three racial/ethnic categories were used: white; black; and Hispanic, American Indian/Alaska Native, Asian/Pacific Islander/Native Hawaiian, and more than one race. Black was used as the reference group. Other illicit drug dependence indicates meeting the dependence criteria of one or more of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Hispanic, Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race

[2] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.10 Percentages with *Past Year Alcohol and/or Illicit Drug Dependence or Abuse* among Past Year Marijuana Users Aged 26 or Older, by Age at First Marijuana Use: 2000

Age of Marijuana Initiation in Years	Illicit Drug Dependence or Abuse	Alcohol or Illicit Drug Dependence or Abuse	Alcohol Dependence	Illicit Drug Dependence	Marijuana Dependence	Other Illicit Drug Dependence
14 or younger	20.7	39.5	11.7	15.2	8.8	8.6
15-17	12.6	27.8	9.4	8.0	4.7	4.2
18-20	9.7	22.9	11.0	7.9	7.1	3.0
21 or older	7.5	16.7	5.4	3.4	2.1	1.3

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Other illicit drug dependence indicates meeting the dependence criteria of one or more of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Menal Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000

Table 6.11 Adjusted Odds Ratios of *Illicit Drug Dependence or Abuse and Alcohol or Illicit Drug Dependence or Abuse* among Lifetime Marijuana Users Aged 26 or Older Who Also Used Marijuana in the Past Year: 2000

	Illicit Drug Dependence or Abuse		Alcohol or Illicit Drug Dependence or Abuse	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	5.69	(2.12 - 15.28)	3.63	(1.86 - 7.06)
15-17 vs. 21 or older	2.94	(1.03 - 8.36)	2.17	(1.09 - 4.32)
18-20 vs. 21 or older	1.80	(0.71 - 4.59)	1.63	(0.88 - 3.01)
Age in Years				
26-34 vs. 50 or older	0.38	(0.13 - 1.09)	0.80	(0.32 - 1.97)
35-49 vs. 50 or older	0.37	(0.14 - 1.01)	0.76	(0.32 - 1.82)
Gender				
Male vs. female	0.89	(0.57 - 1.39)	1.16	(0.83 - 1.63)
Race/Ethnicity				
White vs. black	0.46	(0.26 - 0.80)	1.01	(0.64 - 1.59)
Hispanic vs. black	1.37	(0.59 - 3.19)	1.31	(0.65 - 2.64)
Other[1] vs. black	1.13	(0.49 - 2.62)	--	(-- - --)
Asian/Pacific Islander/Native Hawaiian vs. black	--	(-- - --)	0.23	(0.06 - 0.90)
American Indian/Alaska Native vs. black	--	(-- - --)	1.24	(0.38 - 4.04)
More than one race vs. black	--	(-- - --)	1.68	(0.56 - 5.06)
Education				
Less than high school vs. at least some college	1.02	(0.62 - 1.68)	1.44	(0.91 - 2.26)
High school graduate vs. at least some college	0.62	(0.40 - 0.98)	0.92	(0.63 - 1.34)

-- Not available.

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.12 Adjusted Odds Ratios of *Past Year Alcohol Dependence and Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older Who Also Used Marijuana in the Past Year: 2000

	Alcohol Dependence		Illicit Drug Dependence	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	2.45	(0.79 - 7.63)	8.33	(2.99 - 23.19)
15-17 vs. 21 or older	2.09	(0.69 - 6.32)	3.68	(1.22 - 11.05)
18-20 vs. 21 or older	2.56	(0.94 - 6.95)	3.16	(1.06 - 9.44)
Age in Years				
26-34 vs. 50 or older	0.77	(0.17 - 3.49)	0.41	(0.14 - 1.19)
35-49 vs. 50 or older	0.86	(0.19 - 3.84)	0.45	(0.15 - 1.36)
Gender				
Male vs. female	1.16	(0.69 - 1.95)	0.81	(0.49 - 1.33)
Race/Ethnicity				
White vs. black	1.45	(0.58 - 3.62)	0.41	(0.23 - 0.75)
Hispanic vs. black	1.61	(0.56 - 4.65)	0.68	(0.24 - 1.92)
Other[1] vs. black	1.09	(0.22 - 5.33)	0.41	(0.11 - 1.54)
Education				
Less than high school vs. at least some college	2.94	(1.55 - 5.59)	0.90	(0.47 - 1.70)
High school graduate vs. at least some college	1.35	(0.76 - 2.41)	0.56	(0.32 - 1.00)

Note: Illicit drug dependence indicates dependence on at least one of the following: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.13 Adjusted Odds Ratios of *Past Year Marijuana Dependence and Other Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older Who Also Used Marijuana in the Past Year: 2000

	Marijuana Dependence		Other Illicit Drug Dependence	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	5.05	(1.49 - 17.15)	17.03	(3.44 - 84.16)
15-17 vs. 21 or older	2.27	(0.63 - 8.15)	7.73	(1.41 - 42.32)
18-20 vs. 21 or older	3.55	(0.90 - 14.03)	3.97	(0.72 - 21.80)
Age in Years				
26-34 vs. 50 or older	1.05	(0.27 - 4.11)	0.19	(0.05 - 0.70)
35-49 vs. 50 or older	1.08	(0.26 - 4.53)	0.25	(0.06 - 1.07)
Gender				
Male vs. female	0.84	(0.45 - 1.57)	0.82	(0.41 - 1.65)
Race/Ethnicity				
White vs. black	0.62	(0.25 - 1.50)	0.38	(0.19 - 0.74)
Other[1] vs. black	0.58	(0.16 - 2.16)	0.83	(0.27 - 2.51)
Education				
Less than high school vs. at least some college	0.75	(0.33 - 1.72)	1.69	(0.71 - 4.00)
High school graduate vs. at least some college	0.42	(0.20 - 0.85)	0.99	(0.46 - 2.16)

Note: Other illicit drug dependence indicates meeting the dependence criteria of one or more of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Hispanic, Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.6 Adjusted Odds Ratios of *Past Year Heavy Marijuana Use and Heavy Use of Other Illicit Drugs* among Lifetime Marijuana Users Aged 26 or Older: 1999 and 2000

Variables	Heavy Marijuana Use		Heavy Use of Other Illicit Drugs	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	5.30	(2.43 - 11.56)	4.49	(2.56 - 7.87)
15-17 vs. 21 or older	1.36	(0.63 - 2.95)	2.12	(1.24 - 3.64)
18-20 vs. 21 or older	0.82	(0.32 - 2.13)	1.15	(0.62 - 2.11)
Age in Years				
26-34 vs. 50 or older	4.73	(1.33 - 16.83)	1.72	(0.83 - 3.55)
35-49 vs. 50 or older	2.31	(0.64 - 8.29)	1.52	(0.75 - 3.08)
Gender				
Male vs. female	2.12	(1.47 - 3.05)	1.11	(0.86 - 1.42)
Race/Ethnicity				
White vs. black	1.25	(0.77 - 2.02)	0.62	(0.42 - 0.91)
Hispanic vs. black	1.01	(0.53 - 1.95)	1.23	(0.69 - 2.18)
Other[1] vs. black	1.17	(0.45 - 3.01)	--	(-- - --)
Asian/Pacific Islander/Native Hawaiian vs. black	--	(-- - --)	0.54	(0.21 - 1.40)
American Indian or Alaska Native vs. black	--	(-- - --)	2.63	(1.06 - 6.54)
More than one race vs. black	--	(-- - --)	0.77	(0.26 - 2.29)
Education				
Less than high school vs. at least some college	2.43	(1.47 - 3.99)	2.99	(2.02 - 4.41)
High school graduate vs. at least some college	2.74	(1.24 - 2.43)	1.57	(1.15 - 2.13)

-- Not available.

Note: For heavy marijuana use, four racial/ethnic categories were used: white; black; Hispanic; and American Indian/Alaska Native, Pacific Islander/Native Hawaiian, and more than one race. Black was used as the reference group. Heavy marijuana use refers to using marijuana on 300 or more days in the past year. Heavy use of other illicit drugs refers to using cocaine, hallucinogens, inhalants, heroin, or any prescription-type psychotherapeutic used nonmedically (i.e., pain relievers, sedatives, tranquilizers, or stimulants) on at least 50 days in the past year.

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 1999 and 2000.

Table 6.7 Adjusted Odds Ratios of *Past Year Illicit Drug Dependence or Abuse and Alcohol or Illicit Drug Dependence or Abuse* among Lifetime Marijuana Users Aged 26 or Older: 2000

	Illicit Drug Dependence or Abuse		Alcohol or Illicit Drug Dependence or Abuse	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	4.74	(1.86 - 12.08)	1.90	(1.33 - 2.72)
15-17 vs. 21 or older	1.74	(0.69 - 4.36)	0.99	(0.71 - 1.37)
18-20 vs. 21 or older	1.51	(0.61 - 3.72)	0.94	(0.67 - 1.32)
Age in Years				
26-34 vs. 50 or older	1.31	(0.44 - 3.95)	2.20	(1.41 - 3.43)
35-49 vs. 50 or older	0.88	(0.31 - 2.52)	1.43	(0.92 - 2.22)
Gender				
Male vs. female	1.12	(0.72 - 1.74)	1.94	(1.56 - 2.42)
Race/Ethnicity				
White vs. black	0.52	(0.30 - 0.88)	0.93	(0.70 - 1.25)
Hispanic vs. black	0.89	(0.45 - 1.75)	0.95	(0.62 - 1.47)
Asian/Pacific Islander/Native Hawaiian vs. black	0.13	(0.03 - 0.63)	0.79	(0.27 - 2.28)
American Indian or Alaska Native vs. black	0.96	(0.26 - 3.46)	1.36	(0.59 - 3.13)
More than one race vs. black	3.01	(0.85 - 10.74)	1.59	(0.54 - 4.67)
Education				
Less than high school vs. at least some college	1.81	(1.05 - 3.13)	1.91	(1.42 - 2.56)
High school graduate vs. at least some college	0.75	(0.51 - 1.10)	1.32	(1.07 - 1.63)

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.8 Adjusted Odds Ratios of *Past Year Alcohol Dependence and Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older: 2000

	Alcohol Dependence		Illicit Drug Dependence	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	1.64	(0.91 - 2.95)	6.19	(2.22 - 17.21)
15-17 vs. 21 or older	0.97	(0.57 - 1.65)	1.98	(0.74 - 5.27)
18-20 vs. 21 or older	1.02	(0.56 - 1.84)	2.29	(0.79 - 6.64)
Age in Years				
26-34 vs. 50 or older	1.51	(0.75 - 3.03)	1.20	(0.36 - 4.00)
35-49 vs. 50 or older	1.33	(0.67 - 2.64)	0.99	(0.30 - 3.30)
Gender				
Male vs. female	1.72	(1.23 - 2.41)	1.00	(0.61 - 1.64)
Race/Ethnicity				
White vs. black	0.83	(0.50 - 1.36)	0.49	(0.26 - 0.91)
Hispanic vs. black	0.67	(0.34 - 1.33)	0.57	(0.22 - 1.44)
Asian/Pacific Islander/Native Hawaiian vs. black	1.15	(0.23 - 5.64)	0.17	(0.03 - 0.87)
American Indian/Alaska Native vs. black	0.96	(0.23 - 3.99)	0.27	(0.08 - 0.95)
More than one race	0.81	(0.24 - 2.77)	1.09	(0.30 - 3.97)
Education				
Less than high school vs. at least some college	3.34	(2.21 - 5.07)	1.81	(0.90 - 3.62)
High school graduate vs. at least some college	1.62	(1.15 - 2.30)	0.69	(0.43 - 1.12)

Note: Illicit drug dependence indicates dependence on at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.9 Adjusted Odds Ratios of *Past Year Marijuana Dependence and Other Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older: 2000

Variables	Marijuana Dependence		Other Illicit Drug Dependence	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	9.77	(2.82 - 33.89)	5.67	(1.51 - 21.29)
15-17 vs. 21 or older	2.67	(0.76 - 9.38)	1.94	(0.56 - 6.74)
18-20 vs. 21 or older	2.98	(0.79 - 11.25)	2.52	(0.64 - 9.94)
Age in Years				
26-34 vs. 50 or older	2.47	(0.69 - 8.83)	0.76	(0.19 - 3.14)
35-49 vs. 50 or older	1.70	(0.46 - 6.27)	0.80	(0.19 - 3.33)
Gender				
Male vs. female	1.31	(0.71 - 2.40)	0.83	(0.44 - 1.56)
Race/Ethnicity				
White vs. black	0.52	(0.21 - 1.31)	0.53	(0.24 - 1.16)
Hispanic vs. black	--	(-- - --)	0.80	(0.27 - 2.35)
Other[1] vs. black	0.47	(0.12 - 1.77)	--	(-- - --)
Other[2] vs. black	--	(-- - --)	0.70	(0.20 - 2.50)
Education				
Less than high school vs. at least some college	0.95	(0.41 - 2.24)	2.98	(1.29 - 6.89)
High school graduate vs. at least some college	0.46	(0.23 - 0.92)	1.05	(0.59 - 1.88)

-- Not available.

Note: For marijuana dependence, three racial/ethnic categories were used: white; black; and Hispanic, American Indian/Alaska Native, Asian/Pacific Islander/Native Hawaiian, and more than one race. Black was used as the reference group. Other illicit drug dependence indicates meeting the dependence criteria of one or more of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Hispanic, Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

[2] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.10 Percentages with *Past Year Alcohol and/or Illicit Drug Dependence or Abuse* among Past Year Marijuana Users Aged 26 or Older, by Age at First Marijuana Use: 2000

Age of Marijuana Initiation in Years	Illicit Drug Dependence or Abuse	Alcohol or Illicit Drug Dependence or Abuse	Alcohol Dependence	Illicit Drug Dependence	Marijuana Dependence	Other Illicit Drug Dependence
14 or younger	20.7	39.5	11.7	15.2	8.8	8.6
15-17	12.6	27.8	9.4	8.0	4.7	4.2
18-20	9.7	22.9	11.0	7.9	7.1	3.0
21 or older	7.5	16.7	5.4	3.4	2.1	1.3

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Other illicit drug dependence indicates meeting the dependence criteria of one or more of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.11 Adjusted Odds Ratios of *Illicit Drug Dependence or Abuse and Alcohol or Illicit Drug Dependence or Abuse* among Lifetime Marijuana Users Aged 26 or Older Who Also Used Marijuana in the Past Year: 2000

	Illicit Drug Dependence or Abuse		Alcohol or Illicit Drug Dependence or Abuse	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	5.69	(2.12 - 15.28)	3.63	(1.86 - 7.06)
15-17 vs. 21 or older	2.94	(1.03 - 8.36)	2.17	(1.09 - 4.32)
18-20 vs. 21 or older	1.80	(0.71 - 4.59)	1.63	(0.88 - 3.01)
Age in Years				
26-34 vs. 50 or older	0.38	(0.13 - 1.09)	0.80	(0.32 - 1.97)
35-49 vs. 50 or older	0.37	(0.14 - 1.01)	0.76	(0.32 - 1.82)
Gender				
Male vs. female	0.89	(0.57 - 1.39)	1.16	(0.83 - 1.63)
Race/Ethnicity				
White vs. black	0.46	(0.26 - 0.80)	1.01	(0.64 - 1.59)
Hispanic vs. black	1.37	(0.59 - 3.19)	1.31	(0.65 - 2.64)
Other[1] vs. black	1.13	(0.49 - 2.62)	--	(-- - --)
Asian/Pacific Islander/Native Hawaiian vs. black	--	(-- - --)	0.23	(0.06 - 0.90)
American Indian/Alaska Native vs. black	--	(-- - --)	1.24	(0.38 - 4.04)
More than one race vs. black	--	(-- - --)	1.68	(0.56 - 5.06)
Education				
Less than high school vs. at least some college	1.02	(0.62 - 1.68)	1.44	(0.9[illegible] - 2.26)
High school graduate vs. at least some college	0.62	(0.40 - 0.98)	0.92	(0.63 - 1.34)

-- Not available.

Note: Illicit drug dependence or abuse indicates dependence on or abuse of at least one of the following drugs: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence or abuse is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.12 Adjusted Odds Ratios of *Past Year Alcohol Dependence and Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older Who Also Used Marijuana in the Past Year: 2000

	Alcohol Dependence		Illicit Drug Dependence	
Variables	**Odds Ratio**	**95% Confidence Interval**	**Odds Ratio**	**95% Confidence Interval**
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	2.45	(0.79 - 7.63)	8.33	(2.99 - 23.19)
15-17 vs. 21 or older	2.09	(0.69 - 6.32)	3.68	(1.22 - 11.05)
18-20 vs. 21 or older	2.56	(0.94 - 6.95)	3.16	(1.06 - 9.44)
Age in Years				
26-34 vs. 50 or older	0.77	(0.17 - 3.49)	0.41	(0.14 - 1.19)
35-49 vs. 50 or older	0.86	(0.19 - 3.84)	0.45	(0.15 - 1.36)
Gender				
Male vs. female	1.16	(0.69 - 1.95)	0.81	(0.49 - 1.33)
Race/Ethnicity				
White vs. black	1.45	(0.58 - 3.62)	0.41	(0.23 - 0.75)
Hispanic vs. black	1.61	(0.56 - 4.65)	0.68	(0.24 - 1.92)
Other[1] vs. black	1.09	(0.22 - 5.33)	0.41	(0.11 - 1.54)
Education				
Less than high school vs. at least some college	2.94	(1.55 - 5.59)	0.90	(0.47 - 1.70)
High school graduate vs. at least some college	1.35	(0.76 - 2.41)	0.56	(0.32 - 1.00)

Note: Illicit drug dependence indicates dependence on at least one of the following: marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic used nonmedically. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Table 6.13 Adjusted Odds Ratios of *Past Year Marijuana Dependence and Other Illicit Drug Dependence* among Lifetime Marijuana Users Aged 26 or Older Who Also Used Marijuana in the Past Year: 2000

Variables	Marijuana Dependence		Other Illicit Drug Dependence	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age at First Marijuana Use in Years				
14 or younger vs. 21 or older	5.05	(1.49 - 17.15)	17.03	(3.44 - 84.16)
15-17 vs. 21 or older	2.27	(0.63 - 8.15)	7.73	(1.41 - 42.32)
18-20 vs. 21 or older	3.55	(0.90 - 14.03)	3.97	(0.72 - 21.80)
Age in Years				
26-34 vs. 50 or older	1.05	(0.27 - 4.11)	0.19	(0.05 - 0.70)
35-49 vs. 50 or older	1.08	(0.26 - 4.53)	0.25	(0.06 - 1.07)
Gender				
Male vs. female	0.84	(0.45 - 1.57)	0.82	(0.41 - 1.65)
Race/Ethnicity				
White vs. black	0.62	(0.25 - 1.50)	0.38	(0.19 - 0.74)
Other[1] vs. black	0.58	(0.16 - 2.16)	0.83	(0.27 - 2.51)
Education				
Less than high school vs. at least some college	0.75	(0.33 - 1.72)	1.69	(0.71 - 4.00)
High school graduate vs. at least some college	0.42	(0.20 - 0.85)	0.99	(0.46 - 2.16)

Note: Other illicit drug dependence indicates meeting the dependence criteria of one or more of the following drugs: cocaine, hallucinogens, inhalants, heroin, pain relievers, sedatives, tranquilizers, or stimulants. Dependence is based on the definition found in the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV).

[1] Hispanic, Asian/Pacific Islander/Native Hawaiian, American Indian/Alaska Native, and more than one race.

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Abuse, 2000.

Papers

Prospective cohort study of cannabis use, predisposition for psychosis, and psychotic symptoms in young people

Cecile Henquet, Lydia Krabbendam, Janneke Spauwen, Charles Kaplan, Roselind Lieb, Hans-Ulrich Wittchen, Jim van Os

Abstract

Objective To investigate the relation between cannabis use and psychotic symptoms in individuals with above average predisposition for psychosis who first used cannabis during adolescence.

Design Analysis of prospective data from a population based sample. Assessment of substance use, predisposition for psychosis, and psychotic symptoms was based on standardised personal interviews at baseline and at follow up four years later.

Participants 2437 young people (aged 14 to 24 years) with and without predisposition for psychosis.

Main outcome measure Psychotic symptoms at follow up as a function of cannabis use and predisposition for psychosis at baseline.

Results After adjustment for age, sex, socioeconomic status, urbanicity, childhood trauma, predisposition for psychosis at baseline, and use of other drugs, tobacco, and alcohol, cannabis use at baseline increased the cumulative incidence of psychotic symptoms at follow up four years later (adjusted odds ratio 1.67, 95% confidence interval 1.13 to 2.46). The effect of cannabis use was much stronger in those with any predisposition for psychosis at baseline (23.8% adjusted difference in risk, 95% confidence interval 7.9 to 39.7, $P = 0.003$) than in those without (5.6%, 0.4 to 10.8, $P = 0.033$). The risk difference in the "predisposition" group was significantly greater than the risk difference in the "no predisposition" group (test for interaction 18.2%, 1.6 to 34.8, $P = 0.032$). There was a dose-response relation with increasing frequency of cannabis use. Predisposition for psychosis at baseline did not significantly predict cannabis use four years later (adjusted odds ratio 1.42, 95% confidence interval 0.88 to 2.31).

Conclusion Cannabis use moderately increases the risk of psychotic symptoms in young people but has a much stronger effect in those with evidence of predisposition for psychosis.

Introduction

There is accumulating and converging evidence that cannabis use may be a risk factor for psychotic symptoms.[1-4] The possible causal nature of the association between cannabis and psychosis, however, is still a matter of debate, the main discussion revolving around the role of predisposition for psychosis and adjustment for confounders.[3 4] According to the self medication hypothesis,[5] individuals may start using cannabis because of predisposition for psychosis, rather than cannabis use causing expression of psychosis. To our knowledge, no prospective study to date has tested this hypothesis using information on predisposition for psychosis in relation to later cannabis use. Recent research, however, has suggested that rather than being the cause of cannabis use, such predisposition interacts synergistically with cannabis use. Two studies suggested that the joint effect of cannabis use and predisposition for psychosis on the emergence of psychotic symptoms was greater than the sum of their individual effects.[2 6]

We investigated prospectively whether cannabis use at baseline increases the risk of subsequent development of psychotic symptoms, whether any such increase in risk is higher in individuals with a predisposition for psychosis, and whether baseline expression predisposition increases the risk for subsequent use of cannabis. We adjusted for possible confounding factors in a large population-based sample of adolescents and young adults.

Methods

Sample

The study was part of the early developmental stages of psychopathology (EDSP) study,[7] in which data were collected on the prevalence, incidence, risk factors, comorbidity, and four year course of mental disorders in a random regional representative population sample of adolescents and young adults aged 14-24 years. The EDSP study is prospective, consisting of a baseline survey in 1995, an assessment of a subsample in 1996-7, and a four year follow up of the total sample in 1999.[7] The current analyses used the baseline and four year follow up data. The study sample was randomly drawn from the respective population registry offices of the city and each of the 29 counties of Munich. The base population were all those born between 1 June 1970 and 31 May 1981 who were registered as living in these areas as their primary place of residence and were German citizens. At baseline 3021 participants were interviewed face to face in their homes by using a computer assisted method (response rate 71%). An average of 42 months after the baseline investigations 2548 (response rate 84%) participants were successfully followed up. Of these, 90 participants did not want to respond to questions about illicit drug use at baseline or follow up, and data on the psychosis section of the Munich version of the international composite interview were incomplete for 21 participants. Our analyses were therefore of 2437 participants. To have 80% power to detect an odds ratio of 2.5 at the 5% level, given a base rate of psychotic experiences of 10% and a ratio of unexposed to exposed of 6:1,[2 8] we needed a sample size of 616. As around four times as many subjects are required for an interaction such as between cannabis use and predisposition for psychosis,[1] the sample size of 2437 was large enough.

Instruments

Participants were interviewed by trained psychologists using the Munich version of the composite international diagnostic interview (M-CIDI).[10] At baseline, they used the lifetime version of the interview. The interval version was used at follow up, which refers to the period of assessment between baseline and follow up. We assessed data on the psychosis (G) section only at follow up and these represent lifetime ratings. At baseline and at follow up, participants additionally completed the self report symptom checklist (SCL-90-R)[11] to screen for a broad range of psychopathological experiences including psychosis.

We used the "paranoid ideation" and "psychoticism" subscales of the symptom checklist to explore predisposition for psychosis at baseline and at follow up. Total scores of both subscales were added into a total score. Participants with total scores above the 90th centile were considered as having a predisposition for psychosis, both at baseline and at follow up.

We defined an outcome of psychosis as at least one (broad psychosis outcome) or at least two (narrow psychosis outcome) positive ratings on any of the 15 core psychosis items of the M-CIDI. We used the narrow outcome to exclude the possibility of spurious results due to false positive misclassification. None of these psychotic symptoms was due to acute effects of medication, drugs, or alcohol.

To assess symptoms of depression at baseline and follow up we calculated a mean score of the ratings on the 28 items of the depression section (E) of the M-CIDI. We divided this into two groups at the 90th centile, yielding a measure of significant symptoms at both baseline and follow up.

We assessed use of cannabis and other substances using the L-section of the M-CIDI. Individuals with lifetime cannabis use of five times or more at baseline were considered as exposed to cannabis. Cannabis exposure at baseline was defined as lifetime cannabis use of five times or more (any use) and frequency of use (use during the period of heaviest use: no use; less than once a month; three to four times a month; once to twice a week; three to four times a week; almost daily). Cannabis use at follow up was analysed as cannabis use of five times or more during the four years to follow up (any use at follow up). We combined psychostimulants, sedatives, opiates, cocaine, phencyclidine (PCP), and psychedelic drugs into a group of "other drugs." Lifetime tobacco use at baseline was defined as daily use during at least one month. Alcohol use at baseline was analysed as frequency of use during the past 12 months (no use; less than once a month; three to four times a month; once to twice a week; three to four times a week; almost daily).

Statistical analyses

Associations between any use of cannabis or frequency of use at baseline and psychotic symptoms at follow up were expressed as odds ratios from logistic regression models in Stata, release 8.0 (StataCorp, College Station, TX). All analyses were a priori adjusted for age, sex, socioeconomic status, urbanicity,[12] and experience of childhood trauma[13] as well as for predisposition for psychosis at baseline. To test whether the effect of cannabis on psychosis was independent of other drugs, tobacco, alcohol, and symptoms of depression at baseline and at follow up, we entered these variables in the model with any cannabis use at baseline. We also adjusted the effect of baseline cannabis on psychotic symptoms according to the M-CIDI at follow up for predisposition for psychosis at follow up.

The population attributable fraction was derived from the associations between any use of cannabis and psychotic symptoms according to the M-CIDI at follow up (adjusted for demographics and trauma during childhood) in the logistic regression models, both for the whole dataset and for the individuals with expression of baseline predisposition, using the aflogit procedure in Stata. This parameter gives a measure of the proportion of cases in participants with psychotic symptoms according to the M-CIDI at follow up that could have been prevented, assuming causality, had the exposure to cannabis been eliminated completely from the baseline population.

We calculated the interaction between predisposition for psychosis at baseline and any cannabis use (adjusted for demographics, childhood trauma, and predisposition at follow up) under an additive model rather than a multiplicative model because an additive model is more likely to yield information on the degree of synergism between causes—that is, the extent to which both causes depend on each other or coparticipate in disease causation.[14 15]

We investigated the self medication hypothesis by calculating the association between predisposition for psychosis at baseline and cannabis use at follow up, both for the whole dataset and for the individuals who had not used cannabis at baseline. We used sensitivity analyses to examine whether differential attrition in the sample as a whole (3021 at baseline, 2437 at follow up) could have biased the findings. This was done by multiple imputation of missing values of cannabis use at baseline, predisposition for psychosis at baseline, and psychotic symptoms according to the M-CIDI at follow up with the hotdeck command in Stata.

Results

We followed up 2437 participants, of which 1251 (51.3%) were men. The mean age was 18.3 years (SD 3.3 years) at baseline and 21.6 years (3.4 years) at follow up. At four year follow up the cumulative lifetime incidence of at least one psychotic symptom was 424 (17.4%), irrespective of severity and impairment probe criteria, and 174 (7.1%) participants reported two or more psychotic symptoms. At baseline 320 (13.1%) admitted to any use of cannabis (five times or more) and 361 (14.8 %) did so at follow up.

Any cannabis use at baseline increased the risk of psychotic symptoms according to the M-CIDI at follow up four years later in a dose-response fashion (tables 1-3), regardless of confounders, and with larger effect sizes for the narrowly defined psychosis outcome.

The effect of baseline cannabis use on the psychosis outcome according to the M-CIDI at follow up four years later was much stronger in those with predisposition for psychosis at baseline (23.8% adjusted difference in risk) than in those without (5.6% adjusted difference in risk, table 4). The population attributable fraction was 6.2% for the total group and more than twice as large (14.2%) for the group with predisposition for psychosis at baseline.

Predisposition for psychosis at baseline did not significantly predict cannabis use at follow up four years later (odds ratio 1.42, 95% confidence interval 0.94 to 2.15, for the whole sample and 1.42, 0.88 to 2.31, for the subgroup with no cannabis use at baseline).

Based on 1000 imputation sequences in which we stochastically imputed missing values of cannabis use at baseline and psychotic symptoms according to the M-CIDI at four year follow up in the whole sample, the estimated average additive interaction between predisposition for psychosis at baseline and cannabis

Table 1 Patterns of cannabis use at baseline and psychotic symptoms at follow up. Figures are numbers (percentages) of participants

Cannabis use at baseline	Any psychotic symptom at follow up		At least two psychotic symptoms at follow up	
	Yes (n=424)	No (n=2013)	Yes (n=174)	No (n=2263)
Any use (≥5 times)	82 (19.3)	238 (11.8)	44 (25.3)	276 (12.2)
Cumulative frequency*				
None	342 (80.7)	1775 (88.2)	130 (74.7)	1987 (87.8)
<1 times/month	13 (3.1)	66 (3.4)	5 (2.9)	77 (3.4)
3-4 times/month	18 (4.2)	62 (3.1)	10 (5.7)	70 (3.1)
2 times/week	17 (4.0)	40 (2.0)	7 (4.0)	50 (2.2)
3-4 times/week	12 (2.8)	21 (1.0)	8 (4.6)	25 (1.1)
Almost daily	22 (5.2)	46 (2.3)	14 (8.0)	54 (2.4)

*Some percentages do not total 100 because of rounding.

use at baseline remained significant (19.5% difference in risk, 95% confidence interval 0.3 to 38.6, P = 0.039).

Discussion

Exposure to cannabis during adolescence and young adulthood increases the risk of psychotic symptoms later in life. The findings confirm earlier suggestions that this association is stronger for individuals with predisposition for psychosis[7 8] and stronger for the more severe psychotic outcomes.[7 8] Frequent use of cannabis was associated with higher levels of risk in a dose-response fashion. Associations were independent of other variables known to increase the risk for psychosis. Also, the effect of cannabis remained significant after we corrected for baseline use of other drugs, tobacco, and alcohol. Finally, the data did not support the self medication hypothesis as baseline predisposition for psychosis did not significantly predict cannabis use at follow up.

Strengths and weaknesses

We examined psychotic symptoms according to the M-CIDI at follow up in a non-clinical sample. Symptoms were more prevalent than psychotic disorders defined according to the *Diagnostic and Statistic Manual of Mental Disorders*, fourth edition, but nevertheless have been shown to be on the same continuum of experiences as more severe states of psychosis, such as schizophrenia.[9 10] Established risk factors for schizophrenia, such as urbanicity and familial predisposition, also affect the occurrence of psychotic symptoms.[16 17] Our results confirm those from three previous studies that showed that exposure to cannabis plays a part not only in the expression of psychotic disorder but also in the emergence of less severe psychotic experiences.[7 8 18]

At baseline we used self reported psychotic experiences on the symptom checklist to determine predisposition for psychosis, whereas at follow up four years later we used the M-CIDI to determine psychosis outcome. In the group with predisposition for psychosis at baseline, any effect of cannabis can thus be interpreted as psychosis persisting from baseline to follow up (if we assume that the two measures of psychosis are identical), rather than an effect of transition from expression of predisposition at baseline to expression of overt symptoms at follow up. Although both explanations would be equally important, adjustment for the effect of the follow up equivalent of the baseline measure of predisposition for psychosis did not change the observed association between cannabis and psychotic symptoms according to the M-CIDI, indicating that the effect of cannabis can be interpreted as onset of clinical psychosis outside the continuity between the measure of predisposition for psychosis at baseline and follow up. In addition, cannabis also had a significant effect on psychotic symptoms in the group without predisposition for psychosis at baseline, albeit of smaller effect.

Synergistic interaction between cannabis and predisposition for psychosis

Findings from earlier research suggest biological plausibility, involving the endocannabinoid CB1 receptor system in close interaction with the dopamine neurotransmitter system. For example, delta-9-tetrahydrocannabinol (the major psychoactive component of cannabis) increases presynaptic dopamine efflux and utilisation in the prefrontal cortex in rats.[19] Increased concentrations of CB1 receptors were found in the dorsolateral prefrontal cortex of patients with schizophrenia,[20] and concentrations of anandamide (an endogenous cannabinoid that binds to the CB1 receptor) were found to be higher in the cerebrospinal fluid of these patients.[21] Furthermore, there is evidence from animal studies that puberty in rats is a vulnerable period with respect to the adverse effects of cannabinoids.[22] The longlasting behavioural disturbances observed in this animal study are consistent with impairments generally found in patients with schizophrenia, and the changes in these rats were reversed by the acute administration of the dopamine antagonist haloperidol.[22] Repeated exposure to cannabis may cause initial increases in synaptic dopamine and then lead to more prolonged changes in the endogenous cannabinoid systems. These changes might be most profound after exposure to cannabis during adolescence and in individuals with a pre-existing vulnerability to dysregulation of the cannabinoid system and related neurotransmission systems.

This work is part of the early developmental stages of psychopathology (EDSP) study. Principal investigators are Hans-Ulrich Wittchen and Roselind Lieb. Current or former staff members of the EDSP group include Kirsten von Sydow, Gabriele Lachner, Axel Perkonigg, Peter Schuster, Michael Höfler, Holger Sonntag, Esther Beloch, Martina Fuetsch, Elzbieta Garczynski, Alexandra Holly, Barbara Isensee, Chris Nelson, Hildegard

Table 2 Associations between any cannabis use at baseline and psychotic symptoms at follow up. Figures are odds ratios (95% confidence intervals)

Cannabis exposure at baseline	Any psychotic symptom				At least two psychotic symptoms
	Unadjusted	Adjusted*	Additional adjustment†	Additional adjustment‡	Adjusted*
Any use (≥5 times)	1.79 (1.36 to 2.36)	1.69 (1.26 to 2.25)	1.67 (1.13 to 2.46)	1.53 (1.13 to 2.07)	2.23 (1.52 to 3.29)

*Age, sex, socioeconomic status, urbanicity, childhood trauma, and predisposition for psychosis at baseline.

†Also adjusted for other drug use, tobacco, and alcohol.

‡Also adjusted for predisposition for psychosis at follow up and depression at baseline and follow up.

Table 3 Associations between frequency of cannabis use at baseline and any psychotic symptoms. Figures are odds ratios (95% confidence intervals)

Cumulative frequency of cannabis use	Unadjusted	Adjusted*
None†	1	1
<1/month	1.01 (0.55 to 1.86)	0.99 (0.53 to 1.84)
3-4 times/month	1.56 (0.91 to 2.68)	1.50 (0.86 to 2.62)
1-2 times/week	2.28 (1.28 to 4.09)	1.95 (1.07 to 3.55)
3-4 times/week	3.07 (1.49 to 6.31)	2.44 (1.16 to 5.13)
Almost daily	2.57 (1.52 to 4.34)	2.23 (1.30 to 3.84)
Linear trend‡	1.24 (1.15 to 1.35)	1.20 (1.10 to 1.31)

*Adjusted for age, sex, socioeconomic, urbanicity, childhood trauma, and predisposition for psychosis at baseline.
†Reference category.
‡Increase in risk with one unit change in cannabis frequency.

Pfister, Victoria Reed, Andrea Schuster, and Petra Zimmermann. Scientific advisers are Jules Angst (Zurich), Jurgen Margraf (Basel), Gunther Esser (Potsdam), Kathleen Merikangas (NIMH, Bethesda), Jim van Os (Maastricht), and Ron Kessler (Harvard, Boston).

Contributors: H-UW and RL were the principal investigators of the study. CH analysed the data in collaboration with LK, JvO, and JS. CH drafted the paper. All authors contributed to subsequent drafts and the final version. JvO is guarantor for the paper. CK contributed to drafts of the paper and the final version.

Funding: The EDSP study is funded by grants of the German Ministry of Research, Education and Technology 01EB9405/6 and 01EB9901/6 and the Deutsche Forschungsgemeinschaft (DFG). This paper is also part of NIH-grant "Longitudinal analysis of psychiatric risk factors for SUD" (RO1DA016977-01, PI: E Costello, HU Wittchen Co-PI).

Competing interests: None declared.

Ethical approval: The local ethics committee approved the study.

1 Andreasson S, Allebeck P, Engstrom A, Rydberg U. Cannabis and schizophrenia. A longitudinal study of Swedish conscripts. *Lancet* 1987;ii:1483-6.
2 van Os J, Bak M, Hanssen M, Bijl RV, de Graaf R, Verdoux H. Cannabis use and psychosis: a longitudinal population-based study. *Am J Epidemiol* 2002;156:319-27.
3 Degenhardt L, Hall W. The association between psychosis and problematical drug use among Australian adults: findings from the national survey of mental health and well-being. *Psychol Med* 2001;31:659-68.
4 Macleod J, Oakes R, Copello A, Crome I, Egger M, Hickman M, et al. Psychological and social sequelae of cannabis and other illicit drug use by young people: a systematic review of longitudinal, general population studies. *Lancet* 2004;363:1579-88.
5 Khantzian EJ. The self-medication hypothesis of addictive disorders: focus on heroin and cocaine dependence. *Am J Psychiatry* 1985;142:1259-64.
6 Verdoux H, Gindre C, Sorbara F, Tournier M, Swendsen JD. Effects of cannabis and psychosis vulnerability in daily life: an experience sampling test study. *Psychol Med* 2003;33:23-32.
7 Lieb R, Isensee B, von Sydow K, Wittchen HU. The early developmental stages of psychopathology study (EDSP): a methodological update. *Eur Addict Res* 2000;6:170-82.
8 Poulton R, Caspi A, Moffitt TE, Cannon M, Murray R, Harrington H. Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. *Arch Gen Psychiatry* 2000;57:1053-8.
9 Breslow NE, Day NE. *Statistical methods in cancer research.* Vol 2. *The design and analysis of cohort studies.* New York: Oxford University Press, 1994.
10 Wittchen HU, Lachner G, Wunderlich U, Pfister H. Test-retest reliability of the computerized DSM-IV version of the Munich-Composite International Diagnostic Interview (M-CIDI). *Soc Psychiatry Psychiatr Epidemiol* 1998;33:568-78.
11 Derogatis JR. *SCL-90-R administration, scoring, and procedures manual—II.* Towson: Clinical Psychometric Research, 1983.
12 Sharpley MS, Hutchinson G, Murray RM, McKenzie K. Understanding the excess of psychosis among the African-Caribbean population in England: review of current hypotheses. *Br J Psychiatry* 2001;178(suppl 40):s60-8.

What is already known on this topic

It is generally accepted that cannabis use is strongly associated with psychosis

We do not know whether the association is causal or whether those with a predisposition for psychosis are particularly at risk

What this study adds

Cannabis use in young people moderately increased the risk of developing psychotic symptoms

The risk for the onset of symptoms was much higher in young people with a predisposition for psychosis

Predisposition psychosis at baseline did not predict cannabis use at follow up, thus refuting the self medication hypothesis

13 Read J, Ross CA. Psychological trauma and psychosis: another reason why people diagnosed schizophrenic must be offered psychological therapies. *J Am Acad Psychoanal Dyn Psychiatry* 2003;31:247-68.
14 Darroch J. Biologic synergism and parallelism. *Am J Epidemiol* 1997;145:661-8.
15 Van Os J, Hanssen M, Bak M, Bijl RV, Vollebergh W. Do urbanicity and familial liability coparticipate in causing psychosis? *Am J Psychiatry* 2003;160:477-82.
16 Johns LC, van Os J. The continuity of psychotic experiences in the general population. *Clin Psychol Rev* 2001;21:1125-41.
17 Kendler KS, Thacker L, Walsh D. Self-report measures of schizotypy as indices of familial vulnerability to schizophrenia. *Schizophr Bull* 1996;22:511-20.
18 Verdoux H, Sorbara F, Gindre C, Swendsen JD, van Os J. Cannabis use and dimensions of psychosis in a nonclinical population of female subjects. *Schizophr Res* 2003;59:77-84.
19 Chen J, Paredes W, Lowinson JH, Gardner EL. Delta 9-tetrahydrocannabinol enhances presynaptic dopamine efflux in medial prefrontal cortex. *Eur J Pharmacol* 1990;190:259-62.
20 Dean B, Sundram S, Bradbury R, Scarr E, Copolov D. Studies on [3H]CP-55940 binding in the human central nervous system: regional specific changes in density of cannabinoid-1 receptors associated with schizophrenia and cannabis use. *Neuroscience* 2001;103:9-15.
21 Leweke FM, Giuffrida A, Wurster U, Emrich HM, Piomelli D. Elevated endogenous cannabinoids in schizophrenia. *Neuroreport* 1999;10:1665-9.
22 Schneider M, Koch M. Chronic pubertal, but not adult chronic cannabinoid treatment impairs sensorimotor gating, recognition memory, and the performance in a progressive ratio task in adult rats. *Neuropsychopharmacology* 2003;28:1760-9.

(Accepted 27 September 2004)

doi 10.1136/bmj.38267.664086.63

Department of Psychiatry and Neuropsychology, South Limburg Mental Health Research and Teaching Network, EURON, Maastricht University, PO BOX 616, 6200 MD Maastricht, Netherlands
Cécile Henquet *research psychologist*
Lydia Krabbendam *lecturer*
Janneke Spauwen *research psychologist*
Charles Kaplan *senior lecturer*
Jim van Os *professor*

Max Planck Institute of Psychiatry, Clinical Psychology and Epidemiology Unit, Kraepelinstrasse 2, D-80804 Munich, Germany
Roselind Lieb *private lecturer*

Institute of Clinical Psychology and Psychotherapy, Technical University of

Table 4 Interactions between any cannabis use and predisposition for psychosis

Cannabis use at baseline	No with psychosis outcome*	No without psychosis outcome*	Risk of psychotic symptoms at follow up	Difference in risk: Unadjusted	Difference in risk: Adjusted† (95% CI)
No predisposition for psychosis at baseline					
None	294	1642	15%	6%	5.6% (0.4 to 10.8) P=0.033
Any (≥5 times)	56	216	21%		
Predisposition for psychosis at baseline‡					
None	47	133	26%	25%	23.8% (7.9 to 39.7) P=0.003
Any (≥5 times)	23	22	51%		

*Numbers total 2436 because of one missing value on predisposition for psychosis at baseline.
†Age, sex, socioeconomic status, urbanicity, childhood trauma, and predisposition for psychosis at follow up. Test for additive interaction 18.2% adjusted difference in risk (95% confidence interval 1.6 to 34.8), P=0.032 (tests whether risk difference in "predisposition" group is significantly greater than risk difference in "no predisposition" group).
‡Total score ≥90th centile on "paranoid ideation" and "psychoticism" subscales of symptom checklist.

Dresden, Chemnitzerstrasse 46, D-01187 Dresden, Germany
Hans-Ulrich Wittchen *professor*

Correspondence to: J van Os j.vanos@sp.unimaas.nl

Self reported cannabis use as a risk factor for schizophrenia in Swedish conscripts of 1969: historical cohort study

Stanley Zammit, Peter Allebeck, Sven Andreasson, Ingvar Lundberg, Glyn Lewis

Abstract

Objectives An association between use of cannabis in adolescence and subsequent risk of schizophrenia was previously reported in a follow up of Swedish conscripts. Arguments were raised that this association may be due to use of drugs other than cannabis and that personality traits may have confounded results. We performed a further analysis of this cohort to address these uncertainties while extending the follow up period to identify additional cases.

Design Historical cohort study.

Setting 1969-70 survey of Swedish conscripts (>97% of the country's male population aged 18-20).

Participants 50 087 subjects: data were available on self reported use of cannabis and other drugs, and on several social and psychological characteristics.

Main outcome measures Admissions to hospital for ICD-8/9 schizophrenia and other psychoses, as determined by record linkage.

Results Cannabis was associated with an increased risk of developing schizophrenia in a dose dependent fashion both for subjects who had ever used cannabis (adjusted odds ratio for linear trend of increasing frequency 1.2, 95% confidence interval 1.1 to 1.4, $P < 0.001$), and for subjects who had used only cannabis and no other drugs (adjusted odds ratio for linear trend 1.3, 1.1 to 1.5, $P < 0.015$). The adjusted odds ratio for using cannabis >50 times was 6.7 (2.1 to 21.7) in the cannabis only group. Similar results were obtained when analysis was restricted to subjects developing schizophrenia after five years after conscription, to exclude prodromal cases.

Conclusions Cannabis use is associated with an increased risk of developing schizophrenia, consistent with a causal relation. This association is not explained by use of other psychoactive drugs or personality traits relating to social integration.

Introduction

The relation between cannabis use and subsequent onset of psychosis is complex.[1-3] Although it is clear that high doses of cannabis may lead to a short lived toxic psychosis, it is unclear whether cannabis increases the risk of psychotic illness persisting after abstinence from the drug. An association between self reported use of cannabis in adolescence and subsequent risk of schizophrenia was reported from a cohort study of Swedish conscripts,[4] which supports the view that cannabis might act as an independent risk factor for schizophrenia. Several uncertainties have, however, been raised regarding the interpretation of this result.

Firstly, the apparent effect of cannabis may be caused by other drugs (such as amphetamines) that are more likely to have been misused among cannabis users than among non-users.[5 6] Secondly, premorbid personality traits may have predisposed individuals both to developing schizophrenia and to using cannabis. Traits relating to social behaviour are likely to be particularly important in this respect. Thirdly, use of cannabis may have been secondary to the presence of schizophrenia, as a form of "self medication" for symptoms, despite failure to identify the disorder at the time of conscription.[7] Review of case histories of a small subsample from this cohort shows that the association was not due to use of other drugs and that use of cannabis preceded any mental illness,[8] but the causal pathways are difficult to disentangle and merit further study.

We are not aware of any other cohort studies that have investigated the association between drug use and subsequent risk of schizophrenia, and case-control studies are susceptible to recall bias. In this study we perform a further analysis of the Swedish conscript cohort to address some of the above concerns.[4] The follow up period is now 27 years (15 years in the original study) and covers almost the whole period of risk for schizophrenia.[9] Our improved understanding of risk factors for schizophrenia has also enabled us better to adjust for factors such as personality traits that potentially confound this relation.[10-13]

Methods

Subjects

The cohort consisted of 50 087 Swedish men conscripted for compulsory military training in 1969-1970. More than 98% (49 321) were 18-20 years of age. Only 2-3% of the male population were excused conscription because of severe mental or physical handicap. The conscription procedure included intelligence tests and non-anonymous self reported ques-

Editorial by Rey and Tennant
Papers pp 1195, 1212

Department of Psychological Medicine, University of Wales College of Medicine, Cardiff CF14 4XN
Stanley Zammit
MRC clinical research fellow

Department of Social Medicine, Gothenburg University, Sweden
Peter Allebeck
professor of social medicine

Department of Public Health Sciences, Karolinska Institute, Stockholm, Sweden
Sven Andreasson
associate professor of social medicine
Ingvar Lundberg
professor of occupational epidemiology

Division of Psychiatry, University of Bristol, Bristol
Glyn Lewis
professor of psychiatric epidemiology

Correspondence to: S G Zammit
zammits@cardiff.ac.uk

bmj.com 2002;325:1199

tionnaires on family, social background, behaviour during adolescence, and substance use—including first drug used, drug most commonly used, frequency of use, and direct questions regarding use of a list of specified drugs. Details of the procedure and results of studies of its validity have been reported previously.[14]

All subjects underwent a structured interview conducted by a psychologist, and those reporting any psychiatric symptoms were interviewed by a psychiatrist and given a diagnosis according to ICD-8 (international classification of diseases, 8th revision) where applicable.[15] Thirty four cases of psychosis diagnosed at conscription were excluded from the study. Permission to use the anonymised database was granted by the Karolinska Institute research ethics committee and the Swedish data inspection board.

Follow up

The Swedish national hospital discharge register recorded about 70% of all psychiatric admissions in 1970, rising to 83% in 1973. Coverage was 97% in 1974-83, 95% in 1984-6, and has been virtually complete since 1987. The linkage reported here was from 1970 to 1996. The incomplete registration during some periods is unlikely to have affected the results. Misclassification of outcomes is likely to be low, given that over 90% of people with schizophrenia are admitted to hospital at some point during their illness.[16]

Patients were given clinical diagnoses according to the Nordic version of ICD-8 (ICD-9 from 1987). Outcomes investigated were schizophrenia (codes 295.00-295.99) and other psychoses (including affective and paranoid psychoses, codes 296.00-298.99). It is unlikely that cases diagnosed as schizophrenia in this cohort were either toxic psychoses induced by cannabis (or amphetamine) or acute, transient drug induced psychoses, given the restrictive tradition in Sweden regarding the diagnosis of schizophrenia.[17] Satisfactory validity of schizophrenia diagnoses in a small sample from this cohort has been observed,[3] and ICD-8 diagnoses from the register have shown high specificity with criteria for schizophrenia as defined in DSM-III (*Diagnostic and Statistical Manual of Mental Disorders*, third edition).[18]

Analysis

We used logistic regression to calculate odds ratios and 95% confidence intervals for developing schizophrenia in subjects who used cannabis compared with subjects with no history of drug use, both before and after adjustment for potential confounders. Odds ratios may be interpreted as rate ratios because schizophrenia is a rare outcome.[19] Although a few subjects died during follow up, analysis by using Cox regression made no difference to the results obtained by using logistic regression, which we therefore retained as the method of choice.

Previous research has found that psychiatric diagnosis at conscription, IQ score, personality variables concerned with interpersonal relationships, place of upbringing, paternal age, and cigarette smoking are all associated with schizophrenia.[10-13 20 21] We included these variables as potential confounders in the regression model. Disturbed behaviour in childhood, history of alcohol misuse, family history of psychiatric illness, financial situation of the family, and father's occupation were also considered to be potential confounders and included in the analysis. The variable relating to poor social integration as an aspect of personality was a summed score of questions regarding number of close friends, history of relationships with girlfriends, and individual sensitivity. We selected these questions after a factor analysis of over 40 questions relating to childhood and adolescent behaviour from one of the questionnaires. Only 3% of the sample had missing data for any of the questions.

Subjects were stratified into those receiving a diagnosis within five years of conscription (0-5 years) and those receiving a diagnosis after this time (> 5 years) to investigate possible effects of a prodrome at the time of conscription.

Results

Out of the 50 053 subjects, 362 (0.71%, 95% confidence interval 0.65% to 0.80%) received a diagnosis of schizophrenia by 1996. Data on drug use, derived from all sources of information, were missing on 16 (4.4%) of subjects developing schizophrenia and on 1522 (3.1%) of non-cases ($P < 0.2$).

Of 11 variables initially included as potential confounders, only five had any effect on the adjusted results. Table 1 shows a summary of these in relation to cannabis use. Adjusting for poor social integration made minimal difference to results but is also included in table 1. For the purposes of table 1 only we treated IQ score, poor social integration, and disturbed behaviour as dichotomous variables, using the 10th percentile as a cut-off point for coding.

Ever used cannabis

Altogether 5391 subjects (10.8% of the cohort) had ever used cannabis, and 73 of these (1.4%) developed schizophrenia. In 69 subjects who started using drugs before 1969, 19 (31%, 95% confidence interval 20% to 44%) of those developing schizophrenia had stopped using drugs before conscription, as opposed to 2810 (64%; 62% to 65%) of the 4418 who did not develop schizophrenia ($P < 0.001$).

Table 1 Summary of confounders in relation to subjects' history of drug use at conscription. Values are numbers (percentages) of cohort sample

Subjects by type of drug use	Diagnosis of psychiatric illness on conscription*	Disturbed behaviour	Low IQ score	Brought up in city	Cigarette smoking	Poor social integration
Cannabis (n=5391)	1408 (27)	1582 (31)	297 (6)	2262 (43)	4582 (86)	130 (2.5)
Cannabis only (n=1648)	235 (15)	271 (17)	65 (4)	653 (40)	1331 (81)	34 (2.1)
Any drug (n=11 783)	2325 (20)	2557 (23)	1007 (9)	3358 (31)	8835 (80)	246 (2.3)
No drug (n=36 753)	2827 (8)	1681 (5)	3510 (10)	6759 (19)	19 229 (52)	841 (2.4)

Owing to missing data for each of the confounders, the precentages presented may not tally precisely with the numbers of subjects reported

*Except psychosis or learning disability

The crude and adjusted odds ratios with 95% confidence intervals for developing schizophrenia given a history of ever using cannabis are presented in tables 2, 3, and 4. The crude odds ratio for developing schizophrenia any time after conscription was 2.2 (1.7 to 2.8) and this association persisted, although reduced, after adjustment (adjusted odds ratio 1.5, 1.1 to 2.0).

We found a dose dependent relation between frequency of cannabis use and risk of schizophrenia, with an adjusted odds ratio for linear trend across the categories of frequency of cannabis use used in this study of 1.2 (1.1 to 1.4, $P < 0.001$). The adjusted odds ratio for subjects with a history of heaviest use of cannabis (>50 occasions) was 3.1 (1.7 to 5.5).

The association between cannabis use and schizophrenia was greater in subjects admitted in the first five years after conscription (adjusted odds ratio 2.1, 1.2 to 3.7) compared with those admitted after five years (1.2, 0.8 to 1.8). Frequency of cannabis use was associated with schizophrenia in both the early onset group (adjusted odds ratio for linear trend 1.3, 1.1 to 1.6, $P < 0.001$) and the later onset group (1.2, 1.1 to 1.3, $P < 0.02$).

Cannabis only

Altogether 1648 subjects (3.3% of cohort, 3.1% to 3.5%) had used only cannabis, and 18 of these (1.1%, 0.6 to 1.7%) developed schizophrenia. Those who used only cannabis had an increased risk of schizophrenia compared with those who reported no drug use. The odds ratio before adjustment (1.9, 1.2 to 3.0) and afterwards (1.9, 1.1 to 3.1) was similar (table 5). We found a dose dependent relation for frequency of use, with an adjusted odds ratio for linear trend of 1.3 (1.0 to 1.[illegible] $P < 0.02$).

Stimulant use

We found an association between schizophrenia and stimulant use in the crude analysis (crude odds ratio 3.8, 2.7 to 5.4), but this became non-significant after adjustment for confounders (adjusted odds ratio 1.5, 0.9 to 2.4). Adjusting for frequency of cannabis use further reduced the association between stimulant use and risk of schizophrenia (adjusted odds ratio 1.1, 0.6 to 2.1). The association observed between schizophrenia and frequency of cannabis use was unchanged after adjustment for stimulant use.

Other psychoses

A total of 446 subjects were admitted with other psychoses. Subjects who had ever used cannabis had an increased risk of developing a psychosis other than schizophrenia (crude odds ratio 1.4, 1.1 to 1.9), but this effect was reduced after adjustment (adjusted odds ratio 1.1, 0.8 to 1.5). A similar pattern was observed for the association with cannabis frequency, with a linear trend odds ratio of 1.1 (1.0 to 1.2, $P < 0.02$) before adjustment and of 1.0 (0.9 to 1.1, $P < 0.85$) after adjustment.

For all the analyses, diagnosis on conscription, IQ score, and place of upbringing contributed most to confounding. Adjusting for the other potential confounders made virtually no difference to the final adjusted results.

Table 2 Crude and adjusted odds ratios with 95% confidence intervals for developing schizophrenia any time after conscription in subjects who have ever used cannabis

Drug use	No of subjects	No (%) of subjects developing schizophrenia	Odds ratio (95% CI) Crude	Odds ratio (95% CI) Adjusted*
Cannabis ever†	5391	73 (1.4)	2.2 (1.7 to 2.8)	1.5 (1.1 to 2.0)
Frequency of use of cannabis (ever):				
None	36 429	215 (0.6)	1.0†	1.0†
Once	608	2 (0.3)	0.6 (0.1 to 2.2)	0.6 (0.1 to 2.3)
2-4 times	1380	8 (0.6)	1.0 (0.5 to 2.0)	0.9 (0.4 to 1.9)
5-10 times	806	9 (1.1)	1.9 (1.0 to 3.7)	1.4 (0.7 to 2.8)
11-50 times	689	13 (1.9)	3.2 (1.8 to 5.7)	2.2 (1.2 to 4.0)
>50 times	731	28 (3.8)	6.7 (4.5 to 10.0)	3.1 (1.7 to 5.5)
Linear trend for frequency of use	—	—	1.4 (1.3 to 1.5)	1.2 (1.1 to 1.4)

*Adjusted for diagnosis at conscription to IQ score to poor social integration to disturbed behaviour to cigarette smoking to and place of upbringing

†No drug use as baseline comparison

Table 3 Crude and adjusted odds ratios with 95% confidence intervals (95% CI) for developing schizophrenia in years 0-5 after conscription in subjects who have ever used cannabis

Drug use	No of subjects	No (%) of subjects developing schizophrenia	Odds ratio (95% CI) Crude	Odds ratio (95% CI) Adjusted*
Cannabis ever†	5320	33 (0.6)	2.2 (1.7 to 2.8)	2.1 (1.2 to 3.7)
Frequency of use of cannabis (ever)				
None	36 429	47 (0.1)	1.0†	1.0†
Once	608	0	—	—
2-4 times	1380	2 (0.1)	1.1 (0.3 to 4.6)	1.0 (0.2 to 4.4)
5-10 times	806	4 (0.5)	3.9 (1.4 to 10.7)	2.6 (0.8 to 7.9)
11-50 times	689	4 (0.6)	4.5 (1.6 to 12.6)	2.8 (0.9 to 8.8)
>50 times	731	13 (1.8)	14.0 (7.5 to 26.0)	4.7 (1.8 to 12.4)
Linear trend for frequency of use		—	1.6 (1.4 to 1.8)	1.3 (1.1 to 1.6)

*Adjusted for diagnosis at conscription, IQ score, poor social integration, disturbed behaviour, cigarette smoking, and place of upbringing

†No drug use as baseline comparison

Table 4 Crude and adjusted odds ratios with 95% confidence intervals (95% CI) for developing schizophrenia in years 5+ after conscription in subjects having ever used cannabis

Drug use	No of subjects	No (%) of subjects developing schizophrenia	Odds ratio (95% CI) Crude	Odds ratio (95% CI) Adjusted*
Cannabis ever†	5287	40 (0.8)	1.6 (1.1 to 2.2)	1.2 (0.8 to 1.8)
Frequency of use of cannabis (ever)				
None	36 382	168 (0.5)	1.0†	1.0†
Once	608	2 (0.3)	0.7 (0.2 to 2.9)	0.8 (0.2 to 3.2)
2-4 times	1378	6 (0.4)	0.9 (0.4 to 2.1)	0.9 (0.4 to 2.0)
5-10 times	802	5 (0.6)	1.4 (0.6 to 3.3)	1.0 (0.4 to 2.5)
11-50 times	685	9 (1.3)	2.9 (1.5 to 5.6)	2.1 (1.0 to 4.5)
>50 times	718	15 (2.1)	4.6 (2.7 to 7.8)	2.5 (1.2 to 5.1)
Linear trend for frequency of use	—	—	1.3 (1.2 to 1.4)	1.2 (1.0 to 1.3)

*Adjusted for diagnosis at conscription, IQ score, poor social integration, disturbed behaviour, cigarette smoking, and place of upbringing

†No drug use as baseline comparison

Discussion

Self reported use of cannabis in early adulthood was associated with an increased risk of developing schizophrenia. Risk increased in a dose dependent manner with increasing frequency of cannabis use, and this relation remained when analysis was restricted to subjects who had used only cannabis and no other drugs before conscription. The largest risk was seen in subjects reporting use of cannabis on more than 50 occasions. We found no association between cannabis and other psychotic illnesses, which implies that cannabis has a rather specific association with an increased risk of schizophrenia.

Table 5 Adjusted odds ratios with 95% confidence intervals for developing schizophrenia any time after conscription for subjects taking cannabis only

Drug use	No of subjects	No (%) of subjects developing schizophrenia	Odds ratio (95% CI) Crude	Odds ratio (95% CI) Adjusted*
Cannabis ever	1635	18 (1.1)	1.9 (1.2 to 3.0)	1.9 (1.1 to 3.1)
Frequency of use of cannabis (ever)				
None	36 429	215 (0.6)	1.0†	1.0†
Once	245	0	—	—
2-4 times	499	5 (1.0)	1.7 (0.7 to 4.2)	1.9 (0.8 to 4.8)
5-10 times	255	3 (1.2)	2.0 (0.6 to 6.3)	1.7 (0.5 to 5.7)
11-50 times	176	1 (0.6)	1.0 (0.1 to 6.9)	0.8 (0.1 to 6.0)
>50 times	70	4 (5.7)	10.2 (3.7 to 28.3)	6.7 (2.1 to 21.7)
Linear trend for frequency of use	—	—	1.3 (1.1 to 1.6)	1.3 (1.0 to 1.5)

*Adjusted for diagnosis at conscription, IQ score, poor social integration, disturbed behaviour, cigarette smoking, and place of upbringing.
†No drug use as baseline comparison.

The association between use of cannabis and schizophrenia was stronger in subjects who were first admitted within five years of conscription. One explanation is that subjects with a prodrome of schizophrenia at conscription may have increased their cannabis use, perhaps as a means of self medication.[3] But all subjects were screened at conscription, and we adjusted for other psychiatric problems recorded at that time. The relation with cannabis use was also observed in the later onset group, admitted more than five years after conscription. It seems more likely that the reduced association in the group with later onset is due to misclassification, as the number of people who discontinued cannabis use accumulated over time.[22]

Although adjustment for confounders substantially reduced the odds ratios, adjusting for poor social integration had only minimal effects. A similar effect was observed in the original study by Andreasson et al, who adjusted for the number of friends that the subjects reported having.[4] We used a more comprehensive measure of social integration as it is likely that on its own this question was not a strong measure of sociable personality traits. Personality traits are difficult to measure accurately, however, and residual confounding remains a possibility. The association between cannabis and schizophrenia persisted even after adjusting for use of alcohol, cigarettes, and other drugs, all of which are likely to be indicative of risk taking behaviour. This implies that a shared risk factor (be it biological, genetic, or through personality traits) for developing schizophrenia and for using psychoactive substances does not adequately explain the association observed.

We are limited in that we have only data regarding use of cannabis before conscription. But if the pattern of increased initiation and reduced cessation of drug use seen in the schizophrenia group persisted after the time of conscription, this would result in us underestimating the effect size of cannabis. Fewer subjects in this cohort claimed to have used cannabis and other illicit drugs compared with similar cohorts that used anonymous questionnaires.[23] The effect of under-reporting would again result in an underestimate of the true effect size. Non-response was similar for subjects developing schizophrenia and non-cases, although, as a further check, we repeated the analyses, having recoded non-responders as either users or non-users of cannabis. This made no difference when recoding was non-differential between cases and non-cases, but it increased the odds ratios substantially when recoding was differential.

It is possible that use of stimulants could explain the results if stimulants were able to induce a chronic psychotic illness, identical to schizophrenia. But we did not find an independent association between use of stimulants and schizophrenia, although power was reduced compared with other analyses. Although studies from the United States have found that initiation of amphetamine use peaks by age 18-20,[23] it is possible that initiation of stimulants after conscription was more likely in subjects who had previously used only cannabis. But the absence of an independent association with use of stimulants in our data implies that cannabis is potentially the more important agent.

These findings are in keeping with accumulating evidence that cannabis has detrimental effects on mental health in some people.[3] Molecular studies have shown that Δ^9-tetrahydrocannabinol, the active component of cannabis, increases release of dopamine in the mesolimbic pathway.[24] Given the suggested relation between increased mesolimbic dopamine and positive symptoms of schizophrenia,[25] such observations provide support for the hypothesis that cannabis may act as a risk factor for this disorder.

Use of cannabis use has increased substantially over the past few decades in the United Kingdom, and 50% of the population now report having used cannabis at least once.[26] If cannabis increases the risk of schizophrenia by 30%, as implied by these results, then 13% of cases of schizophrenia could be prevented if cannabis use was eliminated from the population, assuming that a causal relation between cannabis use and schizophrenia really exists. The overall weight of evidence is that occasional use of cannabis has few harmful effects overall,[3] and the drug is less likely to be used regularly and cause dependence than nicotine. Nevertheless, these results indicate a potentially serious risk to the mental health of people who use cannabis, particularly in the presence of other risk factors for schizophrenia. Such risks need to be considered in the current move to liberalise and possi-

What is already known about this topic

Use of cannabis has been associated with an increased risk of developing schizophrenia

Alternative explanations for this association include confounding by personality or by use of other drugs such as amphetamines, and use of cannabis as a form of self medication secondary to the disorder

What this study adds

Self reported cannabis use is associated with an increased risk of subsequently developing schizophrenia, consistent with a causal relation

This association is not explained by sociability personality traits, or by use of amphetamines or other drugs

Self medication with cannabis is an unlikely explanation for the association observed bly legalise the use of cannabis in the United Kingdom and other countries.

We thank Hollie Thomas and Diane McCracken for their help and advice, and Jonas Sadigh for his help with data management.

Contributors: SZ contributed to the conception of the study, data analysis, and drafting of the manuscript. PA contributed to the conception and design of the study, and drafting of the manuscript. SA contributed to the conception and design of the study, and drafting of the manuscript. IL contributed to the design of the study and drafting of the manuscript. GL contributed to the conception of the study, data analysis, and drafting of the manuscript. SZ is the guarantor.

Funding: This research is funded from a clinical training fellowship grant awarded to SZ by the Medical Research Council, UK (grant no G84/5689).

Competing interests: None declared.

1 Thomas H. Psychiatric symptoms in cannabis users. *Br J Psychiatry* 1993;163:141-9.
2 Hall W, Solowij N, Lemon J. *The health and psychological consequences of cannabis use.* Canberra: Australian Government Publishing Service, 1994.
3 Johns A. Psychiatric effects of cannabis. *Br J Psychiatry* 2001;178:116-22.
4 Andreasson S, Allebeck P, Engstrom A, Rydberg U. Cannabis and schizophrenia. A longitudinal study of Swedish conscripts. *Lancet* 1987;2:1483-6.
5 Johnson BA, Smith BL, Taylor P. Cannabis and schizophrenia. *Lancet* 1988;1:592-3.
6 Negrete JC. Cannabis and schizophrenia. *Br J Addict* 1989;84:349-51.
7 Hall W, Degenhardt L. Cannabis use and psychosis: a review of clinical and epidemiological evidence. *Aust N Z J Psychiatry* 2000;34:26-34.
8 Andreasson S, Allebeck P, Rydberg U. Schizophrenia in users and nonusers of cannabis. A longitudinal study in Stockholm County. *Acta Psychiatr Scand* 1989;79:505-10.
9 Johnstone EC. Schizophrenia. In: Johnstone EC, Freeman CPL, Zealley AK. *Companion to psychiatric studies.* 6th ed. London: Churchill Livingstone, 1998:369-97.
10 Lewis G, David A, Andreasson S, Allebeck P. Schizophrenia and city life. *Lancet* 1992;340:137-40.
11 David AS, Malmberg A, Brandt L, Allebeck P, Lewis G. IQ and risk for schizophrenia: a population-based cohort study. *Psychol Med* 1997;27:1311-23.
12 Malmberg A, Lewis G, David A, Allebeck P. Premorbid adjustment and personality in people with schizophrenia. *Br J Psychiatry* 1998;172:308-13.
13 Lewis G, David AS, Malmberg A, Allebeck P. Non-psychotic psychiatric disorder and subsequent risk of schizophrenia. Cohort study. *Br J Psychiatry* 2000;177:416-20.
14 Otto U. Function of male youths during military service. A follow-up study of a youth clientele. *Acta Psychiatr Scand* 1980;282(suppl):1-60.
15 World Health Organization. *Glossary of mental disorders and guide to their classification for use in connection with International Classification of Diseases.* Eight revision. Geneva: WHO, 1974.
16 Geddes JR, Kendell RE. Schizophrenic subjects with no history of admission to hospital. *Psychol Med* 1995;25:859-68.
17 Jablensky A. Epidemiology of schizophrenia: a European perspective. *Schizophr Bull* 1986;12:52-73.
18 Kristjansson E, Allebeck P, Wistedt B. Validity of the diagnosis of schizophrenia in a psychiatric inpatient register. *Nordisk Psykiatrisk Tidsskrift* 1987;41:229-34.
19 Greenland S, Rothman KJ. Introduction to categorical statistics. In: Rothman KJ, Greenland S. *Modern epidemiology.* 6th ed. Philadelphia: Lippincott Raven, 1998:231-52.
20 Zammit S, Allebeck P, Dalman C, Lundberg I, Owen M, Lewis G. Paternal age as a risk factor for schizophrenia (in press).
21 Zammit S, Allebeck P, Dalman C, Lundberg I, Lewis G. Investigating the association between cigarette smoking and schizophrenia using a cohort study (in press).
22 Chen K, Kandel DB. The natural history of drug use from adolescence to the mid-thirties in a general population sample. *Am J Public Health* 1995;85:41-7.
23 Andreasson S. Misuse of alcohol and cannabis among young men. Stockholm: Karolinska Institute, 1990.
24 Tanda G, Pontieri FE, Di Chiara G. Cannabinoid and heroin activation of mesolimbic dopamine transmission by a common mu1 opioid receptor mechanism. *Science* 1997;276:2048-50.
25 Davis KL, Kahn RS, Ko G, Davidson M. Dopamine in schizophrenia: a review and reconceptualization. *Am J Psychiatry* 1991;148:1474-86.
26 Singleton N, Bumpstead R, O'Brien M, Lee A, Meltzer H. Psychiatric morbidity among adults living in private households, 2000. London: Stationery Office, 2001.

(Accepted 12 September 2002)

bmj.com

Self reported cannabis use as a risk factor for schizophrenia in Swedish conscripts of 1969: historical cohort study

Stanley Zammit, Peter Allebeck, Sven Andreasson, Ingvar Lundberg and Glyn Lewis

BMJ 2002;325;1199-
doi:10.1136/bmj.325.7374.1199

THE BRITISH JOURNAL OF PSYCHIATRY

The British Journal of Psychiatry (2001) 178: 116-122

SUBSTANCE MISUSE PAPERS

Psychiatric effects of cannabis†

ANDREW JOHNS, FRCPsych

Department of Forensic Psychiatry, Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AF. Tel: 020 7919 3123

Declaration of interest This review was commissioned and funded by the Department of Health, but the findings are those of the author alone.

† See editorial, p. 98, this issue.

ABSTRACT

Background Cannabis is commonly regarded as an innocuous drug and the prevalence of lifetime and regular use has increased in most developed countries. However, accumulative evidence highlights the risks of dependence and other adverse effects, particularly among people with pre-existing psychiatric disorders.

Aims To re-evaluate the adverse effects of cannabis in the general population and among vulnerable individuals, including those with serious psychiatric disorders.

Method A wide-ranging review of the topics related to these issues.

Results and conclusions An appreciable proportion of cannabis users report short-lived adverse effects, including psychotic states following heavy consumption, and regular users are at risk of dependence. People with major mental illnesses such as schizophrenia are especially vulnerable in that cannabis generally provokes relapse and aggravates existing symptoms. Health workers need to recognise, and respond to, the adverse effects of cannabis on mental health.

UNTOWARD MENTAL EFFECTS OF CANNABIS

The untoward mental effects of cannabis may be classified:

a. Psychological responses such as panic, anxiety, depression or psychosis. These effects may be described as 'toxic' in that they generally relate to excess consumption of the drug.
b. Effects of cannabis on pre-existing mental illness and cannabis as a risk-factor for mental illness.
c. Dependency or withdrawal effects.

The effects of cannabis on cognition are separately reviewed by Ashton (2001, this issue).

PSYCHOLOGICAL RESPONSES TO CANNABIS

There is good evidence that taking cannabis leads to acute adverse mental effects in a high proportion of regular users. Many of these effects are dose-related, but adverse symptoms may be aggravated by constitutional factors including youthfulness, personality attributes and vulnerability to serious mental illness.

Cannabis and mood change

The acute response to cannabis generally includes euphoria and feelings of detachment and relaxation. Adverse effects are not uncommon: these are generally short-lived, but may persist or recur with continued use of the drug.

From New Zealand, a sample of 1000 people aged 18-25 were asked to complete a self-administered questionnaire on cannabis use and related problems (Thomas, 1996). Those respondents who admitted using cannabis (38%) were asked about mental health consequences; of these, 22% reported panic attacks or anxiety. Women were twice as likely as men to report these symptoms. Troisi *et al* (1998) used urine tests on Italian draftees to identify 133 men who used only cannabis. All individuals with a pre-existing psychosis or severe personality disorder had been excluded. An adjustment disorder with depressed mood was found in 16%, major depression in 14%, and dysthymia in 10.5%. The severity of these symptoms was dose-related. No acute psychotic symptoms were reported. Reilly *et al* (1998) describe the adverse effects found among 268 cannabis users who had taken the drug for at least 10 years, and who continued to smoke about two refers a day. The most common adverse effects were feelings of anxiety, paranoia or depression (21%), tiredness and low motivation (21%).

Among individuals making serious attempts at suicide, 16.2% met criteria for cannabis misuse/dependence compared with 1.9% of controls — much of the highly significant association was thought to be due to independent variables including comorbidity, but it is suggested that cannabis misuse makes a direct contribution to the risk of serious self-harm, either directly or by aggravation of other mental disorders (Beautrais *et al*, 1999).

Cannabis and psychosis

Cannabis use can lead to a range of short-lived symptoms such as depersonalisation, derealisation, a feeling of loss of control, fear of dying, irrational panic and paranoid ideas (Thomas, 1993). For example, Thomas (1996) reported that, among cannabis users who responded to his survey, 15% identified psychotic symptoms such as hearing voices or having unwarranted feelings of persecution or risk of harm from others. Two small case studies have reported prolonged depersonalisation after cessation of cannabis use (Szymanski, 1981; Keshaven & Lishman, 1986). 'Flashbacks' or the subsequent partial re-experience when drug-free of symptoms experienced during intoxication are rarely reported after cannabis use (Thomas, 1993).

The casual use of the term 'cannabis psychosis' in clinical psychiatric practice and in the scientific literature results in diagnostic imprecision and research of uncertain validity. Thornicroft (1990) reviews the possible associations between cannabis use and psychosis and suggests that common methodological failings are: (a) studies fail to adequately separate organic from functional psychotic reactions to cannabis; (b) they have insufficiently discriminated between psychotic symptoms and syndromes of a psychosis; and (c) they have not balanced the weight of evidence for and against the category of cannabis psychosis. Although there is good evidence for believing that cannabis use may in certain circumstances contribute to psychotic disorders, the connections are complex.

Hall *et al* (1994) suggest that the fundamental questions are: is there a cannabis psychosis, and does cannabis precipitate an underlying psychosis? In theory, cannabis use may precipitate a psychosis in the following ways.

a. Acute use of large doses of the drug may induce a toxic or organic psychosis with symptoms of confusion and hallucination, which remit on abstinence.
b. Cannabis use may lead to an acute functional psychosis, similar to an acute schizophreniform state and lacking the organic features of a toxic psychosis.
c. Cannabis use may lead to a chronic psychosis, which persists after abstinence.
d. Long-term cannabis use may lead to an organic psychosis which only partially remits after abstinence, leaving a residual deficit state, sometimes called an amotivational syndrome, which is thought to be analogous to the chronic organic brain syndrome seen after prolonged misuse of alcohol.
e. Cannabis use may be a risk-factor for serious mental illness such as schizophrenia.

Cannabis and toxic psychosis

Apart from single-case reports, the nature of cannabis-induced toxic psychosis is considered in the following studies, all of which are weakened by the lack of urine-testing to confirm the presence of cannabis and the absence of other drugs of misuse.

Talbott & Teague (1969) described 12 soldiers in Vietnam who, after their first admitted use of cannabis, showed dis-orientation, impaired memory, confusion, reduced attention span and disordered thinking with labile effect and hallucinations. These symptoms resolved within a week. Tennant & Groesbeck (1972) describe psychoses among 36 000 US servicemen stationed in Germany. Of the 5120 soldiers using cannabis at least three times a week, 720 presented with cannabis-related problems. The hashish available was potent, containing 5-10% tetrahydrocannabinol (THC). The authors identified 19 cases of a panic attack or short-lived toxic psychosis, which appeared after a single high dose of hashish, and a further 85 cases of toxic psychosis which appeared after the consumption of cannabis with other drugs. These acute states tended to resolve within 3 days.

From Calcutta, Chopra & Smith (1974) retrospectively identified 200 in-patients who showed serious psychiatric symptoms after taking cannabis. The most common symptoms in all patients were sudden onset of confusion, often associated with hallucinations and emotional lability. Disorientation, depersonalisation and paranoid symptoms were common. Many patients had taken a large dose of cannabis, which was followed by an intoxicated state for which they were subsequently amnesic. Among the 34% of patients without a previous history of psychiatric disorder, adverse symptoms lasted no more than a few days, followed by full recovery. A previous history of schizophrenia or personality disorder was associated with longer duration of adverse symptoms.

From Pakistan, Chaudry *et al* (1991) report on effects of *bhang*, a potent beverage made from an infusion of cannabis leaves and flowering tops. They identified 15 patients who having taken *bhang*, presented with a psychosis with symptoms of grandiosity, excitement, hostility, dis-orientation, hallucinations and thought disorder. Mental state was assessed systematically, using the Brief Psychiatric Rating Scale (BPRS) (Lukoff *et al*, 1986). The control group of 10 patients all used *bhang*, but less frequently than the study group.

This work suggests that cannabis, especially in high doses, can produce a toxic psychosis in individuals who have no history of severe mental illness. The main features are mild impairment of consciousness, distorted sense of passage of time, dream-like euphoria, progressing to fragmented thought processes and hallucinations, generally resolving within a week of abstinence (Lishman, 1998).

Cannabis and acute functional psychosis

A number of studies suggest that heavy cannabis use can lead to an acute functional illness, that is a state resembling the psychosis of acute schizophrenia without the amnesia and confusion of a toxic psychosis.

Tennant & Croesbeck (1972) identified 115 cases of schizophrenic reaction among the 720 regular users of cannabis; however, all but three had used cannabis with other drugs or alcohol. Thacore & Shukla (1976) compared 25 individuals with a putative diagnosis of 'cannabis psychosis of the paranoid type' with controls diagnosed with paranoid schizophrenia. Patients with cannabis psychosis showed more bizarre behaviour, violence, panicky affect, more insight and less evidence of thought disorder. They also showed a rapid response to neuroleptics with complete recovery. More robust in methodology is the work of Rottanburg *et al* (1982) in which 20 patients with psychosis and with high urinary cannabinoids were compared with 20 matched cannabis-free controls. Mental state was assessed using the Present State Examination (PSE) (Wing *et al*, 1974). The cannabis-positive patients had more symptoms of hypomania and agitation, less auditory hallucinations, flattening of affect, incoherent speech and hysteria than controls. Clouding of consciousness was absent in most cannabis patients. They also showed marked improvements in symptoms within a week, while the controls remained unwell despite receiving comparable antipsychotic drugs. The authors conclude that a high intake of cannabis may be related to a rapidly resolving psychosis with marked hypomanic features. However, 16 cannabis-positive psychotic patients left the study prematurely, which may bias the findings on the 20 who remained. Rapid resolution of symptoms is also reported by Carney *et al* (1984), who identified nine patients with cannabis-related psychotic episodes. Their differing symptomatology was described as 'schizophreniform, manic, delusional psychosis and confusion'.

More recently, Mathers & Ghodse (1992) carried out a prospective study of in-patients with psychotic symptoms and cannabis-positive urine. Blind to the urine test result, researchers applied the PSE on admission and again at 1 and 6 months. Concurrently admitted patients with psychosis but with drug-free urine analysis were controls. At 1 week the two groups differed significantly on only five PSE items: changed perception, thought insertion, non-verbal auditory hallucinations, delusions of control, and delusions of grandiose ability; this symptom cluster at 1 week was thought to be consistent with acute cannabis intoxication. These differences were minor at 1 month and absent at 6 months. Chronic cannabis-induced psychosis was not found. Caucasian patients were more likely to be depressed with depersonalisation and derealisation, while African-Caribbeans showed more culturally influenced delusions. However, these findings could not be replicated by McGuire *et al* (1994) who also used the PSE to assess the psychopathology of 23 patients with psychosis who were cannabis-positive on urinary screening, and 46 matched drug-free controls. Cases and controls were indistinguishable in terms of psychopathology, DSM-III diagnoses (American Psychiatric Association, 1980), onset of recent illness, the proportion of first admissions, ethnicity and socio-economic class, differing only in their histories of substance use.

Having compared groups of drug-misusing patients with psychosis of varying duration, Tsuang *et al* (1982) concluded that the shorter-duration disorders were drug-induced toxic psychoses, and the longer-lasting disorders represented the expression of functional psychiatric illness in vulnerable individuals. If corroborated, this suggests that the 'functional psychosis' related to cannabis use is best explained as a precipitated episode of an underlying functional illness.

Cannabis and chronic psychosis

Ghodse (1986) has suggested that regular heavy users of cannabis may suffer repeated short episodes of psychosis and effectively 'maintain' themselves in a chronic psychotic state. This is a possibility, but Hall *et al* (1994) note that it is difficult to distinguish between a chronic cannabis psychosis and the co-occurrence of an illness such as schizophrenia with continued cannabis use. There is however, no robust evidence that heavy cannabis use may lead to a psychotic illness which persists after abstinence (Thomas, 1993).

Cannabis and amotivational syndrome

It has been suggested that heavy cannabis use could lead to an 'amotivational syndrome' described as personality deterioration with loss of energy and drive to work (Tennant & Groesbeck, 1972). The supporting evidence largely comprises uncontrolled studies of long-term cannabis users in various cultures (Hall *et al*, 1994). It is probable that amotivational syndrome represents nothing more than ongoing intoxication in frequent users of the drug (Negrete *et al*, 1986) and the validity of this diagnosis remains uncertain (Hall *et al*, 1994).

Cannabis as risk-factor for serious mentall illness

Comorbidity rates

Cannabis use is associated with high rates of comorbidity for other psychiatric diagnoses. The Epidemiologic Catchment Area (ECA) survey (Regier *et al*, 1990) of 20 000 subjects in community and institutional settings showed that 50.1% of individuals with cannabis dependence/misuse also met DSM-III criteria for one other non-drug or alcohol mental disorder. Among 133 Italian draftees, Troisi *et al* (1998) found that the prevalence of comorbidity was significantly related to the pattern of cannabis use: 69% of subjects with DSM-III-R cannabis dependence, 41% of those with cannabis abuse and 24% of occasional users reported at least one DSM-III-R Axis 1 psychiatric diagnosis. Most common were adjustment disorder with depressed mood (n=21), major depression (n=19) and dysthymia (n=14). The severity of symptoms also increased with degree of cannabis use. Psychotic symptoms were not found, but it should be noted all individuals with psychotic illness or severe personality disorder were not drafted.

There are high rates of drug misuse among people with mental illness. The ECA study (Regier *et al*, 1990) showed that the risk of meeting criteria for a substance misuse disorder was 4.6 times higher in those suffering from schizophrenia than in the general population. Schizophrenia was associated with a six-fold increase in risk of developing a drug use disorder, and cannabis was the most commonly misused drug. Menezes *et al* (1996) examined the prevalence of substance misuse problems among 171 patients with psychotic illness who had any contact with mental health treatment services in a south London area. Alcohol problems were more prevalent, but current use of one or more drugs was found in 35 subjects (20%); all but two said they used cannabis. Cantwell *et al* (1999) studied 168 subjects presenting with a first episode of psychosis and found 1-year prevalence rates of 19.5% for drug misuse, 11.7% for alcohol misuse, and cannabis was the most commonly misused substance. Given these findings, it is necessary to review the possible role of cannabis as a risk factor for functional illness and for the aggravation of symptoms.

Effects of cannabis on severe mental illness

Given that high doses of cannabis can cause a toxic psychosis, then it may be supposed it will aggravate the symptoms of schizophrenia. However, clinical experience suggests that some patients say that they take cannabis as a form of 'self-medication'. For example, Dixon *et al* (1990) interviewed 83 patients with schizophrenia or schizophreniform psychoses who reported that cannabis reduced anxiety and depression, led to increased suspiciousness and had varied effects on drive and hallucinations. Arndt *et al* (1992) investigated a cohort of 131 patients with schizophrenia and found that previous use of cannabis had no impact on current symptoms. Peralta & Cuesta (1992) reported that cannabis had no significant effect on positive symptoms of schizophrenia, but it did attenuate negative symptoms.

On the other hand, there are a few controlled studies that have tended to demonstrate that cannabis aggravates the severity of positive symptoms. Negrete *et al* (1986) described the history of confirmed cannabis use in 137 patients with schizophrenia in treatment. Subjects who were using cannabis over the 6-month observation period presented with significantly greater delusions and hallucinations, and made more use of psychiatric services. Similarly, Cleghorn *et al* (1991) found that drug-users with schizophrenia, among whom cannabis was the most heavily used drug, had a higher prevalence of hallucinations, delusions and other positive symptoms. This finding was replicated by Baigent *et al* (1995), who reported that among 53 in-patients with a dual diagnosis of substance misuse and schizophrenia, cannabis was the only drug that worsened positive symptoms.

Data from the ECA survey (Swanson *et al*, 1990) also casts some light on the possible effects of cannabis use disorder and violence. Subjects were asked about episodes of violence in the previous year (i.e. hitting a partner, bruising a child, fighting, using a weapon in a fight while drinking). Of the 191 respondents with cannabis abuse or dependence, 19.25% (risk ratio 9.4) had been violent compared with 12.69% (risk ratio 6.2) of those with schizophrenia or schizophreniform disorder and 24.57% (risk ratio 11.9) of those with alcohol abuse or dependence. Here, the risk is expressed relative to the 2.05% who were violent among those of the sample population who showed no psychiatric disorder. However, this does not amount to a causal correlation between cannabis co-morbidity and violence, given the possible role of intervening variables such as individual and social factors.

That cannabis consumption also has an adverse effect on the course of schizophrenia was noted by Negrete *et al* (1986) and confirmed in a prospective study by Linszman *et al* (1994). A cohort of newly admitted patients with schizophrenia were assessed monthly for a year, using the BPRS and self-reports of cannabis use. The cannabis-using group (n=24) experienced significantly more and earlier psychotic relapses and this effect was dose-related.

As Hall *et al* (1994) remark, these findings are a slender basis on which to draw conclusions about the effect of cannabis on schizophrenic symptoms. Until further prospective studies have been carried out, it would be prudent to regard cannabis as a vulnerability factor in relation to major mental illness and to caution at-risk individuals against using the drug.

Cannabis as risk factor for mental illness

There is no evidence that cannabis is a causal factor in schizophrenia and it is more relevant to consider whether the misuse of the drug constitutes a risk factor for this illness. Supporting evidence is found in a prospective study by Andreasson *et al* (1987) of 45 570 Swedish conscripts, of whom 9.4% had used cannabis and 1.7% were 'high consumers' having used more than 50 times. Fifteen-year follow-up data were drawn from national registers of deaths and psychiatric cases. Compared with non-users, the relative risk of schizophrenia was 2.4 in the group that reported use of cannabis at least once, rising to 6.0 among heavy users. Nearly half (430/730) of these high consumers had a psychiatric diagnosis other than psychosis on conscription; controlling for this reduced the relative risk to 2.9. The authors suggest that cannabis consumption is a 'life-event stressor' for individuals vulnerable to schizophrenia. Hall *et al* (1994) offer a number of alternative explanations. There is a large temporal gap between self-reported cannabis use on conscription and the development of schizophrenia over 15 years, and no data as to whether the cannabis use continued during this time. Drugs other than cannabis could have been taken at any time after conscription.

It should also be noted that as only 49 of the 274 conscripts with schizophrenia had ever tried cannabis, then this drug may only be relevant to a minority of cases. Furthermore, Jablensky *et al* (1992) demonstrate a striking uniformity in the incidence of schizophrenia in cultures with very different rates of cannabis consumption.

The possibility of a genetic explanation for the association between cannabis use and schizophrenia was raised by McGuire *et al* (1994). In this study, 23 patients with psychosis and with cannabis in their urine were gender-matched with 46 drug-free controls with psychosis, and the lifetime risk of psychiatric disorder among all the first-degree relatives was ascertained. The cannabis-positive subjects had a significantly greater (7.1%) familial risk of schizophrenia than controls (0.7%), suggesting that the development or recurrence of acute psychosis in the context of cannabis use may be associated with a genetic predisposition to schizophrenia.

CANNABIS DEPENDENCE

Evidence for cannabis dependence

It had been believed that cannabis use did not lead to tolerance and that there was no withdrawal syndrome. However, since the mid-1970s, these views have been challenged by many experimental and observational studies. For example, Jones & Benowitz (1976) administered oral THC in doses of 70-210 mg/day to subjects for 30 days and noted a progressive loss of the subjective 'high'. This finding was replicated by Georgotas & Zeidenberg (1979), who gave an average daily dose of 210 mg THC to volunteers for a 4-week period — the subjects then "found that the marijuana was much weaker". Withdrawal signs were also found: during the first week of abstinence the subjects "became very irritable, uncooperative, resistant and at times hostile"; they also became hungry and experienced insomnia. These effects waned over 3 weeks. Cessation of smoked cannabis has also been shown to lead to withdrawal symptoms (Haney *et al*, 1999). The cannabis-withdrawal syndrome has now been unequivocally demonstrated and includes restlessness, anxiety, dysphoria, irritability, insomnia, anorexia, muscle tremor, increased reflexes and autonomic effects including changes in heart rate, blood pressure, sweating and diarrhoea. The syndrome may appear in about 10 hours, and peaks at about 48 hours (Mendelson *et al*, 1984).

The validity of cannabis dependence

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association, 1994) presents criteria for the diagnosis of psychoactive substance dependence, based largely on the concept of the dependence syndrome (Edwards *et al*, 1981). The key features of DSM-IV substance dependence are cognitive, behavioural and physiological symptoms, indicating that the individual continues to use the substance despite significant substance-related problems. The criteria include tolerance, a withdrawal syndrome, difficulty in controlling consumption and a pattern of use which leads to a reduction in other important activities. In an empirical study, Morgenstern *et al* (1994) found the DSM concept of cannabis dependence as least as valid as those for dependence on alcohol, opiates, stimulants and sedatives.

Prevalence and course of cannabis dependence

From ECA data, Anthony & Helzer (1991) showed that men had a higher prevalence (7.7%) of cannabis abuse or dependence than women (4.8%). This was largely due to the greater exposure to illicit drugs of men, since the prevalence of a diagnosis of abuse/dependence among those who had used cannabis more than five times was the same in men and women (21% and 19%, respectively). Extrapolating from these data, Hall *et al* (1994) suggest that about 17% of those who used cannabis more than five times would meet DSM-III criteria for dependence, and that for those who have ever used there is approximately a 1/10 risk.

From a New Zealand birth cohort of 1265 children, Fergusson & Horwood (2000) found that by the age of 21, nearly 70% had used cannabis and over 9% met DSM-IV criteria for cannabis dependence. Key predictors were male gender, ethnic minority status and measures of adolescent risk-taking behaviours, including cigarette smoking, conduct problems and a delinquent peer group.

Wiesbeck *et al* (1996) set out to determine the prevalence of the cannabis-withdrawal syndrome in people who had used the drug but who were not in treatment. In a cohort of 5611 individuals, 31% had taken the drug on more than 21 occasions in a year. Among these more frequent users, 16% met criteria for a cannabis-withdrawal syndrome — i.e. at least any one of the following: feeling nervous or irritable, insomnia, tremor, sweats, nausea, gastrointestinal disturbance or appetite change. These individuals had used the drug almost daily for an average of 70 months and even when use of alcohol and other drugs was considered, cannabis use was still significantly related to a self-report of a history of cannabis withdrawal.

Thomas (1996) found that 35% of cannabis users said that they could not stop when they wanted to, 24% continued to use despite problems attributed to the drug and 13% felt that they could not control their consumption. Restlessness or irritability if they could not use cannabis was reported by 20% of those surveyed. Interestingly, dependent users were no more likely to report panic or psychotic episodes than those classed as non-dependent. With regard to untoward social consequences, 14% of cannabis users agreed that the consumption of the drug had caused them to neglect activities previously considered important or enjoyable. These findings (Thomas, 1996) have to be qualified by the low overall response rate of 35%, the use of unvalidated criteria for cannabis dependence and by the lack of data on misuse of alcohol or other drugs among the sample.

Swift *et al* (1998) interviewed a sample from New South Wales of 243 long-term cannabis users who were smoking 3-4 times a week. A lifetime prevalence of 57% was found for both DSM-III-R and ICD-10 (World Health Organization, 1992) dependence, but only a quarter perceived that they had a cannabis problem.

VULNERABILITY TO ADVERSE EFFECTS OF CANNABIS

It has previously been emphasised that constitutional factors such as relative youthfulness, personality and misuse of other drugs, may act as vulnerability factors to the adverse mental effects of cannabis. Mental illness as a vulnerability factor has been reviewed in the previous section.

Adolescence

There are a number of reasons why adolescence may be regarded as a time of vulnerability for the adverse mental effects of cannabis. First, adolescents may experience emotional problems that cue cannabis use, and their relative youth may lead to an increased risk of adverse mental states on using the drug. Second, regular use of cannabis may interfere with learning and personal development. Last, early initiation of cannabis use may predict an increased risk of escalation in risk and progression to other drugs.

With regard to the possible impact of emotional problems, Newcombe & Bentler (1988) found a strong relationship between adolescent drug use and the experience of emotional distress, depression and lack of a sense of purpose in life. As to the prospect of adverse mental states on using high doses of cannabis, this review has demonstrated dose-related effects in adults and the younger user is not likely to be at any lesser risk. Crowley *et al* (1998) found that for adolescents with conduct problems, cannabis use was not benign in that misuse was associated with high rates of dependence and withdrawal.

The possible effects of cannabis consumption on the educational performance of adolescents are not easy to demonstrate in population studies (Hall *et al*, 1994). Newcombe & Bentler (1988), having controlled for the higher nonconformity and the lower academic potential among adolescent drug users, found only a modest negative link between drug use and college involvement. Schwartz *et al* (1989) found short-term memory impairment in 10 cannabis-dependent adolescents compared with matched controls. Test results tended to improve over 6 weeks, which suggested that the deficits observed were due to past cannabis use.

Polydrug use

A substantial number of young people in the community use a range of drugs which includes cannabis. Ramsay & Percy (1996) found that 4% of a group of 16- to 29-year-olds admitted using cannabis and other drugs in the past month, by contrast with 8% who had used only cannabis. Clinical observation suggests that cannabis users who also misuse other drugs or alcohol seem to experience more severe mental health problems than those who solely take cannabis, but there do not appear to be any substantial published studies on this issue. Polydrug use is a recognised concern in psychiatric populations: for example, Baigent *et al* (1995) found that 20% of their dual-diagnosis #patients misused more than one substance.

Personality

Given the heterogeneity of the population of cannabis users, it is not surprising that no single personality type or disorder is particular to users of that drug or, indeed, to users of any illicit drug (Allen & Frances, 1986). However, it is a matter of clinical observation that the use of cannabis by some individuals seems to be predisposed by traits such as social anxiety, anxiety or dysphoria. Such posited use as a form of self-medication to relieve unwanted affects or feelings was not corroborated in a study of cannabis-dependent individuals (Greene *et al*, 1993). There is good evidence for the comorbidity of drug misuse and some personality disorders. For example, Regier *et al* (1990) report that some form of substance abuse was identified in 83.6% of individuals with antisocial personality disorder (ASPD), with an odds ratio of 29.6. It should be appreciated that this very high rate arises because substance abuse is one of the major diagnostic criteria for ASPD; only 16% of individuals with ASPD did not have a history of substance abuse. The same study showed that the lifetime prevalence of ASPD in cannabis abuse or dependence was 14.7% with an odds ratio of 8.3. The interaction between ASPD and cannabis use is too complex to explore at length in this review, but it is probable that each disorder exacerbates the adverse effects of the other. See Dolan & Coid (1993) for a discussion of factors determining outcome in ASPD.

Implications for mental health care

How should mental health services respond to these findings? The key priorities are: (a) risk-management and care-planning have to be informed by a thorough substance-misuse assessment (Johns, 1997); (b) community and in-patient psychiatric services should develop policies on substance use which balance the treatment needs of individual patients with duties of care to other patients and to the general public; and (c) research is needed into treatment interventions for patients with mental illness and substance misuse problems.

Clinical Implications and Limitations

CLINICAL IMPLICATIONS

- **Among those who have ever taken cannabis, 1/10 are at risk of dependence.**
- **Heavy cannabis misuse leads to the risk of psychotic episodes, and aggravates the symptoms and course of schizophrenia.**
- **For any psychiatric patient, risk-management and care-planning is incomplete without a thorough assessment of substance misuse.**

LIMITATIONS

- **The available literature shows a preponderance of case reports and uncontrolled studies.**
- **Epidemiological findings from one setting cannot be assumed to generalise to other cultural groups.**
- **It is not easy to determine causal explanations from the studies cited.**

REFERENCES

Allen, M. H. & Frances, R. (1986) Varieties of psychopathology found in patients with addictive disorders: a review. In *Psychopathology and Addictive Disorders* (ed. R. Meyer), pp. 17-38. London: Guilford Press.

American Psychiatric Association (1980) *Diagnostic and Statistical Manual of Mental Disorders* (3rd edn) (DSM-III). Washington, DC: APA.

American Psychiatric Association (1994) *Diagnostic and Statistical Manual of Mental Disorders* (4th edn) (DSM-IV). Washington, DC: APA.

Andreasson, S., Allebeck, P., Engstrom, A., *et al* (1987) Cannabis and schizophrenia: a longitudinal study of Swedish conscripts. *Lancet, ii*, 1483-1486.

Anthony, J. C. & Helzer, J. E. (1991) Syndromes of drug abuse and dependence. In *Psychiatric Disorders in America* (eds L. N. Robins & D. A. Regier). New York: Free Press, Macmillan.

Arndt, S., Tyrrell, G., Flaum, M., *et al* (1992) Comorbidity of substance abuse and schizophrenia: the role of pre-morbid adjustment. *Psychological Medicine*, **22**, 379-388.[Medline]

Ashton, C. H. (2001) Pharmacology and effects of cannabis: a brief review. *British Journal of Psychiatry*, **178**, 101-106.[Abstract/Free Full Text]

Baigent, M., Holme, G. & Hafner, R. J. (1995) Self reports of the interaction between substance abuse and schizophrenia. *Australian and New Zealand Journal of Psychiatry*, **29**, 69-74.[Medline]

Beautrais, A. L., Joyce, P. R. & Mulder, R. T. (1999) Cannabis abuse and serious suicide attempts. *Addiction*, **94**, 1155-1164.[CrossRef][Medline]

Cantwell, R., Brewin, J., Glazebrook, C., *et al* (1999) Prevalence of substance misuse in first-episode psychosis. *British Journal of Psychiatry*, **174**, 150-153.[Abstract]

Carney, M. W. P., Bacelle, L. & Robinson, B. (1984) Psychosis after cannabis abuse. *British Medical Journal*, **288**, 1047.[Medline]

Chaudry, H. R., Moss, H. B., Bashir, A., *et al* (1991) Cannabis psychosis following bhang ingestion. *British Journal of Addiction*, **86**, 1075-1081.[Medline]

Chopra, G. S. & Smith, J. W. (1974) Psychotic reactions following cannabis use in East Indians. *Archives of General Psychiatry*, **30**, 24-27.[CrossRef][Medline]

Cleghorn, J. M., Kaplan, R. D., Szechtman, B., *et al* (1991) Substance abuse and schizophrenia: effect on symptoms but not on neurocognitive function. *Journal of Clinical Psychiatry*, **52**, 26-30.

Crowley, T. J., Macdonald, M. J., Whitmore, E. A., *et al* (1998) Cannabis dependence, withdrawal and reinforcing effects among adolescents with conduct symptoms and substance use disorders. *Drug and Alcohol Dependence*, **50**, 27-37.[CrossRef][Medline]

Dixon, L., Haas, G., Wedien, P. J., *et al* (1990) Acute effects of drug abuse in schizophrenic patients: clinical observations and patients' self-reports. *Schizophrenia Bulletin*, **16**, 69-79.[Medline]

Dolan, B. & Coid, J. (1993) *Psychopathic and Antisocial Personality Disorders: Treatment and Research Issues*. London: Gaskell.

Edwards, G., Arif, A. & Hodgson, R. (1981) Nomenclature and classification of drug- and alcohol-related problems: a WHO memorandum. *Bulletin of the World Health Organization*, **59**, 225-242. [Medline]

Fergusson, D. M. & Horwood, L. J. (2000) Cannabis use and dependence in a New Zealand birth cohort. *New Zealand Medical Journal*, **113**, 56-58.[Medline]

Georgotas, A. & Zeidenberg, P. (1979) Observations on the effects of four weeks of heavy marijuana smoking on group interaction and individual behavior. *Comprehensive Psychiatry*, **20**, 427-432. [CrossRef][Medline]

Ghodse, A. H. (1986) Cannabis psychosis. *British Journal of Addiction*, **81**, 473-478.[Medline]

Greene, R. L., Adyanthaya, A. E., Morse, R. M., *et al* (1993) Personality variables in cocaine and marijuana dependent patients. *Journal of Personality Assessment*, **61**, 224-230.[Medline]

Hall, W., Solowij, N. & Lemon, J. (1994) *The Health and Social Consequences of Cannabis Use*. Monograph Series No. 25. Canberra: Australian Government Publishing Service.

Haney, M., Ward, A. S., Comer, S. D., *et al* (1999) Abstinence symptoms following smoked marijuana in humans. *Psychopharmacology (Berl)*, **141**, 395-404.[CrossRef][Medline]

Jablensky, A., Sartorius, N., Ernberg, G., *et al* (1992) Schizophrenia: manifestations, incidence and course in different cultures. *Psychological Medicine. Monograph Supplement 20.*

Johns, A. (1997) Substance misuse: a primary risk and a major problem of comorbidity. *International Journal of Psychiatry*, **9**, 233-241.[CrossRef]

Jones, R. T. & Benowitz, N. (1976) The 30-day trip. Clinical studies of cannabis tolerance and dependence. In *Pharmacology of Marijuana, Vol. 2* (eds M. C. Braude & S. Szara). New York: Academic Press.

Keshaven, M. S. & Lishman, W. A. (1986) Prolonged depersonalization following cannabis abuse. *British Journal of Addiction*, **81**, 140-142.[Medline]

Linszman, D. H., Dingemans, P. M. & Lenior, M. E. (1994) Cannabis abuse and the course of recent-onset schizophrenic disorders. *Archives of General Psychiatry*, **51**, 273-279.[Abstract]

Lishman, W. A. (1998) *Organic Psychiatry: The Psychological Consequences of Cerebral Disorder* (3rd edn). Oxford: Blackwell.

Lukoff, D., Lieberman, R. & Neuchterlein, K. (1986) Symptom monitoring in the rehabilitation of schizophrenic patients. *Schizophrenia Bulletin*, **12**, 578-603.[Medline]

McGuire, P. K., Jones, P., Harvey, I., *et al* (1994) Cannabis and acute psychosis. *Schizophrenia Research*, **13**, 161-167.[CrossRef][Medline]

Mathers, D. C. & Ghodse, A. H. (1992) Cannabis and psychotic illness. *British Journal of Psychiatry*, **161**, 648-653.[Abstract]

Mendelson, J. H., Mello, N. K., Lex, B. W., *et al* (1984) Marijuana withdrawal syndrome in a woman. *American Journal of Psychiatry*, **141**, 1289-1290.[Abstract]

Menezes, P. R., Johnson, S., Thornicroft, G., *et al* (1996) Drug and alcohol problems among individuals with severe mental illness in south London. *British Journal of Psychiatry*, **168**, 612-619.[Abstract]

Morgenstern, J., Langenbucher, J. & Labouvie, E. W. (1994) The generalizability of the dependence syndrome across substances: an examination of some properties of the proposed DSM-IV dependence criteria. *Addiction*, **89**, 1105-1113.[Medline]

Negrete, J. C., Knapp, W. P., Douglas, D. E., *et al* (1986) Cannabis affects the severity of schizophrenic symptoms: results of a clinical survey. *Psychological Medicine*, **16**, 515-520.[Medline]

Newcombe, M. D. & Bentler, P. (1988) *Consequences of Adolescent Drug Use: Impact on the Lives of Young Adults*. Newbury Park, CA: Sage.

Peralta, V. & Cuesta, M. J. (1992) Influence of cannabis abuse on schizophrenic psychopathology. *Acta Psychiatrica Scandinavica*, **85**, 127-130.[Medline]

Ramsay, M. & Percy, A. (1996) *Drug Misuse Declared: Results of the 1994 British Crime Survey.* London: Home Office.

Regier, D. A., Farmer, M. E., Rae, D. S., *et al* (1990) Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area (ECA) study. *Journal of the American Medical Association*, **264**, 2511-2518.[Abstract]

Reilly, D., Didcott, R., Swift, W., *et al* (1998) Long-term cannabis use: characteristics of users in Australian rural areas. *Addiction*, **93**, 837-846.[CrossRef][Medline]

Rottanburg, D. R., Robins, A. H., Ben-Arie, O., *et al* (1982) Cannabis-associated psychosis with hypomanic features. *Lancet*, *ii*, 1364-1366.

Schwartz, R. H., Gruenewald, P. J., Klitzner, M., *et al* (1989) Short-term memory impairment in cannabis-dependent adolescents. *American Journal of Disorders of Childhood*, **143**, 1214-1219.

Swanson, J. W., Holzer, C. E. 3rd, Ganju, V. K., *et al* (1990) Violence and psychiatric disorder in the community: evidence from the Epidemiologic Catchment Area surveys. *Hospital and Community Psychiatry*, **41**, 761-770.[Medline]

Swift, W., Hall, W., Didcott, P., *et al* (1998) Patterns and correlates of cannabis dependence among long-term users in an Australian rural area. *Addiction*, **93**, 1149-1160.[CrossRef][Medline]

Szymanski, H. V. (1981) Prolonged depersonalisation after marijuana use. *American Journal of Psychiatry*, **138**, 231-233.[Abstract]

Talbott, J. A. & Teague, J. W. (1969) Marijuana psychosis. *Journal of the American Medical Association*, **210**, 299-302.[CrossRef][Medline]

Tennant, F. S. & Groesbeck, C. J. (1972) Psychiatric effects of hashish. *Archives of General Psychiatry*, **27**, 133-136.[CrossRef][Medline]

Thacore, V. R. & Shukla, S. R. P. (1976) Cannabis psychosis and paranoid schizophrenia. *Archives of General Psychiatry*, **33**, 383-386.[Abstract]

Thomas, H. (1993) Psychiatric symptoms in cannabis users. *British Journal of Psychiatry*, **163**, 141-149.[Abstract]

Thomas, H. (1996) A community survey of adverse effects of cannabis use. *Drug and Alcohol Dependence*, **42**, 201-207.[CrossRef][Medline]

Thornicroft, G. (1990) Cannabis and psychosis. Is there epidemiological evidence for an association? *British Journal of Psychiatry*, **157**, 25-33.[Abstract]

Troisi, A., Pasini, A., Saracco, M., *et al* (1998) Psychiatric symptoms in male cannabis users not using other illicit drugs. *Addiction*, **93**, 487-492.[CrossRef][Medline]

Tsuang, M. T., Simpson, J. C. & Kronfol, Z. (1982) Subtypes of drug abuse with psychosis. *Archives of General Psychiatry*, **39**, 141-147.[Abstract]

Northwest Center for Health & Safety

P.O. Box 5853 Portland, OR 97228-5853 Telephone: 360-263-5905 Fax: 360-263-3964

April 24, 2002

Marijuana use often leads to depression

Those claiming that smoking marijuana brings medical relief for a long list of maladies, typically include depression in that list. A new study from the University of Pennsylvania Treatment Center indicates that "cannabis abuse is a risk factor for depressive symptoms rather than an effort to self-medicate depression."

The study, which included a large "randomly sampled adult population over a nearly 15 year period," found that those who used cannabis were "four times more likely" than those who didn't "to have depressive symptoms...in particular...more likely to have experienced suicidal ideation [thoughts] and anhedonia [inability to experience pleasure].

The author states that "The results [of the study] underscore the importance of cannabis abuse prevention rather than treatment.....Treating depression may reduce cannabis use in clinical populations, but depression did not necessarily lead these individuals to initiate cannabis use...Despite the limitations of the current study, the results suggest that the potentially serious consequences of cannabis abuse require further research."

"Cannabis Abuse as a Risk Factor for Depressive Symptoms"
Am J. Psychiatry, 158:12, December 2001
Bovasso

Northwest Center for Health & Safety

P.O. Box 5853 Portland, OR 97228-5853 Telephone: 360-263-5905 Fax: 360-263-3964

Daily Telegraph, Sydney, Australia
August 26, 2002

Cannabis trebles mental illness risk

LONDON: Smoking cannabis can treble the risk of developing a mental illness, a new study has found.

In one of the biggest investigations into the long-term effects of the drug, scientists uncovered evidence proving marijuana is dangerous and can cause serious psychotic disorders in people with no history of mental illness.

The revelation will horrify thousands of people who either use the drug to ease a medical condition or are regular smokers, believing it harmless.

Results of the three-year study come just a month after Home Secretary David Blunkett announced plans to downgrade the drug so it is no longer an offence to possess small amounts.

The research by the University of Maastricht in the Netherlands appears to confirm anecdotal evidence.

It shows that people who smoke cannabis are nearly three times more likely to develop a psychotic disorder like hallucinations, paranoia, manic depression and schizophrenia. The risk increases with the amount smoked.

The Netherlands has one of the highest rates of cannabis use in the world because of its relaxed laws. But the three-year study is the first major study to examine the long-term dangers to mental health.

Experts said last night that the findings sound a warning bell for nations considering softening laws about the drugs usage.

Professor Robin Murray, from the Institute of Psychiatry in London, said services in some parts of the country are struggling to cope with the number of marijuana-related illnesses.

"I work in South London and 90 per cent of patients showing a first episode of psychosis also smoke cannabis. In fact, if theyre not taking cannabis, we think its strange, he said

The British Medical Association warned that the Dutch research - published in the American Journal of Epidemiology - could have serious implications if the British Government's proposal (to soften laws) leads to increased use of marijuana.

Dr Vivienne Nathanson, Head of Science and Ethics, said: "The Government needs to think about this incredibly carefully. This study shows that we do not know the long-term medical effects of cannabis".

The Dutch team tracked 4045 people from 1997 to the end of 1999, monitoring drug use and changes in mental health. At the beginning of the study, all the volunteers were mentally sound but by the end around 55 had been classed as suffering moderate to severe psychosis. Almost a third of these used cannabis, while in the overall group only about seven per cent were regular users.

Professor Jim van Os, who led the study, estimates cannabis could already account for half of all new cases of psychosis. He said: "If you ask any doctor they will tell you this is a problem. And if people continue to use cannabis once they are psychotic it worsens their outcome because they become resistant to medication."

There are three more papers - from New Zealand, Sweden and Israel - coming out in the next few months which will all show the same results.

Why marijuana affects mental health is not clear but experts think it may be to do with how it affects the brains ability to deal with tetrahydrocannibol – a chemical found in the drug.

Another theory is that it switches on a gene that creates biochemical changes which ca facilitate a psychotic experience.

According to Professor Murray, many cannabis users refuse to stop even when psychiatrists plead with them to give up. They make a recovery, go down the road to ge some cannabis and an hour later they come back psychotic.

Mental health charity MIND said its helpline frequently takes calls from relatives of cannabis users worried about its effects.

The Royal College of Psychiatrists is reviewing its policy on the drug.

It is not the first time cannabis has been linked to mental illness. Two months ago, researchers at Okayama University in Japan discovered the first evidence that marijuana can cause genetic abnormalities associated with mental illness.

Scientists have warned for years that cannabis can trigger delusions and hallucinations similar to the symptoms found in schizophrenia. And past studies suggested that under 18-year-olds using the drug were six times more at risk of developing the condition in later life. # # #

Previous Top

Adolescent Depression and Suicide Risk
Association with Sex and Drug Behavior

Denise D. Hallfors, PhD, Martha W. Waller, MA, Carol A. Ford, MD, Carolyn T. Halpern, PhD, Paul H. Brodish, MSPH, Bonita Iritani, MA

Background: Depression is common among adolescents, and suicide is the third leading cause of death among 15- to 19-year-olds. Although both health problems have been associated with drug use and early sexual intercourse, the relationship has not been systematically studied in a nationally representative sample.

Methods: Sixteen patterns of combined sex and drug use behaviors were obtained using cluster analysis of responses to Wave I of the National Longitudinal Study of Adolescent Health conducted from September 1994 through December 1995. Bivariate and multivariate analyses tested correlations between behavior patterns and current depression, serious suicidal ideation, and previous suicide attempt, controlling for gender, race/ethnicity, Hispanic ethnicity, family structure, and parent education.

Results: Compared to youth who abstain from risk behaviors, involvement in any drinking, smoking, and/or sexual activity was associated with significantly increased odds of depression, suicidal ideation, and suicide attempts. Odds ratios were highest among youth who engaged in illegal drug use. There were few differences between boys and girls who abstain from sex and drug behaviors. Girls were less likely than boys to engage in high-risk behaviors, but those who did tended to be more vulnerable to depression, suicidal ideation, and suicide attempt.

Conclusions: Teens engaging in risk behaviors are at increased odds for depression, suicidal ideation, and suicide attempts. Although causal direction has not been established, involvement in any sex or drug use is cause for concern, and should be a clinical indication for mental health screening for girls; both boys and girls should be screened if engaging in any marijuana or illegal drug use.

(Am J Prev Med 2004;27(3):224–230)

Introduction

Suicide represents a significant and preventable loss of life. Among 15- to 19-year-olds, suicide is the third leading cause of death, accounting for approximately 2000 (or 12%) of the annual deaths in this age group.[1,2] Death rates from suicide among 15- to 19-year-olds doubled between 1960 and 2001, with reported rates peaking in 1990.[3] Reported rates for 2001 were 12.9 per 100,000 among males and 2.7 among females.[3] The lifetime prevalence of suicide attempts in this age group has been estimated to be 7.1% (10.1% for females and 3.8% for males).[4]

Data on adolescent suicide risk have generally been reported from either clinical population studies or from the Centers for Disease Control and Prevention's Youth Risk Behavior Survey (YRBS), which produces national estimates based on a biannual, school-based survey conducted in participating high schools. The 2001 YRBS[5] ($n = 13{,}601$) found that 28% of U.S. high school students reported severe depressive feelings, 19% had seriously considered attempting suicide, and 9% had attempted suicide at least once in the preceding year. Ninth, tenth, and eleventh graders (11%, 9%, and 8%, respectively) were significantly more likely than twelfth graders (5.5%) to have attempted suicide in the past year. Hispanic youth were significantly more likely to attempt suicide (12.1%) than blacks (8.8%) and whites (7.9%).

Girls were about twice as likely as boys to report severe depressive feelings, consider attempting suicide, or attempt suicide. Empirical studies have indicated that major depression is most highly correlated with suicide for girls (increasing the risk by up to 20-fold), followed by a previous suicide attempt. Among boys, a previous attempt is the most highly correlated factor (increasing the risk by over 30-fold), followed by de-

From the Pacific Institute for Research and Evaluation (Hallfors, Brodish, Iritani), Chapel Hill, North Carolina, and Departments of Maternal and Child Health, School of Public Health (Halpern), and the Departments of Pediatrics and Internal Medicine (Ford), School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina

Address correspondence and reprint requests to: Denise Hallfors, PhD, Senior Research Scientist, PIRE, 1516 E. Franklin Street, Suite 200, Chapel Hill NC 27514-2812. E-mail: Hallfors@PIRE.org.

0749-3797/04/$–see front matter
doi:10.1016/j.amepre.2004.06.001

pression, alcohol or drug abuse, and disruptive behavior.[4,6–9]

Depression, suicidal ideation, and suicide attempts have previously been linked to adolescent substance use and sexual activity.[10–16] Participation in these activities is widespread among teens.[5,17] In 2001, 45.6% of all high school students reported ever having had sexual intercourse, 33.9% reported current cigarette or other tobacco use, and nearly half (47.1%) had used alcohol in the previous 30 days.[5]

Knowledge about risk factors is important for diagnosing and treating adolescent depression and suicide risk.[18] An important clinical consideration is whether certain patterns of substance use and sexual behaviors are differentially associated with depression and suicide risk. Previous research on adolescent risk behaviors has shown that risk behaviors tend to cluster together rather than occur in isolation.[13,19–27] Cluster analytic methods can reveal the extent to which individuals participate in multiple risk behaviors.[28]

This paper examines the extent to which adolescent sex and drug behavior patterns are associated with depression, controlling for gender, age, race/ethnicity, Hispanic ethnicity, parental education, and family structure. The associations between behavior patterns and both suicidal ideation and attempt are also examined, adding depression as a control variable. Data were from Wave I of the National Longitudinal Study of Adolescent Health (Add Health).[29]

Although the YRBS is an important source of information about biennial trends, and both surveys measure adolescent depression, suicide risk, drug use, and sexual behavior, Add Health offers certain unique strengths. First, Wave-I data were carefully collected and weighted to provide a nationally representative sample of youth in grades 7 through 12; national YRBS data are representative of students in grades 9 through 12.[5] Second, Add Health collected sensitive data using an audio computer-assisted (ACASI) survey instrument, which maximizes confidentiality, improves veracity,[30] and reduces missing data.[31] Third, although both surveys measured the construct of depression, the YRBS included only a single "past 12-month" item, while Add Health questions were based on the 20-item Center for Epidemiological Studies-Depression Scale (CES-D). The present study built on the strengths of Add Health to contribute new information about patterns of adolescent sex and drug use and their association with important mental health problems.

Methods

Sample

Data were from the Wave-I in-home contractual data set of Add Health, a nationally representative probability sample of adolescents in grades 7 through 12 from 132 schools ($n = 18{,}924$) gathered from September 1994 through December 1995 and analyzed in November 2003. All students who had completed an in-school questionnaire or who were listed on a school roster were eligible for inclusion in the more in-depth follow-up interview, which was conducted in the home (see Bearman et al.[29] for additional detail). In-home questionnaires were administered via laptop computers and utilized ACASI technology to collect information on sensitive topics such as sexual activity and substance use. Informed assent by adolescents and parental consent were obtained for all participants.

Independent Measures

Sociodemographic measures. Gender was a self-reported dichotomous variable, with male as the referent. Chronological age in years was determined by subtracting the date of birth from the date of the interview, rounded to two decimal places. Race/ethnicity was based on respondent's self-report, categorized for multivariate analyses as two dichotomous variables: black and other (primarily Asian), with white as the referent. Hispanic ethnicity was based on the respondent's self-report of Hispanic origin and was a dichotomous variable, with non-Hispanic as the referent. Two different measures served as proxies for socioeconomic status (SES). Highest parental education was based on the adolescent's report of the highest education level attained by either the resident mother or father, with categories of less than high school (referent), high school graduate/General Educational Development (GED), some college, and college graduate or higher. Family structure was based on household roster information[32] and grouped into the following categories: two resident parents (referent), single mother, and other.

Cluster membership. K-means cluster analysis was used to group respondents into homogeneous profiles based on responses to 12 items concerning risk behavior. Similar to factor analysis, which groups variables together, cluster analysis groups individuals, based on the assumption that risk behaviors often occur together and interact with each other. By combining individuals with similar behavior patterns, cluster analysis allows for the interaction of all the variables (in the present case, up to 12-way interactions), resulting in a more parsimonious model and a more holistic way of considering youth behavior.[33,34]

Four clusters were defined a priori based on the complete absence of risk behavior (abstainers) or engagement in highly distinctive risk behaviors for HIV and other sexually transmitted diseases (IV drug users, sex for drugs or money, and males who have sex with males [MSM]). Since K-means analysis becomes unreliable with extreme observations, these less common behaviors were examined first. Next, using K-means cluster analysis to identify the modal risk patterns, all other participants were grouped into 12 clusters based on the following self-reported risk behaviors: cigarette use, alcohol consumption, binge drinking, marijuana use, other illicit drug use, sexual intercourse, condom use, number of sexual partners, and engaging in sex while under the influence of alcohol or drugs. The resulting 16 clusters accounted for almost 80% of the total variation in behavior patterns.

Table 2. Behavioral patterns defining clusters and cluster size (largest to smallest)

Cluster name	Patterns of sexual behavior and substance use	n	Weighted %*
Light substance dabblers	Infrequent or no current ATOD use None have had sexual intercourse	4559	25.20
Abstainers	Never engaged in any ATOD use None have had sexual intercourse	4292	23.41
Sex dabblers	All have had sexual intercourse Median number of partners=1 Low levels of ATOD use	3146	14.27
Drinkers	All report past-year alcohol use About 50% report binge drinking Infrequent or no illegal drug use None report sexual intercourse	1403	7.46
Smokers	All are daily cigarette smokers Infrequent use of alcohol or illegal drugs Majority have had sexual intercourse	1109	6.56
Alcohol and sex dabblers	All report occasional alcohol use and all have had sexual intercourse Low tobacco & illegal drug use	1068	5.30
Binge drinkers	All report frequent binge drinking Low cigarette, marijuana, and other drug use More than half binge one or more times/week About half have had sexual intercourse	856	4.44
Sex and drugs in combination	All have had sexual intercourse and all report alcohol or illegal drug use at most recent intercourse	602	3.38
Heavy dabblers	All report moderate levels of smoking, drinking, and binge drinking Half use marijuana; few use other illegal drugs Most (91%) have had sexual intercourse	541	3.27
Marijuana users	All use marijuana frequently; few use other illegal drugs Almost all drink alcohol Most smoke cigarettes Three quarters have had sexual intercourse	314	1.67
Multiple partners	All report ≥14 sex partners Moderate ATOD use	230	1.25
Sex for drugs or money	All report sex for drugs or money Most are moderate ATOD users Median sex partners=3	195	1.11
High marijuana and sex	All use marijuana frequently and all have had sexual intercourse All report AOD use at last intercourse Most report multiple partners (median=6)	193	1.09
Marijuana and other drugs	Most report heavy marijuana use and all report other illegal drug use Two thirds have had sexual intercourse One third report drug use during intercourse	107	0.63
IV drug users	All have injected drugs >80% have had sexual intercourse Median number of partners=4	100	0.56
MSM	All are males who have had sex with other males Most have had multiple partners (median=5) 40% have used marijuana in last 30 days Most are occasional drinkers 17% have had sex for drugs or money	82	0.37
Total		18,799	100.00

*Weighted percentage yielding national probability estimates for 7th- to 12th-grade youth.
AOD/ATOD, alcohol [tobacco] and other drugs; MSM, males having sex with males.

drug use showed the highest proportions. After abstainers, the lowest proportions were in clusters with the lowest levels of legal drug use (light substance dabblers, drinkers) and those marked by sexual activity but relatively low drug use (sex dabblers, alcohol and sex dabblers). Multiple partners, smokers, heavy dabblers, and MSM clusters were at the midpoint, with proportions of affected individuals roughly four times that of abstainers. For girls, there was a dramatic rise in risk among light substance dabblers compared to abstainers (e.g., depression rose to 9.5% from 4.5%). For boys, there was a more modest difference between abstainers and light substance dabblers (depression rates were 3.6% and 5.6%, respectively). In most of the subse-

Table 2. Behavioral patterns defining clusters and cluster size (largest to smallest)

Cluster name	Patterns of sexual behavior and substance use	n	Weighted %[a]
Light substance dabblers	Infrequent or no current ATOD use None have had sexual intercourse	4559	25.20
Abstainers	Never engaged in any ATOD use None have had sexual intercourse	4292	23.41
Sex dabblers	All have had sexual intercourse Median number of partners=1 Low levels of ATOD use	3148	14.27
Drinkers	All report past-year alcohol use About 50% report binge drinking Infrequent or no illegal drug use None report sexual intercourse	1403	7.48
Smokers	All are daily cigarette smokers Infrequent use of alcohol or illegal drugs Majority have had sexual intercourse	1109	6.58
Alcohol and sex dabblers	All report occasional alcohol use and all have had sexual intercourse Low tobacco & illegal drug use	1068	5.30
Binge drinkers	All report frequent binge drinking Low cigarette, marijuana, and other drug use More than half binge one or more times/week About half have had sexual intercourse	856	4.44
Sex and drugs in combination	All have had sexual intercourse and all report alcohol or illegal drug use at most recent intercourse	602	3.38
Heavy dabblers	All report moderate levels of smoking, drinking, and binge drinking Half use marijuana; few use other illegal drugs Most (91%) have had sexual intercourse	541	3.27
Marijuana users	All use marijuana frequently; few use other illegal drugs Almost all drink alcohol Most smoke cigarettes Three quarters have had sexual intercourse	314	1.67
Multiple partners	All report ≥14 sex partners Moderate ATOD use	230	1.25
Sex for drugs or money	All report sex for drugs or money Most are moderate ATOD users Median sex partners=3	195	1.11
High marijuana and sex	All use marijuana frequently and all have had sexual intercourse All report AOD use at last intercourse Most report multiple partners (median=6)	193	1.09
Marijuana and other drugs	Most report heavy marijuana use and all report other illegal drug use Two thirds have had sexual intercourse One third report drug use during intercourse	107	0.63
IV drug users	All have injected drugs >80% have had sexual intercourse Median number of partners=4	100	0.56
MSM	All are males who have had sex with other males Most have had multiple partners (median=5) 40% have used marijuana in last 30 days Most are occasional drinkers 17% have had sex for drugs or money	82	0.37
Total		18,799	100.00

[a]Weighted percentage yielding national probability estimates for 7th- to 12th-grade youth.
AOD/ATOD, alcohol [tobacco] and other drugs; MSM, males having sex with males.

drug use showed the highest proportions. After abstainers, the lowest proportions were in clusters with the lowest levels of legal drug use (light substance dabblers, drinkers) and those marked by sexual activity but relatively low drug use (sex dabblers, alcohol and sex dabblers). Multiple partners, smokers, heavy dabblers, and MSM clusters were at the midpoint, with proportions of affected individuals roughly four times that of abstainers. For girls, there was a dramatic rise in risk among light substance dabblers compared to abstainers (e.g., depression rose to 9.5% from 4.5%). For boys, there was a more modest difference between abstainers and light substance dabblers (depression rates were 3.6% and 5.6%, respectively). In most of the subse-

other studies, females, Hispanics, and lower-SES adolescents are at elevated risk for depression. Controlling for sociodemographic characteristics, present analyses showed a dramatic relationship between sex and drug behaviors and multiple indicators of adolescent mental health. Compared to abstainers, membership in any of the risk clusters was associated with increased odds of depression, serious thoughts about suicide, and suicide attempts. Use of marijuana and other illegal drugs was associated with especially high risk.

The prevalence of current major depression (10.8%) in this study was lower than the prevalence of serious suicidal ideation (13.2%). This was not the case with YRBS data (28% and 19%, respectively), likely because of differences in the measurement of depression between the two surveys. The Add Health CES-D items tap current depressive symptoms, while the single YRBS item queries depressive symptoms over the past 12 months. Both surveys ask about serious suicidal ideation over the past 12 months.

Beyond the time-frame differences for depression assessment, there were other differences that likely contributed to the disparities between the two surveys in prevalence estimates of suicidal ideation and suicide attempt. The Add Health sample, for example, included 7th- and 8th-grade students; excluding these students, however, yielded only a modest increase (14.2%) in suicidal ideation. Given differences in sample construction, Add Health may provide a more representative sample of adolescents for that point in time. Examining the reasons for differences in the prevalence estimates of the two studies was beyond the scope of this paper. However, further examination is warranted, given the importance of the YRBS in documenting national prevalence and trends in adolescent depression and suicide risk.

Most YRBS reports do not control for sociodemographic characteristics. The present findings indicated that SES, as captured by parental education, does seem to have a strong independent association with depression, even after accounting for youth risk behaviors, with more education reducing the likelihood of depression by about half. Conversely, higher parental education was associated with an elevated relative risk of suicidal ideation, after controlling for depression. Further research is warranted to understand how SES may influence these two variables. Controlling for SES and risk behaviors may also explain why Hispanic ethnicity all but disappeared as an independent predictor of depression and suicide risk. Ethnicity was a significant predictor only in the depression regression model, with an OR of 1.19 that was much smaller than expected given the findings of previous studies, including those attempting to control for SES.[39]

The widely documented sex differences in depression that appear at puberty persisted in the regression models. However, descriptive analyses indicated little difference between abstaining boys and girls, and demonstrated variation in gender differences according to risk behavior pattern. Girls were less likely than boys to engage in high-risk behaviors, but those who did tended to be more vulnerable to depression, suicidal ideation, and suicide attempt. These findings indicate that further examination of the role of risk behavior in depression prevalence is warranted.

Although a small percentage of abstaining adolescents reported major depressive symptoms, risk was clearly elevated in association with substance use and sexual activity. Further, certain patterns of these behaviors identified adolescents who are at extremely high risk. These findings point to the need for longitudinal analyses in order to better address the causal ordering of risk behavior and depression, and to determine whether causal sequences differ by subgroup. There was some indication that substance use, such as cigarette smoking, led to depression rather than the reverse,[11,38] but there are other studies indicating that adolescents may become involved in risk taking in response to preexisting depression.[40,41] Determining the circumstances leading to these different developmental sequences will have important theoretical implications regarding etiology as well as important clinical and public health implications.

The present study findings have more immediate implications for preventive health care. Although many professional organizations recommend routine screening for depression and risk of suicide during adolescent health visits,[42] there is a lack of consensus regarding these recommendations. For example, based on a systematic review of the literature, the U.S. Preventive Services Task Force concluded that there is insufficient evidence to recommend for or against routine screening of asymptomatic adolescents for depression[43] or risk of suicide.[44]

These results suggest that healthcare professionals who identify adolescent patients reporting sexual intercourse or drug use should strongly consider screening for depression and risk of suicide. Although most adolescents engaging in these behaviors will not be depressed or at risk of suicide, the odds of identifying adolescents with clinically important depression or risk for suicide are increased—sometimes quite substantially—among adolescents engaging in sex and drug use behaviors. Identifying mental health problems among adolescent patients who are engaging in sexual intercourse and/or drug use increases the likelihood that an appropriate management plan is developed. Management plans may need to address issues related to sexually transmitted infections, HIV, unintended pregnancy, drug use, injury prevention, and depression and/or suicide risk. It is particulary important not to miss opportunities to diagnose depression because effective treatments are available,[45–48] or to overlook suicide risk because suicide can be prevented.

What This Study Adds . . .

Teens engaging in risk behaviors are at increased odds for depression, suicidal ideation, and suicide attempts.

This study uses cluster analysis to identify and estimate the prevalence of 16 separate patterns of sexual intercourse and drug use behaviors in a representative sample of U.S. adolescents.

Logistic regression findings demonstrate the strong, independent association between engagement in these behaviors and depression, suicidal ideation, and suicide attempts, after controlling for gender, age, race/ethnicity, Hispanic ethnicity, parental education, and family structure.

Further research is needed to better understand clustering patterns of sex behaviors, drug use, and mental health problems within a developmental context. Furthermore, it is important to identify the best ways to intervene when specific patterns are recognized. Until then, healthcare professionals should consider the pragmatic approach of screening all adolescent patients for sexual behaviors and drug use. Adolescents who report either—and especially adolescents reporting high-risk patterns of behaviors—should be screened for depression and risk of suicide.

We are grateful to Guang Guo, PhD, and Daniel Bauer, PhD, for their assistance with statistical methods. Funding for the study was from the National Institute of Drug Abuse (grant R01-DA14496; DDH, principal investigator). This research used data from Add Health, a program project designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris, and funded by the National Institute of Child Health and Human Development (grant P01-HD31921), with cooperative funding from 17 other agencies. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123 W. Franklin Street, Chapel Hill NC 27516-2524, www.cpc.unc.edu/addhealth/contract.html.

References

1. Anderson R. Deaths: leading causes for 1999. Natl Vital Stat Rep 2001;49:14.
2. Minino A, Smith B. Deaths: preliminary data for 2000. Hyattsville MD: National Center for Health Statistics, 2001.
3. Freid V, Prager K, MacKay A, Xia H. Chartbook on Trends in the health of Americans. Health, United States, 2003. Hyattsville MD: National Center for Health Statistics, 2003.
4. Lewinsohn P, Rohde P, Seeley J. Adolescent suicidal ideation and attempts: prevalence, risk factors, and clinical implications. Clin Psychol 1996;3:25–46.
5. Grunbaum JA, Kann L, Kinchen SA, Williams B, Ross JG, Lowry R, Kolbe L. Youth risk behavior surveillance—United States, 2001. In: Surveillance summaries. MMWR 2002;51:5–11.
6. Petronis KR, Samuels JF, Moscicki EK, Anthony JC. An epidemiologic investigation of potential risk factors for suicide attempts. Soc Psychiatry Psychiatr Epidemiol 1990;25:193–9.
7. Gould MS, Greenberg T, Velting DM, Shaffer D. Youth suicide risk and preventive interventions: a review of the past 10 years. J Am Acad Child Adolesc Psychiatry 2003;42:386–405.
8. Brent DA, Perper J, Moritz G, Baugher M, Allman C. Suicide in adolescents with no apparent psychopathology. J Am Acad Child Adolesc Psychiatry 1993;32:494–500.
9. Shaffer D, Gould MS, Fisher P, et al. Psychiatric diagnosis in child and adolescent suicide. Arch Gen Psychiatry 1996;53:339–48.
10. King RA, Schwab-Stone M, Flisher AJ, et al. Psychosocial and risk behavior correlates of youth suicide attempts and suicidal ideation. J Am Acad Child Adolesc Psychiatry 2001;40:837–46.
11. Brook JS, Cohen P, Brook DW. Longitudinal study of co-occurring psychiatric disorders and substance use. J Am Acad Child Adolesc Psychiatry 1998;37:322–30.
12. Brooks TL, Harris SK, Thrall JS, Woods ER. Association of adolescent risk behaviors with mental health symptoms in high school students. J Adolesc Health 2002;31:240–6.
13. Burge V, Felts M, Chenier T, Parrillo AV. Drug use, sexual activity, and suicidal behavior in U.S. high school students. J School Health 1995;65:222–7.
14. Felts MWP, Chenier TP, Barnes RE. Drug use and suicide ideation and behavior among North Carolina public school students. Am J Public Health 1992;82:870–2.
15. Kandel DB, Raveis VH, Davies M. Suicidal ideation in adolescence: depression, substance use, and other risk factors. J Youth Adolesc 1991;20:289–309.
16. Rector RE, Johnson KA, Noyes LR. Sexually active teenagers are more likely to be depressed and to attempt suicide. Washington DC: Heritage Foundation, 2003.
17. Johnston LD, O'Malley PM, Bachman JG. Monitoring the Future national results on adolescent drug use: overview of key findings, 2002. Bethesda MD: National Institute on Drug Abuse, 2003.
18. American Academy of Child and Adolescent Psychiatry. Shaffer D, Pfeffer C, Issues WGoQ. Practice parameter for the assessment and treatment of children and adolescents with suicidal behavior. J Am Acad Child Adolesc Psychiatry 2001;40(suppl 7):24–51.
19. Basen-Engquist K, Edmundson EW, Parcel GS. Structure of health risk behavior among high school students. J Consult Clin Psychol 1996;64:764–75.
20. Brener ND, Collins JL. Co-occurrence of health-risk behaviors among adolescents in the United States. J Adolesc Health 1998;22:209–13.
21. Donovan JE, Jessor R. Structure of problem behavior in adolescence and young adulthood. J Consult Clin Psychol 1985;53:890–904.
22. Farrell AD, Danish SJ, Howard CW. Relationship between drug use and other problem behaviors in urban adolescents. J Consult Clin Psychol 1992;60:705–12.
23. Garrison CZ, McKeown RE, Valois RF, Vincent ML. Aggression, substance use, and suicidal behaviors in high school students. Am J Public Health 1993;83:179–84.
24. Jessor R, Jessor SL. The sociol-psychological framework. In: Jessor R, Jessor SL, editors. Problem behavior and psychosocial development: a longitudinal study of youth. New York: Academic Press, 1977:17–42.
25. Lindberg LD, Boggess S, Williams S. Multiple threats: The co-occurrence of teen health risk-behaviors. In: Trends in the wellbeing of America's children and youth, 1999. Washington DC: U.S. Department of Health and Human Services, 2000:489–504.
26. Neumark-Sztainer D, Story M, French S, Cassuto N, Jacobs Jr, DR Resnick MD. Patterns of health-compromising behaviors among Minnesota adolescents: sociodemographic variations. Am J Public Health 1996;86:1599–606.
27. Shrier LA, Emans SJ, Woods ER, MPH, DuRant RH. The association of sexual risk behaviors and problem drug behaviors in high school students. J Adolesc Health 1996;20:377–83.
28. Bergman LR. A pattern-oriented approach to studying individual development: snapshots and processes. In: Cairns RB, Bergman LR, Kagan J, eds. Methods and models for studying the individual: essays in honor of Marian Radke-Yarrow. Thousand Oaks CA: Sage, 1998:83–122.
29. Bearman PS, Jones J, Udry JR. The National Study of Adolescent Health: research design. Chapel Hill NC: Carolina Population Center, 1997. Available at: www.cpc.unc.edu/addhealth/design.
30. Turner CF, Ku L, Rogers SM, Lindberg LD, Pleck JH, Sonenstein FL. Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. Science 1998;280:867–73.
31. Hallfors D, Watson K, Khatapoush S, Kadushin K, Saxe L. A comparison of paper vs. computer assisted self interview for school alcohol, tobacco, and other drug surveys. Eval Prog Planning 2000;1–8.

32. Harris KM. The health status and risk behavior of adolescents in immigrant families. In: Hernandez D. ed. Children of immigrants: health, adjustments, and public assistance. Washington DC: National Academy Press, 1999:286–347.
33. Magnusson D. The logic and implications of a person-oriented approach. In: Cairns RB, Bergman LR, eds. Methods and models for studying the individual. Thousand Oaks CA: Sage Publications, 1998:33–64.
34. Bauer DJ, Shanahan MJ. Modeling complex interactions: person-centered and variable-centered approaches. In: Little TD, Bovaird J, Marquis J, eds. Modeling developmental processes in ecological context, 2004. In press.
35. Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. Appl Psychol Measurement 1977;1:385–401.
36. Rushton JL, Forcier M, Schectman RM. Epidemiology of depressive symptoms in the National Longitudinal Study of Adolescent Health. J Am Acad Child Adolesc Psychiatry 2002;41:199–205.
37. Roberts RE, Lewinsohn PM, Seeley JR. Screening for adolescent depression: a comparison of depression scales. J Am Acad Child Adolesc Psychiatry 1991;30:58–66.
38. Goodman E, Capitman J. Depressive symptoms and cigarette smoking among teens. Pediatrics 2000;106:748–55.
39. Canino G, Roberts R. Suicidal behavior among Latino youth. Suicide Life Threat Behav 2001;31(suppl):122–31.
40. Metha A, Weber B, Webb LD. Youth suicide prevention: a survey and analysis of policies and efforts in the 50 states. Suicide Life Threat Behav 1998;28:150–64.
41. Kessler RC, Nelson CB, McGonagle KA, Edlund MJ, Frank RG, Leaf PJ. The Epidemiology of co-occurring addictive and mental disorders: implications for prevention and service utilization. Am J Orthopsychiatry 1996;66:17–31.
42. Elster AB. Comparison of recommendations for adolescent clinical preventive services developed by national organizations. Arch Pediatr Adolesc Med 1998;152:193–8.
43. U.S. Preventive Services Task Force. Screening for depression. Washington DC: Agency for Health Care Research and Quality, Department of Health and Human Services, 2002.
44. Gaynes BN, West SL, Ford CA, Frame P, Klein J, Lohr KN. Screening for suicide risk in adults: A summary of evidence for the U.S. Preventive Services Task Force. Ann Intern Med 2004;140:822–35.
45. Emslie GJ, Rush AJ, Weinberg WA, et al. A double-blind, randomized, placebo-controlled trial of fluoxetine in children and adolescents with depression. Arch Gen Psychiatry 1997;54:1031–7.
46. Reinecke MA, Ryan NE, DuBois DL. Cognitive-behavioral therapy of depression and depressive symptoms during adolescence: a review and meta-analysis. J Am Acad Child Adolesc Psychiatry 1998;37:26–34.
47. Hughes CW, Emslie GJ, Crismon ML, et al. The Texas Children's Medication Algorithm Project: report of the Texas Consensus Conference Panel on Medication Treatment of Childhood Major Depressive Disorder. J Am Acad Child Adolesc Psychiatry 1999;38:1442–54.
48. Keller MB, Ryan ND, Strober M, et al. Efficacy of paroxetine in the treatment of adolescent major depression: a randomized, controlled trial. J Am Acad Child Adolesc Psychiatry 2001;40:762–72.

Cannabis use and mental health in young people: cohort study

George C Patton, Carolyn Coffey, John B Carlin, Louisa Degenhardt, Michael Lynskey, Wayne Hall

Abstract

Objective To determine whether cannabis use in adolescence predisposes to higher rates of depression and anxiety in young adulthood.
Design Seven wave cohort study over six years.
Setting 44 schools in the Australian state of Victoria.
Participants A statewide secondary school sample of 1601 students aged 14-15 followed for seven years.
Main outcome measure Interview measure of depression and anxiety (revised clinical interview schedule) at wave 7.
Results Some 60% of participants had used cannabis by the age of 20; 7% were daily users at that point. Daily use in young women was associated with an over fivefold increase in the odds of reporting a state of depression and anxiety after adjustment for intercurrent use of other substances (odds ratio 5.6, 95% confidence interval 2.6 to 12). Weekly or more frequent cannabis use in teenagers predicted an approximately twofold increase in risk for later depression and anxiety (1.9, 1.1 to 3.3) after adjustment for potential baseline confounders. In contrast, depression and anxiety in teenagers predicted neither later weekly nor daily cannabis use.
Conclusions Frequent cannabis use in teenage girls predicts later depression and anxiety, with daily users carrying the highest risk. Given recent increasing levels of cannabis use, measures to reduce frequent and heavy recreational use seem warranted.

Introduction

After increases in cannabis use during the early 1990s, a majority of young people in the United Kingdom, United States, New Zealand, and Australia now use cannabis recreationally.[1 2] Despite the high prevalence of cannabis use, uncertainty persists about its physical and psychological consequences.[3]

Among the most prominent concerns have been putative links between use of cannabis and mental disorders. A large intake of cannabis seems able to trigger acute psychotic episodes and may worsen outcomes in established psychosis.[4 5] Associations with non-psychotic disorders have received less attention. Yet evidence for an association between cannabis use and depression and anxiety has grown.[6] Chronic daily users report high levels of anxiety, depression, fatigue, and their motivation is low.[7] In one recent survey of young adults, over a third reported symptoms of anxiety that were associated with cannabis use; young women reported these more commonly.[8] Cross sectional associations between cannabis use and depression and anxiety have now been reported in surveys in both adolescents and adults,[9-11] although not all studies have found an association in male participants.[12]

Questions remain about the level of association between cannabis use and depression and anxiety and about the mechanism underpinning the link. Pre-existing symptoms might raise the likelihood of cannabis use through a mechanism of self medication.[13] Alternatively, cannabis use may be more likely in people with a background of social adversity or particular characteristics—factors that might also raise risks for mental disorders. Cannabis may also carry a direct risk for depression and anxiety.

We examined the risks for later depression and anxiety associated with cannabis use in teenagers. Specifically, the study addressed three questions. Firstly, does cannabis use in adolescents predict the development of symptoms of depression and anxiety in young adults? Secondly, do symptoms of depression and anxiety in adolescence predict cannabis use in young adults? Thirdly, is any relation explained by factors such as family background or intercurrent use of other substances?

Methods

Sample

Between August 1992 and December 1998 we conducted a seven wave cohort study of adolescent health in the Australian state of Victoria. The cohort was defined in a two stage cluster sample, in which we selected two classes at random from each of 44 schools drawn from a stratified frame of government run, Catholic, and independent schools (total number of students 60 905). School retention rates to year nine in the year of sampling were 98%. One class from each school entered the cohort in the latter part of the ninth school year (wave 1) and the second class six months later, early in the 10th school year (wave 2). Participants were subsequently reviewed at six month intervals for the next two years (waves 3 to 6), with a final follow up (wave 7) at the age of 20-21, three years after the final school year in Victoria. In waves 1 to 6, participants self administered the questionnaire on laptop computers,[14] and those absent from school were followed up by tele-

Editorial by Rey and Tennant
Papers pp 1199, 1212

Centre for Adolescent Health, Murdoch Children's Research Institute, Parkville, Victoria 3052, Australia
George C Patton *professor of adolescent health*
Carolyn Coffey *epidemiologist*

Clinical Epidemiology and Biostatistics Unit, Murdoch Children's Research Institute
John B Carlin *director of unit*

National Drug and Alcohol Research Centre, University of New South Wales, Sydney 2052, Australia
Louisa Degenhardt *research fellow*

Department of Psychiatry, Washington University School of Medicine, St Louis, MO 63110, USA
Michael Lynskey *visiting research fellow*

Office of Public Policy and Ethics, Institute for Molecular Bioscience, University of Queensland, Brisbane 4072, Australia
Wayne Hall *professor of bioethics*

Correspondence to: G Patton gpatton@cryptic.rch.unimelb.edu.au

BMJ 2002;325:1195-8

phone. The seventh wave of data collection used computer assisted telephone interviews. All stages of the study were approved by the ethics committee of the Royal Children's Hospital.

From a total sample of 2032 students, 1947 (95.8%) participated at least once during the first six (adolescent) waves. In wave 7, 1601 young adults (79% of the initial sample or 82% of teenage participants) were interviewed between April and December 1998. Response rates are shown in figure 1. Reasons for non-completion at follow up were refusal (n=152), loss of contact (n=192), and death (n=2). We examined characteristics of non-completers in a logistic regression model. Male participants were over-represented (odds ratio 1.9, 95% confidence interval 1.5 to 2.4), as were parental divorce or separation (1.8, 1.4 to 2.5), and daily tobacco smoking at study inception (2.1, 1.5 to 2.9). Neither teenage depression and anxiety nor cannabis use were independently associated with loss to follow up. The mean age at wave 1 was 14.5 (SD 0.5) years; at wave 7 it was 20.7 (0.5) years. Of the 1601 participants in wave 7, 1130 (71%) still lived at home, 429 (27%) lived with others, and 42 (3%) lived alone. A total of 1345 (82%) had completed the final year of school; 1355 (85%) had started post-school study.

Measures

We used the computerised revised clinical interview schedule (CIS-R) to assess depression and anxiety at each wave.[14] The schedule provides data on the frequency, severity, persistence, and intrusiveness of 14 common psychiatric symptoms and has been widely used in population based surveys.[15] A total score of 12 or greater was taken to define a mixed state of depression and anxiety at a lower threshold than syndromes of major depression and anxiety disorder but one where clinical intervention would still be appropriate.[16]

We assessed cannabis use on the basis of self reported frequency of use in the previous six months in waves 1 to 6 and in the previous 12 months in wave 7. This allowed classification as never used, less than weekly use, at least weekly use, and daily use (defined as using on five or more days per week), and initiation after wave 6.

We assessed use of alcohol, tobacco, and other illicit drugs (including ecstasy, heroin, amphetamines, LSD, and steroids) on the basis of self reported frequency of use and with retrospective diaries over seven days for participants reporting recent drinking or smoking. Participants drinking on three or more days in the previous week were classified as frequent drinkers.

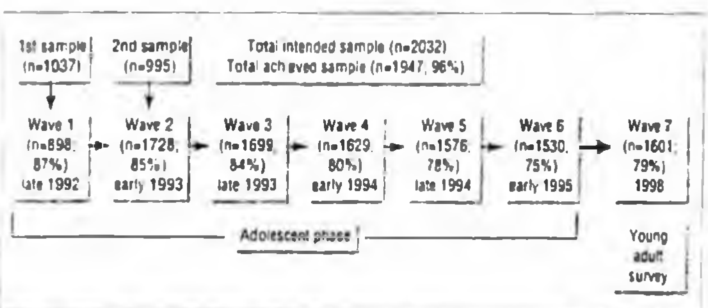


Fig 1 Participation rates of 2032 secondary school students in the Victorian adolescent health cohort study. The percentages in waves 2-7 are the proportions of the total intended sample for which complete data were collected

We assessed antisocial behaviour in waves 1 to 6 by using items from the self reported early delinquency scale that covered property damage, interpersonal violence, and theft.[17]

Analysis

We collected data at a developmental point when young people are difficult to trace because of high mobility. Although the response rate was high and attrition low, 70% of respondents missed at least one wave of data collection, which led to potential bias in summary measures of exposure to cannabis and mental health problems calculated from the six waves of data collection among adolescents. To circumvent this, we used multiple imputation with five complete datasets created by imputation under the multivariate mixed effects model of Schafer and Yucel, incorporating the covariates sex, age, rural or urban residence, and parental education (available for all participants).[18 19] These covariates were strongly associated with missingness, and the model incorporated a random effects structure to accommodate correlation within participants over time. We constructed principal measures by classifying participants according to whether they fell into categories of interest at least once during wave 1 to 6 (adolescence) and, separately, in wave 7 (young adulthood). Data analysis was performed with Stata 7. We modelled associations by univariate and multivariate logistic regression analyses and used Wald tests and related confidence intervals to assess statistical significance and precision.

Results

Altogether 71 male participants (9.7%, 95% confidence interval 7.5% to 12%) and 188 (22%, 19% to 25%) of female participants reported depression and anxiety as young adults (odds ratio 2.6, 1.9 to 3.5). Sixty six per cent (484/731) of male participants and 52% (448/859) of female participants reported using cannabis at some time (11 participants did not respond to this question), with three quarters starting use when they were teenagers. Twenty per cent (146; 17% to 22%) of male participants and 8% (69; 6% to 10%) of female participants were using cannabis at least weekly, with 10% (73; 8% to 12%) of young men and 4% (37; 3% to 6%) of young women using it daily.

Cannabis and depression in young adults

The prevalence of depression and anxiety increased with higher extents of cannabis use, but this pattern was clearest in female participants (table 1). We used logistic regression to analyse the level of association between depression and anxiety and cannabis use in young adults (table 2) after adjustment for concurrent substance use. We found a significant interaction between sex and daily cannabis use. In the adjusted model, young women who used cannabis daily had an over fivefold increase in the odds of depression and anxiety found in non-users.

Cannabis in adolescence and depression in young adults

We used logistic regression to examine the prediction of depression and anxiety in young adults by cannabis use in adolescence. In the univariate analysis a dose response was evident: daily use in female teenagers

Table 1 Prevalence of depression and anxiety according to cannabis use by sex in 1590 young adults in wave 7 (n=1601) of the Victorian adolescent health cohort study

Frequency of cannabis use in previous 12 months	Men			Women		
	No	% (95% CI)	Odds ratio* (95% CI)	No	% (95% CI)	Odds ratio* (95% CI)
None to <5 times ever	522	9 (6 to 11)	(1)	744	19 (17 to 22)	(1)
5 times ever to less than weekly	62	10 (2 to 17)	1.1 (0.46 to 2.8)	46	17 (6 to 29)	0.87 (0.40 to 1.9)
1 to 4 times per week	73	12 (5 to 20)	1.5 (0.70 to 3.2)	32	31 (14 to 48)	1.9 (0.87 to 4.1)
Daily	73	15 (7 to 23)	1.9 (0.93 to 3.8)	37	68 (52 to 83)	5.6 (4.2 to 18)

*Obtained from univariate logistic regression models.
11 (7 female) participants in wave 7 did not answer the questions about cannabis use
*Obtained from univariate logistic regression models.

predicted fourfold higher odds of later depression and anxiety (odds ratio 4.2, 1.6 to 11), weekly use a twofold elevation (2.3, 1.3 to 4.2). In the multivariate model we collapsed the top categories of cannabis use (table 3). The interaction between sex and weekly or more frequent use was significant. An almost twofold increase in risk for weekly or more frequent users who were female persisted after adjustment for potential confounders.

Depression in adolescence and cannabis in young adults

We considered whether depression and anxiety in adolescence predicted later cannabis use in young adulthood in two further logistic regression models, examining the predictions of weekly and daily use (table 4). After adjustment for adolescent cannabis use and other potential confounders, adolescent depression and anxiety predicted neither weekly nor daily use.

Discussion

Around 60% of the statewide secondary school sample had used cannabis recreationally by young adulthood; most participants first experimented while at secondary school. By young adulthood 7% were daily users and in young women this level of use was associated with over five times the odds of depression and anxiety found in non-users. In young women, weekly use as teenagers predicted a twofold increase in later depression and anxiety and daily use a fourfold increase. In contrast, depression in teenagers did not predict higher cannabis use.

Strengths

Earlier cohort studies had a limited capacity to address the key questions of this study. One study reported a prospective relation between cannabis use and later depression but started well after the risk period of onset for both.[20] Two important studies in adolescence examined either monthly cannabis use or use in the preceding year—doses that in the light of this study are unlikely to be associated with mental health problems.[21 22]

Our close to representative sample, high rates of participation, and frequent measures during participants' teenage years are strengths of this study. A telephone interview strategy was used in data collection in the last wave, and, although prevalence estimates may vary slightly as a result, it is unlikely to have caused a systematic bias in patterns of association. The use of multiple imputation minimised measurement biases arising from missing data during the teenage years, but we did not attempt to adjust for differential participation of young adults. Even though depression and anxiety in teenagers and cannabis use did not predict dropout from the study, the difference in non-responders on other factors (for example, sex or family structure) may have had some bearing on the specification of associations.

What the results might mean

Possible explanations for the high degree of depression and anxiety found in young women who used cannabis often include underlying characteristics that predispose to both anxiety and depression, self medication of pre-existing depressive symptoms, and an adverse effect of cannabis on mental health.[2] The association with cannabis use persisted after adjustment for concurrent use of alcohol, tobacco, and other illicit substances as well as indices of family disadvantage—findings consistent with a more direct relation. We considered self medication with cannabis

Table 2 Association between cannabis use in the previous 12 months and depression and anxiety in 1590 young adults in wave 7 (n=1601) of the Victorian adolescent health study, derived from a multivariate logistic model

Cannabis use	No	Adjusted odds ratio (95% CI)
None to <5 times in previous 12 months	1267	1
5 times ever to <weekly	108	0.80 (0.44 to 1.5)
1-4 times/week	105	1.1 (0.60 to 2.0)
Daily*		
Men	73	1.1 (0.55 to 2.6)
Women	37	5.6 (2.6 to 12)
Female sex in the absence of daily cannabis use	822	2.5 (1.8 to 3.4)

Odds ratios are adjusted for parental separation, parental education, current smoking, frequency of drinking, and use of other illicit drugs.
11 (7 female) participants did not answer the questions about cannabis use in wave 7.
*Wald test for interaction between daily cannabis use and sex: P=0.003.

Table 3 Association of cannabis use in teenagers with later depression and anxiety in 1601 young adults in wave 7 of the Victorian adolescent health cohort study

Measures in waves 1-6	No*	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)†
Depression and anxiety (at least one wave)	744	6 (4.3 to 8.4)	5.1 (3.6 to 7.3)
Maximal cannabis use			
None	1083	1	1
<Weekly	332	1.5 (1.1 to 2.1)	1.4 (94 to 2.0)
>Weekly‡			
Male teenagers	108	0.62 (0.24 to 1.6)	0.47 (0.17 to 1.3)
Female teenagers	78	2.6 (1.6 to 4.3)	1.9 (1.1 to 3.3)
Female sex in the absence of >weekly cannabis use	788	2.3 (1.6 to 3.1)	1.6 (1.1 to 2.3)

*Numbers for adolescent cannabis use and depression and anxiety were estimated from five imputed datasets.
†Odds ratios by the highest frequency of cannabis use in teenagers (waves 1 to 6), obtained by using a multivariate logistic model, adjusted for teenagers' depression and anxiety, alcohol use, antisocial behaviour, parental separation, and parental education.
‡Wald test for interaction between more frequent than weekly cannabis use and sex: unadjusted P<0.001, adjusted P=0.011.

Table 4 Association of cannabis use in teenagers (waves 1-6) with later depression and anxiety in 1590 young adults in wave 7 (n=1601) of the Victorian adolescent health cohort study

		Odds ratio (95% CI)†	
Measures in waves 1 to 6	**No***	**≥Weekly use**	**Daily use**
Depression and anxiety, at least one wave	739	1.2 (0.86 to 1.8)	1.3 (0.80 to 2.2)
Maximal cannabis use			
None	1074	1	1
<Weekly	330	3.7 (2.4 to 5.6)	3.1 (1.7 to 5.7)
≥Weekly	185	15 (9.2 to 23)	15 (8.2 to 27)
Female sex	859	0.38 (0.26 to 0.54)	0.5 (0.29 to 0.77)

11 (7 female) participants in wave 7 did not answer the questions about cannabis use.
*Numbers for adolescent cannabis use and depression and anxiety estimated from five imputed datasets.
†Odds ratios obtained by using multivariate logistic models, adjusted for teenagers' cannabis use, drinking frequency, parental separation, and parental education.

but found no prospective relation between depression and anxiety in adolescence and later frequent cannabis use, consistent with an earlier report.[22]

The persistence of associations in the multivariate models and the evidence for a prospective dose-response relation are consistent with a view that frequent use of cannabis in young people increases the risks of later depression and anxiety. Psychosocial mechanisms—for example, the adoption of a countercultural lifestyle—possibly underlie the association. Social consequences of frequent use include educational failure, dropout, unemployment, and crime—all factors that may lead to higher rates of mental disorders. Because risks seem confined largely to daily users, however, the question about a direct pharmacological effect remains. Cannabinoid receptors (CB1) are found widely in the central nervous system, with a distribution that is consistent with effects on a wide range of brain functions including memory, emotion, cognition, and movement.[23]

Cannabis use in young people remains a controversial area, and absence of good data has handicapped the development of rational public health policies.[3] These findings contribute to evidence that frequent cannabis use may have a deleterious effect on mental health beyond a risk for psychotic symptoms. Strategies to reduce frequent use of cannabis might reduce the level of mental disorders in young people.

Contributors: GCP was the principal investigator and prepared the manuscript. CC was the study coordinator and contributed to data analysis and manuscript preparation. JBC contributed to the data analysis and manuscript preparation. LD, ML, and WH contributed to the preparation of the manuscript. GCP is the guarantor.

Funding: National Health and Medical Research Council and Victorian Health Promotion Foundation.

Competing interests: None declared.

1 Smart RG, Ogborne AC. Drug use and drinking among students in 36 countries. Addict Behav 2000;25:455-60.
2 Ramsay M, Spiller J. Drug use declared in 1996: latest results from the British crime survey. London: Home Office, 1997.
3 Strang J, Witton J, Hall W. Improving the quality of the cannabis debate: defining the different domains. BMJ 2000;320:108-10.
4 Linszen DH, Dingemans PM, Lenior ME. Cannabis abuse and the course of recent-onset schizophrenic disorders. Arch Gen Psychiatry 1994;51:273-9.
5 Hall W. Cannabis use and psychosis. Alcohol Rev 1998;17:433-44.
6 Degenhardt L, Hall W, Lynskey MT. Alcohol, cannabis and tobacco use among Australians: a comparison of their associations with other drug use and use disorders, affective and anxiety disorders, and psychosis. Addiction 2001;96:1603-14.
7 Reilly D, Didcott R, Swift W. Long-term cannabis use: characteristics of users in Australian rural areas. Addiction 1998;93:837-46.
8 Thomas H. A community survey of adverse effects of cannabis use. Drug Alcohol Depend 1996;42:201-7.
9 Rey JM, Sawyer MG, Raphael B, Patton GC, Lynskey MT. The mental health of teenagers who use marijuana. Br J Psychiatry 2001;180:216-21.

What is already known on this topic

Frequent recreational use of cannabis has been linked to high rates of depression and anxiety in cross sectional surveys and studies of long term users

Why cannabis users have higher rates of depression and anxiety is uncertain

Previous longitudinal studies of cannabis use in youth have not analysed associations with frequent cannabis use

What this study adds

A strong association between daily use of cannabis and depression and anxiety in young women persists after adjustment for intercurrent use of other substances

Frequent cannabis use in teenage girls predicts later higher rates of depression and anxiety

Depression and anxiety in teenagers do not predict later cannabis use; self medication is therefore unlikely to be the reason for the association

10 Troisi A, Pasini A, Saracco M. Psychiatric symptoms in male cannabis users not using other illicit drugs. Addiction 1998;93:487-92.
11 Green BE, Ritter C. Marijuana use and depression. J Health Soc Behav 2000;41:40-9.
12 Paton S, Kessler R, Kandel D. Depressive mood and adolescent illicit drug use: a longitudinal analysis. J Gen Psychol 1977;92:267-87.
13 Paperny DM, Aono JY, Lehman RM. Computer assisted detection and intervention in adolescent high-risk health behaviour. J Pediatr 1990;116:456-62.
14 Lewis G, Pelosi AJ. The manual of CIS-R. London: Institute of Psychiatry, 1992.
15 Bebbington PE, Dunn G, Jenkins R, Lewis G, Brugha TS, Farrell M, et al. The influence of age and sex on the prevalence of depressive conditions: report from the national survey of psychiatric morbidity. Psychol Med 1998;28:9-19.
16 Lewis G, Pelosi AJ, Araya R, Dunn G. Measuring psychiatric disorder in the community: a standardised assessment for use by lay interviewers. Psychol Med 1992;22:465-86.
17 Moffitt TE, Silva PA. Self-reported delinquency: results from an instrument for New Zealand. Aust N Z J Criminol 1988;21:227-40.
18 Rubin DB. Multiple imputation for non-response in surveys. New York: Wiley, 1987.
19 Schafer JL, Yucel RM. Computational strategies for multivariate linear mixed-effects models with missing values. J Comput Graph Stat 2002;11:437-57.
20 Bovasso GB. Cannabis abuse as a risk factor for depressive symptoms. Am J Psychiatry 2001;158:2033-7.
21 Fergusson DM, Horwood LJ. Early onset cannabis use and psychosocial adjustment in young adults. Addiction 1997;92:279-96.
22 McGee R, Williams S, Poulton RG, Moffitt TE. A longitudinal study of cannabis use and mental health from adolescence to early adulthood. Addiction 2000;95:491-503.
23 Ameri A. The effects of cannabinoids on the brain. Prog Neurobiol 1999;58:315-48.

(Accepted 15 August 2002)

Endpiece

Surgical innovation

It is infinitely better to transplant a heart than to bury it so it can be devoured by worms.

Christiaan Barnard (1922-2001), who performed the first human heart transplant in 1967

Submitted by Max Edwards, surgical trainee, London

Cannabis use and mental health in young people: cohort study

George C Patton, Carolyn Coffey, John B Carlin, Louisa Degenhardt, Michael Lynskey and Wayne Hall

BMJ 2002;325;1195-1198
doi:10.1136/bmj.325.7374.1195

Adolescent Depression and Suicide Risk

Association with Sex and Drug Behavior

Denise D. Hallfors, PhD, Martha W. Waller, MA, Carol A. Ford, MD, Carolyn T. Halpern, PhD, Paul H. Brodish, MSPH, Bonita Iritani, MA

Background: Depression is common among adolescents, and suicide is the third leading cause of death among 15- to 19-year-olds. Although both health problems have been associated with drug use and early sexual intercourse, the relationship has not been systematically studied in a nationally representative sample.

Methods: Sixteen patterns of combined sex and drug use behaviors were obtained using cluster analysis of responses to Wave I of the National Longitudinal Study of Adolescent Health conducted from September 1994 through December 1995. Bivariate and multivariate analyses tested correlations between behavior patterns and current depression, serious suicidal ideation, and previous suicide attempt, controlling for gender, race/ethnicity, Hispanic ethnicity, family structure, and parent education.

Results: Compared to youth who abstain from risk behaviors, involvement in any drinking, smoking, and/or sexual activity was associated with significantly increased odds of depression, suicidal ideation, and suicide attempts. Odds ratios were highest among youth who engaged in illegal drug use. There were few differences between boys and girls who abstain from sex and drug behaviors. Girls were less likely than boys to engage in high-risk behaviors, but those who did tended to be more vulnerable to depression, suicidal ideation, and suicide attempt.

Conclusions: Teens engaging in risk behaviors are at increased odds for depression, suicidal ideation, and suicide attempts. Although causal direction has not been established, involvement in any sex or drug use is cause for concern, and should be a clinical indication for mental health screening for girls; both boys and girls should be screened if engaging in any marijuana or illegal drug use.

(Am J Prev Med 2004;27(3):224–230)

Introduction

Suicide represents a significant and preventable loss of life. Among 15- to 19-year-olds, suicide is the third leading cause of death, accounting for approximately 2000 (or 12%) of the annual deaths in this age group.[1,2] Death rates from suicide among 15- to 19-year-olds doubled between 1960 and 2001, with reported rates peaking in 1990.[3] Reported rates for 2001 were 12.9 per 100,000 among males and 2.7 among females.[3] The lifetime prevalence of suicide attempts in this age group has been estimated to be 7.1% (10.1% for females and 3.8% for males).[4]

Data on adolescent suicide risk have generally been reported from either clinical population studies or from the Centers for Disease Control and Prevention's Youth Risk Behavior Survey (YRBS), which produces national estimates based on a biannual, school-based survey conducted in participating high schools. The 2001 YRBS[5] (n =13,601) found that 28% of U.S. high school students reported severe depressive feelings, 19% had seriously considered attempting suicide, and 9% had attempted suicide at least once in the preceding year. Ninth, tenth, and eleventh graders (11%, 9%, and 8%, respectively) were significantly more likely than twelfth graders (5.5%) to have attempted suicide in the past year. Hispanic youth were significantly more likely to attempt suicide (12.1%) than blacks (8.8%) and whites (7.9%).

Girls were about twice as likely as boys to report severe depressive feelings, consider attempting suicide, or attempt suicide. Empirical studies have indicated that major depression is most highly correlated with suicide for girls (increasing the risk by up to 20-fold), followed by a previous suicide attempt. Among boys, a previous attempt is the most highly correlated factor (increasing the risk by over 30-fold), followed by de-

From the Pacific Institute for Research and Evaluation (Hallfors, Brodish, Iritani), Chapel Hill, North Carolina, and Departments of Maternal and Child Health, School of Public Health (Halpern), and the Departments of Pediatrics and Internal Medicine (Ford), School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina

Address correspondence and reprint requests to: Denise Hallfors, PhD, Senior Research Scientist, PIRE, 1516 E. Franklin Street, Suite 200, Chapel Hill NC 27514-2812. E-mail: Hallfors@PIRE.org

0749-3797/04/$–see front matter
doi:10.1016/j.amepre.2004.06.001

pression, alcohol or drug abuse, and disruptive behavior.[4,6–9]

Depression, suicidal ideation, and suicide attempts have previously been linked to adolescent substance use and sexual activity.[10–16] Participation in these activities is widespread among teens.[5,17] In 2001, 45.6% of all high school students reported ever having had sexual intercourse, 33.9% reported current cigarette or other tobacco use, and nearly half (47.1%) had used alcohol in the previous 30 days.[5]

Knowledge about risk factors is important for diagnosing and treating adolescent depression and suicide risk.[18] An important clinical consideration is whether certain patterns of substance use and sexual behaviors are differentially associated with depression and suicide risk. Previous research on adolescent risk behaviors has shown that risk behaviors tend to cluster together rather than occur in isolation.[13,19–27] Cluster analytic methods can reveal the extent to which individuals participate in multiple risk behaviors.[28]

This paper examines the extent to which adolescent sex and drug behavior patterns are associated with depression, controlling for gender, age, race/ethnicity, Hispanic ethnicity, parental education, and family structure. The associations between behavior patterns and both suicidal ideation and attempt are also examined, adding depression as a control variable. Data were from Wave 1 of the National Longitudinal Study of Adolescent Health (Add Health).[29]

Although the YRBS is an important source of information about biennial trends, and both surveys measure adolescent depression, suicide risk, drug use, and sexual behavior, Add Health offers certain unique strengths. First, Wave-I data were carefully collected and weighted to provide a nationally representative sample of youth in grades 7 through 12; national YRBS data are representative of students in grades 9 through 12.[5] Second, Add Health collected sensitive data using an audio computer-assisted (ACASI) survey instrument, which maximizes confidentiality, improves veracity,[30] and reduces missing data.[31] Third, although both surveys measured the construct of depression, the YRBS included only a single "past 12-month" item, while Add Health questions were based on the 20-item Center for Epidemiological Studies-Depression Scale (CES-D). The present study built on the strengths of Add Health to contribute new information about patterns of adolescent sex and drug use and their association with important mental health problems.

Methods

Sample

Data were from the Wave-I in-home contractual data set of Add Health, a nationally representative probability sample of adolescents in grades 7 through 12 from 132 schools ($n = 18{,}924$) gathered from September 1994 through December 1995 and analyzed in November 2003. All students who had completed an in-school questionnaire or who were listed on a school roster were eligible for inclusion in the more in-depth follow-up interview, which was conducted in the home (see Bearman et al.[29] for additional detail). In-home questionnaires were administered via laptop computers and utilized ACASI technology to collect information on sensitive topics such as sexual activity and substance use. Informed assent by adolescents and parental consent were obtained for all participants.

Independent Measures

Sociodemographic measures. Gender was a self-reported dichotomous variable, with male as the referent. Chronological age in years was determined by subtracting the date of birth from the date of the interview, rounded to two decimal places. Race/ethnicity was based on respondent's self-report, categorized for multivariate analyses as two dichotomous variables: black and other (primarily Asian), with white as the referent. Hispanic ethnicity was based on the respondent's self-report of Hispanic origin and was a dichotomous variable, with non-Hispanic as the referent. Two different measures served as proxies for socioeconomic status (SES). Highest parental education was based on the adolescent's report of the highest education level attained by either the resident mother or father, with categories of less than high school (referent), high school graduate/General Educational Development (GED), some college, and college graduate or higher. Family structure was based on household roster information[32] and grouped into the following categories: two resident parents (referent), single mother, and other.

Cluster membership. K-means cluster analysis was used to group respondents into homogeneous profiles based on responses to 12 items concerning risk behavior. Similar to factor analysis, which groups variables together, cluster analysis groups individuals, based on the assumption that risk behaviors often occur together and interact with each other. By combining individuals with similar behavior patterns, cluster analysis allows for the interaction of all the variables (in the present case, up to 12-way interactions), resulting in a more parsimonious model and a more holistic way of considering youth behavior.[33,34]

Four clusters were defined a priori based on the complete absence of risk behavior (abstainers) or engagement in highly distinctive risk behaviors for HIV and other sexually transmitted diseases (IV drug users, sex for drugs or money, and males who have sex with males [MSM]). Since K-means analysis becomes unreliable with extreme observations, these less common behaviors were examined first. Next, using K-means cluster analysis to identify the modal risk patterns, all other participants were grouped into 12 clusters based on the following self-reported risk behaviors: cigarette use, alcohol consumption, binge drinking, marijuana use, other illicit drug use, sexual intercourse, condom use, number of sexual partners, and engaging in sex while under the influence of alcohol or drugs. The resulting 16 clusters accounted for almost 80% of the total variation in behavior patterns.

Cluster name	Patterns of sexual behavior and substance use	n	Weighted %*
Light substance dabblers	Infrequent or no current ATOD use None have had sexual intercourse	4559	25.20
Abstainers	Never engaged in any ATOD use None have had sexual intercourse	4292	23.41
Sex dabblers	All have had sexual intercourse Median number of partners=1 Low levels of ATOD use	3148	14.27
Drinkers	All report past-year alcohol use About 50% report binge drinking Infrequent or no illegal drug use None report sexual intercourse	1403	7.48
Smokers	All are daily cigarette smokers Infrequent use of alcohol or illegal drugs Majority have had sexual intercourse	1109	6.58
Alcohol and sex dabblers	All report occasional alcohol use and all have had sexual intercourse Low tobacco & illegal drug use	1068	5.30
Binge drinkers	All report frequent binge drinking Low cigarette, marijuana, and other drug use More than half binge one or more times/week About half have had sexual intercourse	856	4.44
Sex and drugs in combination	All have had sexual intercourse and all report alcohol or illegal drug use at most recent intercourse	602	3.38
Heavy dabblers	All report moderate levels of smoking, drinking, and binge drinking Half use marijuana; few use other illegal drugs Most (91%) have had sexual intercourse	541	3.27
Marijuana users	All use marijuana frequently; few use other illegal drugs Almost all drink alcohol Most smoke cigarettes Three quarters have had sexual intercourse	314	1.67
Multiple partners	All report ≥14 sex partners Moderate ATOD use	230	1.25
Sex for drugs or money	All report sex for drugs or money Most are moderate ATOD users Median sex partners=3	195	1.11
High marijuana and sex	All use marijuana frequently and all have had sexual intercourse All report AOD use at last intercourse Most report multiple partners (median=6)	193	1.09
Marijuana and other drugs	Most report heavy marijuana use and all report other illegal drug use Two thirds have had sexual intercourse One third report drug use during intercourse	107	0.63
IV drug users	All have injected drugs >80% have had sexual intercourse Median number of partners=4	100	0.56
MSM	All are males who have had sex with other males Most have had multiple partners (median=5) 40% have used marijuana in last 30 days Most are occasional drinkers 17% have had sex for drugs or money	82	0.37
Total		18,799	100.00

Table 2. Behavioral patterns defining clusters and cluster size (largest to smallest)

*Weighted percentage yielding national probability estimates for 7th- to 12th-grade youth.
AOD/ATOD, alcohol [tobacco] and other drugs; MSM, males having sex with males.

drug use showed the highest proportions. After abstainers, the lowest proportions were in clusters with the lowest levels of legal drug use (light substance dabblers, drinkers) and those marked by sexual activity but relatively low drug use (sex dabblers, alcohol and sex dabblers). Multiple partners, smokers, heavy dabblers, and MSM clusters were at the midpoint, with proportions of affected individuals roughly four times that of abstainers. For girls, there was a dramatic rise in risk among light substance dabblers compared to abstainers (e.g., depression rose to 9.5% from 4.5%). For boys, there was a more modest difference between abstainers and light substance dabblers (depression rates were 3.6% and 5.6%, respectively). In most of the subse-

Cluster name	Patterns of sexual behavior and substance use	n	Weighted %*
Light substance dabblers	Infrequent or no current ATOD use None have had sexual intercourse	4559	25.20
Abstainers	Never engaged in any ATOD use None have had sexual intercourse	4292	23.41
Sex dabblers	All have had sexual intercourse Median number of partners = 1 Low levels of ATOD use	3148	14.27
Drinkers	All report past-year alcohol use About 50% report binge drinking Infrequent or no illegal drug use None report sexual intercourse	1403	7.48
Smokers	All are daily cigarette smokers Infrequent use of alcohol or illegal drugs Majority have had sexual intercourse	1109	6.58
Alcohol and sex dabblers	All report occasional alcohol use and all have had sexual intercourse Low tobacco & illegal drug use	1068	5.30
Binge drinkers	All report frequent binge drinking Low cigarette, marijuana, and other drug use More than half binge one or more times/week About half have had sexual intercourse	856	4.44
Sex and drugs in combination	All have had sexual intercourse and all report alcohol or illegal drug use at most recent intercourse	602	3.38
Heavy dabblers	All report moderate levels of smoking, drinking, and binge drinking Half use marijuana; few use other illegal drugs Most (91%) have had sexual intercourse	541	3.27
Marijuana users	All use marijuana frequently; few use other illegal drugs Almost all drink alcohol Most smoke cigarettes Three quarters have had sexual intercourse	314	1.67
Multiple partners	All report ≥14 sex partners Moderate ATOD use	230	1.25
Sex for drugs or money	All report sex for drugs or money Most are moderate ATOD users Median sex partners = 3	195	1.11
High marijuana and sex	All use marijuana frequently and all have had sexual intercourse All report AOD use at last intercourse Most report multiple partners (median = 6)	193	1.09
Marijuana and other drugs	Most report heavy marijuana use and all report other illegal drug use Two thirds have had sexual intercourse One third report drug use during intercourse	107	0.63
IV drug users	All have injected drugs >80% have had sexual intercourse Median number of partners = 4	100	0.56
MSM	All are males who have had sex with other males Most have had multiple partners (median = 5) 40% have used marijuana in last 30 days Most are occasional drinkers 17% have had sex for drugs or money	82	0.37
Total		18,799	100.00

Table 2. Behavioral patterns defining clusters and cluster size (largest to smallest)

*Weighted percentage yielding national probability estimates for 7th- to 12th-grade youth.
AOD/ATOD, alcohol (tobacco) and other drugs; MSM, males having sex with males.

drug use showed the highest proportions. After abstainers, the lowest proportions were in clusters with the lowest levels of legal drug use (light substance dabblers, drinkers) and those marked by sexual activity but relatively low drug use (sex dabblers, alcohol and sex dabblers). Multiple partners, smokers, heavy dabblers, and MSM clusters were at the midpoint, with proportions of affected individuals roughly four times that of abstainers. For girls, there was a dramatic rise in risk among light substance dabblers compared to abstainers (e.g., depression rose to 9.5% from 4.5%). For boys, there was a more modest difference between abstainers and light substance dabblers (depression rates were 3.6% and 5.6%, respectively). In most of the subse-

other studies, females, Hispanics, and lower-SES adolescents are at elevated risk for depression. Controlling for sociodemographic characteristics, present analyses showed a dramatic relationship between sex and drug behaviors and multiple indicators of adolescent mental health. Compared to abstainers, membership in any of the risk clusters was associated with increased odds of depression, serious thoughts about suicide, and suicide attempts. Use of marijuana and other illegal drugs was associated with especially high risk.

The prevalence of current major depression (10.3%) in this study was lower than the prevalence of serious suicidal ideation (13.2%). This was not the case with YRBS data (28% and 19%, respectively), likely because of differences in the measurement of depression between the two surveys. The Add Health CES-D items tap current depressive symptoms, while the single YRBS item queries depressive symptoms over the past 12 months. Both surveys ask about serious suicidal ideation over the past 12 months.

Beyond the time-frame differences for depression assessment, there were other differences that likely contributed to the disparities between the two surveys in prevalence estimates of suicidal ideation and suicide attempt. The Add Health sample, for example, included 7th- and 8th-grade students; excluding these students, however, yielded only a modest increase (14.2%) in suicidal ideation. Given differences in sample construction, Add Health may provide a more representative sample of adolescents for that point in time. Examining the reasons for differences in the prevalence estimates of the two studies was beyond the scope of this paper. However, further examination is warranted, given the importance of the YRBS in documenting national prevalence and trends in adolescent depression and suicide risk.

Most YRBS reports do not control for sociodemographic characteristics. The present findings indicated that SES, as captured by parental education, does seem to have a strong independent association with depression, even after accounting for youth risk behaviors, with more education reducing the likelihood of depression by about half. Conversely, higher parental education was associated with an elevated relative risk of suicidal ideation, after controlling for depression. Further research is warranted to understand how SES may influence these two variables. Controlling for SES and risk behaviors may also explain why Hispanic ethnicity all but disappeared as an independent predictor of depression and suicide risk. Ethnicity was a significant predictor only in the depression regression model, with an OR of 1.19 that was much smaller than expected given the findings of previous studies, including those attempting to control for SES.[39]

The widely documented sex differences in depression that appear at puberty persisted in the regression models. However, descriptive analyses indicated little difference between abstaining boys and girls, and demonstrated variation in gender differences according to risk behavior pattern. Girls were less likely than boys to engage in high-risk behaviors, but those who did tended to be more vulnerable to depression, suicidal ideation, and suicide attempt. These findings indicate that further examination of the role of risk behavior in depression prevalence is warranted.

Although a small percentage of abstaining adolescents reported major depressive symptoms, risk was clearly elevated in association with substance use and sexual activity. Further, certain patterns of these behaviors identified adolescents who are at extremely high risk. These findings point to the need for longitudinal analyses in order to better address the causal ordering of risk behavior and depression, and to determine whether causal sequences differ by subgroup. There was some indication that substance use, such as cigarette smoking, led to depression rather than the reverse,[11,38] but there are other studies indicating that adolescents may become involved in risk taking in response to preexisting depression.[40,41] Determining the circumstances leading to these different developmental sequences will have important theoretical implications regarding etiology as well as important clinical and public health implications.

The present study findings have more immediate implications for preventive health care. Although many professional organizations recommend routine screening for depression and risk of suicide during adolescent health visits,[42] there is a lack of consensus regarding these recommendations. For example, based on a systematic review of the literature, the U.S. Preventive Services Task Force concluded that there is insufficient evidence to recommend for or against routine screening of asymptomatic adolescents for depression[43] or risk of suicide.[44]

These results suggest that healthcare professionals who identify adolescent patients reporting sexual intercourse or drug use should strongly consider screening for depression and risk of suicide. Although most adolescents engaging in these behaviors will not be depressed or at risk of suicide, the odds of identifying adolescents with clinically important depression or risk for suicide are increased—sometimes quite substantially—among adolescents engaging in sex and drug use behaviors. Identifying mental health problems among adolescent patients who are engaging in sexual intercourse and/or drug use increases the likelihood that an appropriate management plan is developed. Management plans may need to address issues related to sexually transmitted infections, HIV, unintended pregnancy, drug use, injury prevention, and depression and/or suicide risk. It is particulary important not to miss opportunities to diagnose depression because effective treatments are available,[45–48] or to overlook suicide risk because suicide can be prevented.

What This Study Adds . . .

Teens engaging in risk behaviors are at increased odds for depression, suicidal ideation, and suicide attempts.

This study uses cluster analysis to identify and estimate the prevalence of 16 separate patterns of sexual intercourse and drug use behaviors in a representative sample of U.S. adolescents.

Logistic regression findings demonstrate the strong, independent association between engagement in these behaviors and depression, suicidal ideation, and suicide attempts, after controlling for gender, age, race/ethnicity, Hispanic ethnicity, parental education, and family structure.

Further research is needed to better understand clustering patterns of sex behaviors, drug use, and mental health problems within a developmental context. Furthermore, it is important to identify the best ways to intervene when specific patterns are recognized. Until then, healthcare professionals should consider the pragmatic approach of screening all adolescent patients for sexual behaviors and drug use. Adolescents who report either—and especially adolescents reporting high-risk patterns of behaviors—should be screened for depression and risk of suicide.

We are grateful to Guang Guo, PhD, and Daniel Bauer, PhD, for their assistance with statistical methods. Funding for the study was from the National Institute of Drug Abuse (grant R01-DA14496; DDH, principal investigator). This research used data from Add Health, a program project designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris, and funded by the National Institute of Child Health and Human Development (grant P01-HD31921), with cooperative funding from 17 other agencies. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123 W. Franklin Street, Chapel Hill NC 27516-2524, www.cpc.unc.edu/addhealth/contract.html.

References

1. Anderson R. Deaths: leading causes for 1999. Natl Vital Stat Rep 2001;49:11.
2. Minino A, Smith B. Deaths: preliminary data for 2000. Hyattsville MD: National Center for Health Statistics, 2001.
3. Freid V, Prager K, MacKay A, Xia H. Chartbook on Trends in the health of Americans. Health, United States, 2003. Hyattsville MD: National Center for Health Statistics, 2003.
4. Lewinsohn P, Rohde P, Seeley J. Adolescent suicidal ideation and attempts: prevalence, risk factors, and clinical implications. Clin Psychol 1996;3:25–46.
5. Grunbaum JA, Kann L, Kinchen SA, Williams B, Ross JG, Lowry R, Kolbe L. Youth risk behavior surveillance—United States, 2001. In: Surveillance summaries. MMWR 2002;51:5–11.
6. Petronis KR, Samuels JF, Moscicki EK, Anthony JC. An epidemiologic investigation of potential risk factors for suicide attempts. Soc Psychiatry Psychiatr Epidemiol 1990;25:193–9.
7. Gould MS, Greenberg T, Velting DM, Shaffer D. Youth suicide risk and preventive interventions: a review of the past 10 years. J Am Acad Child Adolesc Psychiatry 2003;42:386–405.
8. Brent DA, Perper J, Moritz G, Baugher M, Allman C. Suicide in adolescents with no apparent psychopathology. J Am Acad Child Adolesc Psychiatry 1993;32:494–500.
9. Shaffer D, Gould MS, Fisher P, et al. Psychiatric diagnosis in child and adolescent suicide. Arch Gen Psychiatry 1996;53:339–48.
10. King RA, Schwab-Stone M, Flisher AJ, et al. Psychosocial and risk behavior correlates of youth suicide attempts and suicidal ideation. J Am Acad Child Adolesc Psychiatry 2001;40:837–46.
11. Brook JS, Cohen P, Brook DW. Longitudinal study of co-occurring psychiatric disorders and substance use. J Am Acad Child Adolesc Psychiatry 1998;37:322–30.
12. Brooks TL, Harris SK, Thrall JS, Woods ER. Association of adolescent risk behaviors with mental health symptoms in high school students. J Adolesc Health 2002;31:240–6.
13. Burge V, Felts M, Chenier T, Parrillo AV. Drug use, sexual activity, and suicidal behavior in U.S. high school students. J School Health 1995;65:222–7.
14. Felts MWP, Chenier TP, Barnes RE. Drug use and suicide ideation and behavior among North Carolina public school students. Am J Public Health 1992;82:870–2.
15. Kandel DB, Raveis VH, Davies M. Suicidal ideation in adolescence: depression, substance use, and other risk factors. J Youth Adolesc 1991;20:289–309.
16. Rector RE, Johnson KA, Noyes LR. Sexually active teenagers are more likely to be depressed and to attempt suicide. Washington DC: Heritage Foundation, 2003.
17. Johnston LD, O'Malley PM, Bachman JG. Monitoring the Future national results on adolescent drug use: overview of key findings, 2002. Bethesda MD: National Institute on Drug Abuse, 2003.
18. American Academy of Child and Adolescent Psychiatry, Shaffer D, Pfeffer C. Issues WGoQ. Practice parameter for the assessment and treatment of children and adolescents with suicidal behavior. J Am Acad Child Adolesc Psychiatry 2001;40(suppl 7):24–51.
19. Basen-Engquist K, Edmundson EW, Parcel GS. Structure of health risk behavior among high school students. J Consult Clin Psychol 1996;64:764–75.
20. Brener ND, Collins JL. Co-occurrence of health-risk behaviors among adolescents in the United States. J Adolesc Health 1998;22:209–13.
21. Donovan JE, Jessor R. Structure of problem behavior in adolescence and young adulthood. J Consult Clin Psychol 1985;53:890–904.
22. Farrell AD, Danish SJ, Howard CW. Relationship between drug use and other problem behaviors in urban adolescents. J Consult Clin Psychol 1992;60:705–12.
23. Garrison CZ, McKeown RE, Valois RF, Vincent ML. Aggression, substance use, and suicidal behaviors in high school students. Am J Public Health 1993;83:179–84.
24. Jessor R, Jessor SL. The social-psychological framework. In: Jessor R, Jessor SL, editors. Problem behavior and psychosocial development: a longitudinal study of youth. New York: Academic Press, 1977:17–42.
25. Lindberg LD, Boggess S, Williams S. Multiple threats: The co-occurrence of teen health risk-behaviors. In: Trends in the wellbeing of America's children and youth, 1999. Washington DC: U.S. Department of Health and Human Services, 2000:489–504.
26. Neumark-Sztainer D, Story M, French S, Cassuto N, Jacobs Jr, DR Resnick MD. Patterns of health-compromising behaviors among Minnesota adolescents: sociodemographic variations. Am J Public Health 1996;86:1599–606.
27. Shrier LA, Emans SJ, Woods ER, MPH, DuRant RH. The association of sexual risk behaviors and problem drug behaviors in high school students. J Adolesc Health 1996;20:377–83.
28. Bergman LR. A pattern-oriented approach to studying individual development: snapshots and processes. In: Cairns RB, Bergman LR, Kagan J, eds. Methods and models for studying the individual: essays in honor of Marian Radke-Yarrow. Thousand Oaks CA: Sage, 1998:83–122.
29. Bearman PS, Jones J, Udry JR. The National Study of Adolescent Health: research design. Chapel Hill NC: Carolina Population Center, 1997. Available at: www.cpc.unc.edu/addhealth/design.
30. Turner CF, Ku L, Rogers SM, Lindberg LD, Pleck JH, Sonenstein FL. Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. Science 1998;280:867–73.
31. Hallfors D, Watson K, Khatapoush S, Kadushin K, Saxe L. A comparison of paper vs. computer assisted self interview for school alcohol, tobacco, and other drug surveys. Eval Prog Planning 2000:1–8.

32. Harris KM. The health status and risk behavior of adolescents in immigrant families. In: Hernandez D, ed. Children of immigrants: health, adjustments, and public assistance. Washington DC: National Academy Press, 1999:286–347.
33. Magnusson D. The logic and implications of a person-oriented approach. In: Cairns RB, Bergman LR, eds. Methods and models for studying the individual. Thousand Oaks CA: Sage Publications, 1998:33–64.
34. Bauer DJ, Shanahan MJ. Modeling complex interactions: person-centered and variable-centered approaches. In: Little TD, Bovaird J, Marquis J, eds. Modeling developmental processes in ecological context, 2004. In press.
35. Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. Appl Psychol Measurement 1977;1:385–401.
36. Rushton JL, Forcier M, Schectman RM. Epidemiology of depressive symptoms in the National Longitudinal Study of Adolescent Health. J Am Acad Child Adolesc Psychiatry 2002;41:199–205.
37. Roberts RE, Lewinsohn PM, Seeley JR. Screening for adolescent depression: a comparison of depression scales. J Am Acad Child Adolesc Psychiatry 1991;30:58–66.
38. Goodman E, Capitman J. Depressive symptoms and cigarette smoking among teens. Pediatrics 2000;106:748–55.
39. Canino G, Roberts R. Suicidal behavior among Latino youth. Suicide Life Threat Behav 2001;31(suppl):122–31.
40. Metha A, Weber B, Webb LD. Youth suicide prevention: a survey and analysis of policies and efforts in the 50 states. Suicide Life Threat Behav 1998;28:150–64.
41. Kessler RC, Nelson CB, McGonagle KA, Edlund MJ, Frank RG, Leaf PJ. The Epidemiology of co-occurring addictive and mental disorders: implications for prevention and service utilization. Am J Orthopsychiatry 1996;66:17–31.
42. Elster AB. Comparison of recommendations for adolescent clinical preventive services developed by national organizations. Arch Pediatr Adolesc Med 1998;152:193–8.
43. U.S. Preventive Services Task Force. Screening for depression. Washington DC: Agency for Health Care Research and Quality, Department of Health and Human Services, 2002.
44. Gaynes BN, West SL, Ford CA, Frame P, Klein J, Lohr KN. Screening for suicide risk in adults: A summary of evidence for the U.S. Preventive Services Task Force. Ann Intern Med 2004;140:822–35.
45. Emslie GJ, Rush AJ, Weinberg WA, et al. A double-blind, randomized, placebo-controlled trial of fluoxetine in children and adolescents with depression. Arch Gen Psychiatry 1997;54:1031–7.
46. Reinecke MA, Ryan NE, DuBois DL. Cognitive-behavioral therapy of depression and depressive symptoms during adolescence: a review and meta-analysis. J Am Acad Child Adolesc Psychiatry 1998;37:26–34.
47. Hughes CW, Emslie GJ, Crismon ML, et al. The Texas Children's Medication Algorithm Project: report of the Texas Consensus Conference Panel on Medication Treatment of Childhood Major Depressive Disorder. J Am Acad Child Adolesc Psychiatry 1999;38:1442–54.
48. Keller MB, Ryan ND, Strober M, et al. Efficacy of paroxetine in the treatment of adolescent major depression: a randomized, controlled trial. J Am Acad Child Adolesc Psychiatry 2001;40:762–72.

Cerebrovascular perfusion in marijuana users during a month of monitored abstinence

Ronald I. Herning, PhD; Warren E. Better, MS; Kimberly Tate, BS; and Jean L. Cadet, MD

Abstract—*Objective:* To determine possible effects of prolonged marijuana use on the cerebrovascular system during a month of monitored abstinence and to assess how the intensity of current use might have influenced cerebrovascular perfusion in these marijuana users. *Method:* The authors recorded blood flow velocity in the anterior and middle cerebral arteries using transcranial Doppler sonography in three groups of marijuana users who differed in the intensity of recent use (light: n = 11; moderate: n = 23; and heavy: n = 20) and in control subjects (n = 18) to assess the nature and duration of any potential abnormalities. Blood flow velocity was recorded within 3 days of admission and 28 to 30 days of monitored abstinence on an inpatient research unit in order to evaluate subacute effects of the drug and any abstinence-generated changes. *Results:* Pulsatility index, a measure of cerebrovascular resistance, and systolic velocity were significantly increased in the marijuana users vs control subjects. These increases persisted in the heavy marijuana users after a month of monitored abstinence. *Conclusions:* Chronic marijuana use is associated with increased cerebrovascular resistance through changes mediated, in part, in blood vessels or in the brain parenchyma. These findings might provide a partial explanation for the cognitive deficits observed in a similar group of marijuana users.

NEUROLOGY 2005;64:488–493

Marijuana is the most commonly used drug among young persons.[1] Prolonged effects of marijuana on the neurovasculature might be responsible, in part, for the reports of cognitive deficits observed in some of these users[2] because the acute administration of marijuana or delta-9-tetrahydrocannbinal (THC) causes increases in cerebral blood flow in marijuana users[3] and because reduced cerebral blood flow is observed in recently abstinent chronic marijuana users.[4] It remains to be determined whether the reported changes in cerebral blood flow might persist over an extended period of monitored abstinence, and whether the intensity of current marijuana use might influence the severity or duration of the perfusion deficits associated with use of the drug.

In order to address these issues further, three groups of marijuana users differing in the current intensity of use were tested with transcranial Doppler (TCD) sonography early and late during a month of monitored abstinence. Their data were contrasted with those of control subjects. In order to delineate possible effects of marijuana on cerebral vessels, we opted for TCD because TCD assessment is noninvasive, economical, and rapid.[5] Because TCD is a test that is easily available in clinical neurology settings, it allows for easy replication, unlike some of the more expensive imaging techniques.

Methods. *Subjects.* Fifty-four marijuana users (14 women, 40 men) and 18 control subjects (6 women, 12 men) were studied. Before undergoing blood flow velocity assessment by TCD, all volunteers had undergone medical, neurologic, psychological, and laboratory evaluations. Fourteen marijuana users also met criteria for a diagnosis of antisocial personality disorder and four met Diagnostic and Statistical Manual of Mental Disorders (DSM)–IV criteria for nicotine dependence.[6]

Exclusion criteria, which applied to all subjects, included 1) major medical and psychiatric illnesses including history of hypertension, 2) head injuries with loss of consciousness for greater than 5 minutes, 3) evidence of any neurologic abnormalities by history or examination, 4) HIV seropositivity, and 5) drug (e.g., cocaine, heroin) or excessive alcohol use by DSM-IV criteria for alcohol abuse or dependence. The research protocol was approved by the National Institute on Drug Abuse and Johns Hopkins Bayview Medical Center Institutional Review Boards for Human Research and was carried out in accordance the with the Declaration of Helsinki. Written informed consent was obtained from all subjects.

Demographic information and drug use history information were obtained from the Addiction Severity Index (ASI).[7] The metric, joints per week, was determined from the subjects' self-reported drug history. Since the number of marijuana joints per week ranged from 2 to 350, the 54 marijuana users were divided into three groups using the procedure described by Bolla et al.[2] Fifteen marijuana users in the present study were also in the Bolla study. In that procedure, a blunt (cigar-size marijuana smoking material) was equal to four joints (small diameter cigarette-size smoking material). The light group smoked 11.0 ± 3.5 joints per week (n = 11; range 2.2 to 15.0). The moderate group smoked the equivalent of 43.7 ± 16.4 joints per week (n = 23; range 17 to 70). The heavy group smoked the equivalent of 130.8 ± 73.0 joints per week (n = 20; range 78 to 350). Table 1 lists these measures for the control subjects and the three groups of marijuana users. The three groups of marijuana users did not differ in years of use. Other than alcohol, tobacco, and marijuana use reported in table 1, illicit drug use was not self-reported or observed in urine toxicologies obtained during the screening process. Subjects with drug use other than marijuana use were screened out of the present study. Subjects with a lifetime diagno-

From the Molecular Neuropsychiatry Branch, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD.
Received July 2, 2004. Accepted in final form October 14, 2004.
Address correspondence and reprint requests to Dr. Ronald I. Herning, Molecular Neuropsychiatry Branch, National Institute on Drug Abuse, PO Box 5180, Baltimore, MD 21224; e-mail: rherning@intra.nida.nih.gov

Table 1 Demographic measures and drug history

Demographic measures	Control, n = 18, mean (SD)	Marijuana users: Light, n = 11, mean (SD)	Moderate, n = 23, mean (SD)	Heavy, n = 20, mean (SD)
Age, y	24.2 (3.2)	25.5 (6.3)	22.6 (4.9)	21.6 (2.8)
Education, y	13.0 (1.7)	12.2 (1.6)	11.7 (1.8)	11.2 (1.5*)
Shipley, IQ	102.5 (13.8)	95.8 (11.8)	95.7 (11.8)	97.0 (10.7)
Women, %	33.3	27.3	26.1	25.0
African Americans, %	88.9	81.8	78.3	100.0
Drug history measures				
Alcohol, d/30 d,† CV‡	0.6 (1.1)	3.4 (4.7)	3.7 (4.8)	6.2 (6.3*)
Alcohol, y§	1.2 (2.4)	1.4 (3.3)	3.4 (5.8)	2.5 (3.3)
Marijuana, d/30 d		15.9 (3.7)	24.5 (7.1)	29.2 (3.4)
Marijuana, y‖		5.6 (3.8)	7.2 (5.8)	6.1 (3.1)
Last use to early test, d		4.0 (1.5)	2.6 (1.9)	2.2 (0.9)
Median (range)		4 (2 to 7)	2 (1 to 10)	2 (1 to 4)
Cigarettes/day, CV	0.6 (1.5)	4.7 (5.3)	5.9 (5.8)	8.9 (9.2*)
Cigarettes, y	4.8 (11.0)	4.5 (4.9)	3.7 (4.2)	4.1 (2.6)

* $p < 0.05$ Alcohol days and cigarettes/day: heavy > control

† The number of days of substance use in the last 30 days from the ASI.[7]

‡ Variable was used as a covariate in the analysis of blood flow velocity measures.

§ Years of substance use calculated from ASI.[7]

‖ The three groups of marijuana users did not differ on this measure [$F(2,50) = 0.40$, $p > 0.5$].

CV = covariate; ASI = Addiction Severity Index.

sis of alcohol abuse or dependence by DSM-IV criteria were also screened out of the study.

Procedures. TCD measurements were made within 72 hours of admission to our closed clinical research ward. A second measurement was made after 28 to 30 days of monitored abstinence on the research ward. Our closed research ward was assessable only to authorized staff and no visitors were permitted. Random urine samples were collected for urine toxicologies. The control subjects were tested once during an outpatient visit since it is difficult to recruit control subjects who would be willing to spend a month on a closed research ward and none of the measures were expected to change over this period.

Resting heart rate and blood pressure (BP) were measured in all subjects. Measurements were made within 72 hours of admission and at 28 to 30 days after admission to the clinical unit for the marijuana users. These cardiovascular measures were recorded on an outpatient visit for the control subjects as a comparison.

Blood flow velocity was determined using a temporal window (zygomatic arch) for four arteries: right and left middle (MCA) and right and left anterior (ACA) cerebral arteries using pulsed TCD sonography (Nicolet, Model TC2000). The evaluation of all four arteries took from 15 to 20 minutes. Mean velocity (Vm: cm/second), systolic velocity (Vs: cm/second), diastolic velocity (Vd: cm/second), and pulsatility index (PI = [Vs-Vd]/Vm) were determined for each artery. Any possible acute effects of nicotine on TCD measures were eliminated by testing subjects 20 minutes or longer after cigarette smoking. Caffeinated beverages were not allowed for 2 hours or more before the recording session. In one marijuana user, the 28-day TCD recording from the anterior cerebral arteries was not obtained due to recording difficulties. Thus, the evaluation of the effects of a month of monitored abstinence is based on 54 subjects for the MCA and 53 subjects for the ACA.

Statistical analysis. A group (three groups of marijuana users and control subjects) by sex analysis of variance (ANOVA) was used to test for differences in cardiovascular measures. An ANOVA with time (less than 72 hours vs 28 days) as well as dose groups (light, moderate, and heavy) between subject factor was used to determine if any of the cardiovascular measures were affected by the month of abstinence for the marijuana users.

An analysis of covariance (ANCOVA) was used on the blood flow velocity measures. A group (three groups of marijuana users and control subjects) by sex by side (right vs left) were the factors in each ANCOVA. The analysis compared the blood flow velocity data of the control subjects with that of the marijuana users collected early in abstinence. The covariates in ANCOVA were days of alcohol use in the last month and the cigarettes smoked per day since these variables differed across groups (see table 1). An ANCOVA with time (less than 72 hours vs 28 days) and side as well as the between-subject factor, dose group (light, moderate, and heavy), was used to determine if any of the blood flow velocity measures changed during the month of abstinence for the marijuana users. After each ANCOVA, post hoc tests were made using the Bonferroni procedure on the appropriate means. Statistical testing was performed with SPSS, version 11 (Chicago, IL).

Results. *Drug history and cardiovascular measures.* The drug history measures are reported in table 1. While the subject groups differed significantly by years of education [$F(3,64) = 3.67$, $p < 0.05$], there were no significant differences in Shipley estimates of IQ across groups. Cardiovascular measures are shown in table 2. Heart rate and systolic BP were similar for control and marijuana groups. Heart rate for the marijuana subjects tested at 28 to 30 days after admission was significantly greater than the values obtained within 72 hours of admission. No differences in systolic BP between the control and marijuana groups were observed. There were also no differences in systolic BP between the two test times for the marijuana groups. Diastolic BP for the marijuana users was significantly lower than that of the control subjects at the beginning of their inpatient stay. Diastolic BP did not differ

Table 2 Cardiovascular measures

Measure/time	Control	Marijuana users: Light	Moderate	Heavy
Heart rate, BPM				
<72 h	71.8 (6.9)	72.4 (10.0)	69.9 (10.7)	68.8 (12.5)
28–30 d		80.4* (9.6)	81.8* (9.4)	80.9* (10.6)
Systolic blood pressure, mm Hg				
<72 h	124.8 (11.5)	121.5 (14.4)	127.7 (15.0)	126.5 (15.0)
28–30 d		124.6 (8.2)	128.6 (15.6)	126.6 (12.0)
Diastolic blood pressure, mm Hg				
<72 h	76.8 (9.0)	68.3† (9.3)	69.3† (10.7)	70.0† (10.2)
28–30 d		69.1 (9.8)	71.8 (10.4)	68.6 (10.4)

Values are mean (SD).

* The means for the marijuana subjects tested at 28–30 days after admission is greater than the values obtained within 72 hours of admission [test time effect for marijuana groups: $F(1, 50) = 53.5$, $p < 0.001$]. Each early–late Bonferroni post hoc comparison was also significant at $p < 0.05$.

† The means of the diastolic blood pressure for the marijuana subjects tested within 72 hours after admission are lower than those of the control subjects [group effect for all groups: $F(3, 64) = 3.42$, $p < 0.05$] followed by post hoc comparisons ($p < 0.05$).

BPM = beats per minute.

among the three marijuana groups. There were no significant differences in diastolic BP throughout the stay of the marijuana users on the closed research unit.

TCD measures. No sex-related differences were observed in any of the TCD measures. There were no significant sex main effects or group by sex interactions in any of the MCA measures. There were no significant sex main effects or group by sex interactions in any of the ACA measures. In view of the lack of significant group by sex interactions in the analyses between the control subjects and marijuana users, sex was not considered in the analyses of the blood velocity values over time.

Vs and Vm for the MCA were higher for marijuana users in comparison to those for control subjects [Vs: $F(3,62) = 4.59$, $p < 0.002$; Vm: $F(3,62) = 3.14$, $p < 0.05$]. Vs and Vm did not differ among the marijuana groups (light, moderate, heavy). Figure 1A shows the means for the Vs measures for the control subjects and three marijuana groups. The results for Vm (not shown) were similar to Vs and Vd measures and were not significantly different in any of the groups. Figure 1B shows the means for the Vd measures for the control and three marijuana groups. The marijuana users also had higher PI values than the control subjects [$F(3,62) = 3.72$, $p < 0.02$]. PI did not differ among the marijuana groups (light, moderate, heavy). Figure 1C shows the means for PI for the control and marijuana groups.

Vs for the ACA was higher for marijuana users as compared to the control subjects [Vs: $F(3,62) = 5.68$, $p < 0.002$]. Vs values did not differ among the marijuana groups (light, moderate, heavy). Figure 2A shows the means for the Vs measures for the control subjects and three marijuana groups. Vd and Vm values were not significantly different among the groups. Figure 2B shows the means for the Vd measures for the control and three marijuana groups. The marijuana users also had higher PI values than the control subjects [$F(3,62) = 4.02$, $p < 0.01$], but PI did not differ among the marijuana groups (light, moderate, heavy). Figure 2C shows the plot of mean PI for the control and marijuana groups.

An ANCOVA with time and side and dose group (light, moderate, and heavy) was used to determine if any of the blood flow velocity measures changed during the month of abstinence for the marijuana users. For the MCA, the time by group interaction for Vs and PI was significant [Vs: $F(2,49) = 3.80$, $p < 0.05$; PI: $F(2,49) = 3.43$, $p < 0.05$]. This interaction indicated that there was a significant change over time for some of the marijuana groups. There was a significant decrease late in abstinence in Vs values for the light marijuana users compared to early abstinence (see figure 1A). A significant increase was observed for the heavy users late during the course of abstinence in comparison to the earlier time of testing (see figure 1A). PI for the light and moderate marijuana users decreased significantly from early to late abstinence (see figure 1C).

For the ACA, the time by marijuana group interaction was significant for Vs [$F(2,48) = 5.31$, $p < 0.01$], Vm [$F(2,48) = 3.35$, $p < 0.05$], and PI [$F(2,48) = 3.14$, $p < 0.05$]. Vs for the heavy marijuana users increased during the month of monitored abstinence (see figure 2B). PI values were reduced late in abstinence for the light marijuana users (see figure 2C).

Discussion. The main findings of the study are that, in comparison to control subjects, marijuana users show 1) elevated systolic and mean blood flow velocity in the MCA and ACA; 2) higher PI values in both the MCA and ACA; 3) no significant improvements in systolic velocity during a month of monitored abstinence; and 4) improvement in PI values only for the light and moderate marijuana users during the month of monitored abstinence. The present measurements, obtained during a month of observed abstinence from marijuana users, document poten-

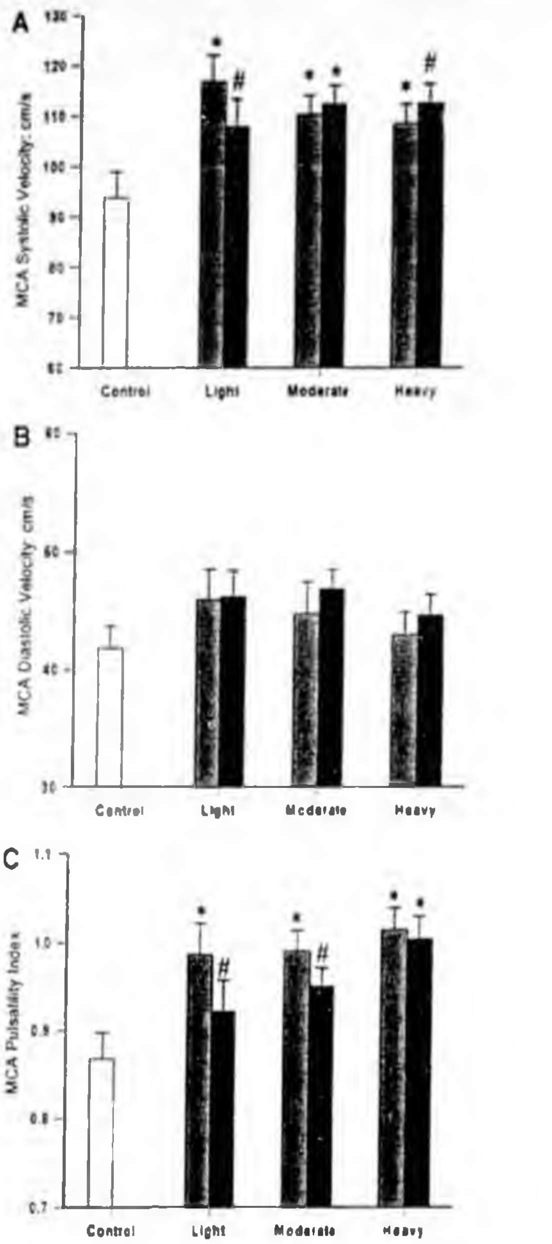


Figure 1. Mean systolic velocity is plotted for middle cerebral artery (A). Measurements were made within 72 hours of admission (gray bars) and after 28 days of monitored abstinence (black bars) for the marijuana users and at an outpatient test day for the control subjects (white bars). The error bar indicates the standard error. The asterisks indicate differences (p < 0.05) between the control and the marijuana groups at each test time using the Bonferroni procedure. The pound signs indicate significant decreases from early to late testing for the light group and increases from early to late testing for the heavy group. Mean diastolic velocity is plotted for the control subjects and the three marijuana groups for middle cerebral artery (B). No significant differences among the experimental groups were observed for diastolic velocity. Mean PI values are plotted for middle cerebral artery (C). The asterisks indicate differences (p < 0.05) between the control and the marijuana groups at each test time using the Bonferroni procedure. The pound signs indicate a significant reduction in PI from early to late abstinence for the light and moderate groups.

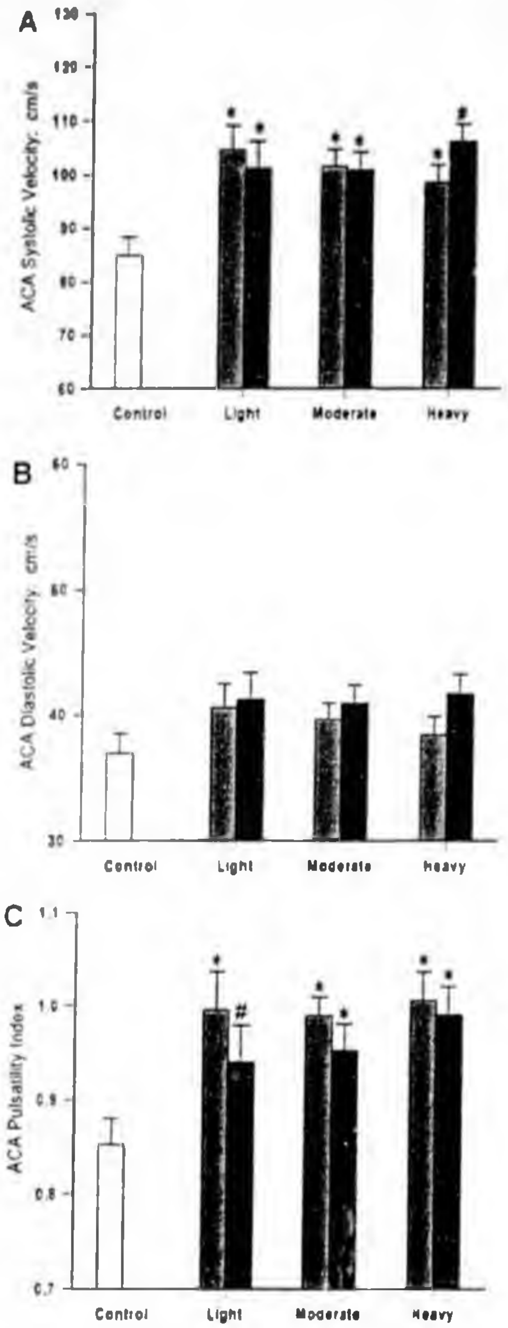


Figure 2. Mean systolic velocity is plotted for anterior cerebral artery (A). Recordings were made within 72 hours of admission (gray bars) and after 28 days of monitored abstinence (black bars) for the marijuana users and at an outpatient test day for the control subjects (white bars). The asterisks indicate differences (p < 0.05) between the control and the marijuana groups at each test time using the Bonferroni procedure. The pound signs indicate significant increases from early to late testing for the heavy group. Mean diastolic velocity is plotted for the control subjects and the three marijuana groups for the anterior cerebral artery (B). No significant differences were observed among the experimental groups. Mean PI values are plotted for anterior cerebral artery (C). The asterisks indicate differences (p < 0.05) between the control and the marijuana groups at each test time using the Bonferroni procedure. The pound signs indicate a significant reduction in PI from early to late abstinence for the light group.

tially prolonged marijuana-mediated changes in vascular hemodynamics.

Reported increased cerebral blood flow velocities with increased PI observed in other patient populations are thought to be due to increased cerebrovascular resistance secondary to vasoconstriction of both small and large cortical vessels.[8] These changes might be secondary to increased cerebral perfusion pressure when vascular autoregulation is impaired.[9] Although caution must be taken when comparing different methods of assessing cerebral perfusion, the present study extends previous reports of marijuana-associated alterations in blood flow measured by SPECT,[10] PET,[4] or MRI.[11] For example, a study, using dynamic susceptibility contrast MRI, revealed significant increases in cerebral blood volume in marijuana users as compared to control subjects over a month of monitored abstinence.[11] Because increased blood volume has been reported to occur in areas of reduced perfusion,[12] it is possible that our present observations and those of others[11] might reflect similar distal perfusion deficits in marijuana patients. In contrast to the decreases observed during abstinence, acute administration of marijuana increases cerebral blood flow.[3] Taken together, those observations and ours are consistent with reports indicating that the acute effects of marijuana are opposite to those observed during withdrawal.[13]

The PI values of the marijuana users in the present study are higher than those of control subjects in this and other studies.[14] The marijuana users showed elevated PI values that are somewhat higher than those of patients with chronic hypertension[15] and diabetic patients[16] who show mean PI values ranging from 0.87 to 0.89. However, their PI values are lower than those reported for patients with multi-infarct dementia who have mean values of 1.20 to 1.27.[17] Given that the PI values from the present marijuana users fall between the ranges of less affected patients[15,16] and those patients with neurologic impairment,[17] we suggest that our findings might be secondary to abnormalities in small vessels because similar MCA PI values have been reported to reflect small-vessel diseases.[18]

Although we are suggesting that our observations are associated with marijuana use, it is also possible to suggest that they might be consequent to the concurrent use of other substances since cocaine users also show abnormalities in TCD indices.[19] This is probably not the case because the marijuana users in our study reported the use of no other substances except for alcohol and tobacco (see table 1). In fact, prospective subjects who reported other abuse of other substances or had urine tests positive for other substances were excluded from the study. Subjects with excessive use of alcohol were also screened out of this study. An analysis of covariance was also used in order to control for subjects with even modest use of these substances. These analyses revealed that neither alcohol nor tobacco use contributed to any of the differences in blood flow velocity observed between the control subjects and marijuana users. Furthermore, preliminary data from this laboratory have documented that chronic cigarette smoking does not alter PI.[20]

The changes in cerebrovascular flow observed in the present study might be related to the blood pressure differences between the control and marijuana groups. In the present study, systolic blood flow velocity was increased in marijuana users compared to control individuals. However, diastolic blood pressure was lower in the marijuana users, findings that are opposite of what might be expected if pressure and velocity were directly related. Furthermore, changes in cerebrovascular blood flow velocity appear to be related to blood pressure changes only when there is a loss of cerebral autoregulation.[9] It is more likely that the changes in blood pressure and blood flow velocity in the anterior and middle arteries might both be associated with withdrawal from the prolonged use of marijuana. In any case, the present observations suggest that more research is needed to study the effects of chronic marijuana use on cerebral and peripheral vascular systems.

A number of possible scenarios might be responsible for our present observations because of reported effects of the marijuana on the sympathetic and parasympathetic nervous systems. Specifically, marijuana administration is known to cause postural hypotension with dizziness as a result of drug-induced decreases in peripheral resistance.[21] These effects are thought to be mediated by CB1 receptors located on neurons and smooth muscle[22] and via stimulation of non-CB1 or non-CB2 receptors located on endothelial cells[23] which can also cause vasodilation.[24] This suggestion is consistent with our finding that the marijuana users in the present study had low resting diastolic blood pressure throughout the month of abstinence. The marijuana-associated cerebrovascular changes might be due to changes in the density of CB1 receptors in the brain and blood vessels as a result of the use of high doses of the drug. Chronic injections of THC have been shown to increase in the number of these receptors in the brain.[24] Therefore, it is possible that chronic intake of marijuana by drug users might affect cerebrovascular resistance through changes mediated in blood vessels or in the brain parenchyma.

References

1. Substance Abuse & Mental Health Services Administration. Results of the 2002 National Survey on Drug Use and Health: national findings. Rockville, MD: DHHS Publications Office of Applied Studies, NHSDA Series H-22, No SMA 03–3836, 2003.
2. Bolla KI, Brown K, Eldreth D, Tate K, Cadet JL. Dose-related neurocognitive effects of marijuana use. Neurology 2002;59:1337–1343.
3. Mathew RJ, Wilson WH, Turkington TG, et al. Time course of tetrahydrocannabinol-induced changes in regional cerebral blood flow measured with positron emission tomography. Psychiatry Res 2002;116:173–185.
4. Block RI, O'Leary DS, Hichwa RD, et al. Effects of frequent marijuana use on memory-related regional cerebral blood flow. Pharmacol Biochem Behav 2002;72:237–250.
5. Sloan MA, Alexandrov AV, Tegeler CH, et al. Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Assessment: transcranial Doppler ultrasonography: report of the

Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Neurology 2004;62:1468–1481.
6. Robins LN, Cottler L, Bucholz K, Compton W. Diagnostic Interview Schedule for DSM-IV. St. Louis: Washington University Press, 1995.
7. McLellan AT, Luborsky L, Cacciola J, et al. Guide to the Addiction Severity Index: background, administration, and field testing results. Rockville, MD: National Institute on Drug Abuse, Treatment Research Reports, 1986.
8. Grubb BP, Hahn H, Elliott L, et al. Cerebral syncope: loss of conscious associated with cerebral vasoconstriction in the absence of systemic hypotension. Pacing Clin Electrophysiol 1998;21:652–658.
9. Reinhard M, Roth M, Miller T, et al. Cerebral autoregulation in carotid artery occlusive disease assessed from spontaneous blood pressure fluctuations by correlation coefficient index. Stroke 2003;34:2138–2144.
10. Amen DG, Waugh M. High resolution brain SPECT imaging of marijuana smokers with AD/AD. J Psychoactive Drugs 1998;30:209–214.
11. Yurgelun-Todd DA, Simpson NS, Gruber SA, Renshaw PF, Pope HG. Cerebral blood volume changes after a 28-day washout period in chronic marijuana smokers: DSC-MRI study. Drug Alc Depend 2001;63 supl:s175.
12. Kuwabara Y, Ichiya Y, Sasaki M. PET evaluation of cerebral hemodynamics in occlusive cerebrovascular disease pre- and postsurgery. J Nucl Med 1998;39:760–765.
13. Jones RT, Benowitz NL, Herning RI. Clinical relevance of cannabis tolerance and dependence. J Clin Pharmacol 1981;21:143S–152S.
14. Steinmeier R, Laumer R, Bondar I, Priem R, Fahlbush R. Cerebral hemodynamics in subarachnoid hemorrhage evaluated by transcranial Doppler sonography. Part 2. Pulsatility index: normal reference values and characteristics in subarachnoid hemorrhage. Neurosurgery 1993;31:10–19.
15. Cho S, Kim GW, Sohn YH. Blood flow velocity changes in the middle cerebral artery as an index of chronicity of hypertension. J Neurol Sci 1997;50:77–80.
16. Lee KY, Sohn YH, Baik JS, Kim GW, Kim S-J. Arterial pulsatility as an index of cerebral microangiopathy in diabetes. Stroke 2000;31:1111–1115.
17. Sattel H, Biedert S, Forstl H. Senile dementia of Alzheimer type and multi-infarct dementia investigated by transcranial Doppler. Dementia 1997;7:41–46.
18. Kidwell CS, El-Saden D, Livhits Z, et al. Transcranial Doppler pulsatility indices as a measure of diffuse small-vessel disease. J Neuroimaging 2001;11:229–234.
19. Herning RI, King DE, Better WE, Cadet JL. Neurovascular deficits in cocaine abusers. Neuropsychopharmacology 1999;21:110–118.
20. Better W, Herning RI, Tate K, Cadet JL. Cerebral blood flow velocity in cigarette smokers. Drug Alc Depend 2004;74(supl):s75.
21. Jones RT. Cardiovascular system effects of marijuana. J Clin Pharmacol 2002;42:58S–63S.
22. Wilson RI, Nicoll RA. Endocannabinoid signaling in the brain. Science 2002;296:678–682.
23. Jarai Z, Wagner JA, Varga K, et al. Cannabinoid-induced mesenteric vasodilation through an endothelial site distinct from CB1 or CB2 receptors. PNAS 1999;96:14136–14141.
24. Hillard CJ. Endocannabinoids and vascular function. J Pharmacol Exp Ther 2000;294:27–32.

ALERT: NEUROLOGY NOW USING ONLINE PEER REVIEW AND MANUSCRIPT SUBMISSION SYSTEM

Neurology is now using an online peer review and manuscript submission system called Bench>Press.

Authors should upload all original submissions via the *Neurology* website (www.submit.neurology.org). The Instructions to Authors detail the submission process and adjusted specifications.

ORIGINAL CONTRIBUTION

Cognitive Functioning of Long-term Heavy Cannabis Users Seeking Treatment

Nadia Solowij, PhD

Robert S. Stephens, PhD

Roger A. Roffman, DSW

Thomas Babor, PhD, MPH

Ronald Kadden, PhD

Michael Miller, PhD

Kenneth Christiansen, PsyD

Bonnie McRee, MPH

Janice Vendetti, MPH

for the Marijuana Treatment Project Research Group

Context Cognitive impairments are associated with long-term cannabis use, but the parameters of use that contribute to impairments and the nature and endurance of cognitive dysfunction remain uncertain.

Objective To examine the effects of duration of cannabis use on specific areas of cognitive functioning among users seeking treatment for cannabis dependence.

Design, Setting, and Participants Multisite retrospective cross-sectional neuropsychological study conducted in the United States (Seattle, Wash; Farmington, Conn, and Miami, Fla) between 1997 and 2000 among 102 near-daily cannabis users (51 long-term users: mean, 23.9 years of use; 51 shorter-term users: mean, 10.2 years of use) compared with 33 nonuser controls.

Main Outcome Measures Measures from 9 standard neuropsychological tests that assessed attention, memory, and executive functioning, and were administered prior to entry to a treatment program and following a median 17-hour abstinence.

Results Long-term cannabis users performed significantly less well than shorter-term users and controls on tests of memory and attention. On the Rey Auditory Verbal Learning Test, long-term users recalled significantly fewer words than either shorter-term users ($P = .001$) or controls ($P = .005$); there was no difference between shorter-term users and controls. Long-term users showed impaired learning ($P = .007$), retention ($P = .003$), and retrieval ($P = .002$) compared with controls. Both user groups performed poorly on a time estimation task ($P < .001$ vs controls). Performance measures often correlated significantly with the duration of cannabis use, being worse with increasing years of use, but were unrelated to withdrawal symptoms and persisted after controlling for recent cannabis use and other drug use.

Conclusions These results confirm that long-term heavy cannabis users show impairments in memory and attention that endure beyond the period of intoxication and worsen with increasing years of regular cannabis use.

JAMA. 2002;287:1123-1131 www.jama.com

IN THE CURRENT CLIMATE OF DEBATE about marijuana laws and interest in marijuana as medicine,[1] one issue remains unresolved: Does heavy, frequent, or prolonged use of cannabis lead to a deterioration in cognitive function that persists well beyond any period of acute intoxication? Is the functioning of the brain altered in the long term? With over 7 million people using cannabis weekly or more often in the United States alone[2] and the potential for increased physician recommendations for select patients to use cannabis therapeutically,[1] answers to these questions are of significant public health concern.[1-4] Scientific evidence from past research clearly showed that gross impairment related to chronic cannabis use did not occur but was inconclusive with regard to the presence of more specific deficits.[5,6] Recent studies with improved methods have demonstrated changes in cognition and brain function associated with long-term or frequent use of cannabis. Specific impairments of attention, memory, and executive function have been found in cannabis users in the unintoxicated state (and in children exposed to cannabis in utero[7]) in controlled studies using brain event-related potential techniques[8-10] and neuropsychological assessments[11-15] including complex tasks.

Brain imaging studies of cannabis users have demonstrated altered function, blood flow, and metabolism in prefrontal and cerebellar regions.[16-19] Studies failing to detect cognitive decline associated with cannabis use[20] may reflect insufficient heavy or chronic use of cannabis in the sample or the use of insensitive assessment instruments. Impairments appear to increase with duration and frequency of cannabis use; however, the parameters of use that are associated with short- or long-lasting cognitive and brain dysfunction have not

For editorial comment see p 1172.

Author Affiliations: National Drug and Alcohol Research Centre, University of New South Wales, Sydney, and Department of Psychology, University of Wollongong, Wollongong (Dr Solowij), New South Wales, Australia; Department of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va (Dr Stephens); Innovative Programs Research Group, School of Social Work, University of Washington, Seattle (Dr Roffman); Department of Community Medicine (Dr Babor and Mss McRee and Vendetti) and Department of Psychiatry (Dr Kadden), University of Connecticut Health Center, Farmington; and The Village South Inc, Miami, Fla (Drs Miller and Christiansen).

Other Members of the Marijuana Treatment Project Research Group are listed at the end of this article.

Corresponding Author and Reprints: Nadia Solowij, PhD, National Drug and Alcohol Research Centre, University of New South Wales, Sydney, NSW 2052, Australia (e-mail: n.solowij@unsw.edu.au).

been fully elucidated. The attribution of deficits to lingering acute effects, drug residues, abstinence effects, or lasting changes caused by chronic use continues to be debated.[5,6] Animal research suggests an important role for the cannabinoid receptor in regulating the neural activity critical for memory processing.[21-24] Long-term use of cannabis may result in altered functioning of the cannabinoid receptor and its associated neuromodulator systems.

This study investigated the nature of cognitive impairments associated with long-term cannabis use employing data collected from a large clinical trial of chronic users seeking treatment for cannabis dependence. The study compared 102 cannabis users assessed prior to treatment on carefully selected neuropsychological tests with 33 nonuser controls. The parameters of cannabis use that contribute to impairment were examined. It was hypothesized that performance would deteriorate as the number of years of regular use increased.

METHODS

Design

A multisite, retrospective, cross-sectional comparison-group design was used to compare (1) long-term users with a mean of 23.9 years of regular cannabis use, (2) shorter-term users with a mean of 10.2 years of regular use, and (3) nonusers of cannabis. Key confounding variables (age, IQ, other drug use) were controlled through matching or statistical methods. The sample size required for this study was determined by estimating a 94% chance of detecting a moderate effect size of 0.5 SD units at a 2-tailed α of .05.

Recruitment Procedure and Assessment of Drug Use

Sixty-five of the 102 cannabis users were delayed-treatment participants from the Marijuana Treatment Project, a multisite US study (Seattle, Wash, Farmington, Conn, and Miami, Fla) conducted between 1997 and 2000 of the effectiveness of brief treatments for cannabis dependence.[25] The remainder were recruited through the Marijuana Treatment Project specifically for this study. Participants provided written informed consent as approved by the ethics committees of the participating institutions and were paid $75 for completing the cognitive assessments. Controls (n = 33) were recruited from the general population through media advertisements at only 1 site. The controls were told that the researchers were studying the effects of exposure to drugs and alcohol on cognitive functioning, and that at present only individuals at the lighter end of the spectrum of drug experience were required. The aim was to minimize cannabis use among controls while approximating the other characteristics of the cannabis-using sample. Assessors were not blinded with regard to group assignment. Self-reported drug and alcohol use were assessed by the Addiction Severity Index,[26] a separate structured interview, and the Time Line Follow Back procedure.[27,28] The Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV)* Axis 1 Disorders (SCID)[29] assessed cannabis dependence. Duration of regular (at least twice per month) cannabis use was an averaged composite measure derived from the Addiction Severity Index, SCID, and the structured interview. Current frequency of cannabis use was calculated from the Time Line Follow Back procedure.

Inclusion/Exclusion Criteria

Cannabis users were included if they had used cannabis regularly for at least 3 years, were currently using at least once a week, were seeking treatment to assist them to cease or reduce their use of cannabis, and were willing to participate in the treatment program offered. Participants were excluded if they had ever had a serious illness or injury that may have affected the brain, any psychotic disorder, met a current *DSM-IV* diagnosis of dependence on any other drug or alcohol, or had a poor command of the English language.

Sample Characteristics

TABLE 1 provides demographic information and cannabis use parameters.

Table 1. Demographic and Cannabis Use Details of the Sample*

	Cannabis Users			
	All	Shorter-term Users	Long-term Users	Controls
No.	102	51	51	33
Sex, male (%)	75 (74)	36 (71)	39 (76)	22 (67)
Age, mean (SD) [range], y	35.4 (8.6) [19-55]	28.7 (5.5) [19-45]†	42.1 (5.2) [34-55]†	34.8 (11.1) [19-65]
Education, mean (SD) [range], y‡	14.3 (2.3) [10-22]	14.1 (2.5) [10-22]	14.5 (2.0) [11-20]	14.8 (1.8) [12-18]
Full-scale IQ, mean (SD) [range]§	105.4 (6.7) [87.4-118.5]‖	105.1 (7.4) [87.4-118.5]	105.7 (5.9) [92.7-118.3]	107.9 (4.7) [94.5-117.2]
Duration of use, mean (SD) [range], y¶	17.1 (7.9) [2.7-31.7]	10.2 (3.8) [2.7-17.0]	23.9 (4.1) [17.3-31.7]	
Frequency of use, median (range), d/mo#	27.9 (3.5-30)	28.3 (5.2-30)	27.4 (3.5-30)	...

*Ellipses indicate not applicable.
†Significantly different from controls at $P < .001$.
‡The self-reported number of years of formal education completed.
§Estimated from a combination of North American Adult Reading Test, Wide Range Achievement Test–Revised reading subtest scores, and the Barona Index.
‖Significantly different from controls at $P < .05$.
¶The number of years that cannabis had been used since regular use commenced (at least twice per month), composite from self-report, Addiction Severity Index, and Structured Clinical Interview Axis 1 Disorders assessments.
#The median number of days per month that cannabis was used at entry to the study, based on average use per 30 days from self-reported use during the past 14 weeks.

The user group was split at the median for duration of cannabis use to enable comparisons of long-term users, shorter-term users, and controls. No meaningful division of groups could be achieved on the basis of frequency of cannabis use, which was almost daily for the majority of the sample. Sex distribution and years of education did not differ between groups. The majority of users (68.6%) and controls (63.6%) were white. Overall, users and controls did not differ in age, but long-term users were significantly older and shorter-term users were significantly younger than controls ($P<.001$). Premorbid intelligence was estimated by several methods and averaged: the Wide Range Achievement Test—Revised reading subtest (WRAT-R READ)[30,31]; the North American Adult Reading Test (NAART)[32]; and the Barona Index.[33] The mean estimated full-scale IQ (FSIQ) did not differ between the 3 groups based on duration of cannabis use. The majority of the sample (62.4% long-term, 88.2% shorter-term users) reported experiencing problems with memory, attention, or concentration, which they attributed to their use of cannabis.

Cannabis Use, Required Abstinence, and Urinalysis

Users first tried cannabis at a mean age of 15.3 (SD, 2.6) years with regular use (at least twice a month) commencing at age 17.5 (SD, 3.2) years. Cannabis had been used on a median 29 of the past 30 days (range, 1-30). Almost the entire sample (98%) met the *DSM-IV* criteria for cannabis dependence. The median amount of cannabis smoked per week was 1 quarter of an ounce (range, 0.01-2.00 oz) with 2 average-sized joints typically smoked per day (range, 0.12-20.00). None of these cannabis-use parameters differed between the long- and shorter-term user groups. Twenty-two controls had either never tried cannabis or used it 10 or fewer times in their lives and 11 had used cannabis weekly to monthly while at school or college between 4 and 30 years ago. Controls with a history of cannabis use were excluded from "pure sample" analyses.

Participants were required to abstain from cannabis for at least 12 hours prior to testing and to provide 2 urine samples (1 the night before testing, another during the test session). The median self-reported time since last use of cannabis was 17 hours (range, 7-240 hours); this did not differ between long- and shorter-term users. At the time of testing, 70% of the sample reported that they were not experiencing any discomfort after abstaining from cannabis. Twice as many shorter-term users than long-term users ($P=.03$) reported mild withdrawal symptoms such as cravings, irritability, depression, anxiety, sleep, or appetite disturbances. In 78.3% of cases, creatinine-normalized urinary cannabinoid metabolite (THC-COOH) levels on the day of testing were less than or equivalent to those from the night before.[34,35] Abstinence from cannabis was supported by significant correlations between the level of normalized urinary cannabinoid metabolite on the day of testing and the self-reported time since last use (bivariate correlation coefficient [r], −0.46; $P<.001$), and the quantity used on the last occasion divided by the time since last use (r, 0.39; $P<.001$). The effects of these measures of recent use were examined in relation to test performance. "Pure sample" analyses excluded users with higher metabolites in the second urine sample. No cannabinoid metabolites were detected in the urine of the control participants.

Other Drug Use

No other drug metabolites were detected in any urine sample. Tobacco and alcohol use was minimal. Alcohol was consumed on a median of 3.4 and 1.7 days per month among users and controls, respectively. Almost one third of users and 46.8% of controls drank less than once a month or not at all. Forty-eight percent of the cannabis users had only tried drugs other than cannabis a few times or never; 52% had used other drugs socially/recreationally primarily during high school and college. Past histories of regular drug use included cocaine (n=24), amphetamines (n=11), hallucinogens (n=17), and sedatives/hypnotics or minor tranquilizers (n=7). Current use of other drugs was less than once a month or not at all for 93.1% of the sample. More than half of the controls (51.5%) had never tried any other drug and the remainder had only tried other drugs experimentally. "Pure sample" analyses excluded all participants with histories of regular or heavy use of alcohol or other drugs.

Neuropsychological Tests and Procedures

Nine neuropsychological tests were administered in the order listed in TABLE 2,[36-46] along with the 2 tests used to assess premorbid IQ.[30-32] A 10-minute rest break was given after the Rey Auditory Verbal Learning Test (RAVLT) Recognition test. Tests were administered by trained assistants and took approximately 2 hours to complete. Quality assurance procedures were adopted to ensure that procedures were standardized at each site with ongoing supervision and review of audiotaped assessments by centralized staff throughout the course of the study.

Data Analysis

Each cognitive test was analysed using SPSS version 10.0 (SPSS Institute, Chicago, Ill) with analysis of covariance (ANCOVA) for normally distributed variables or nonparametric tests of group differences for skewed data. The FSIQ and age were included as covariates in analyses where they correlated with test performance. All participants were initially included in analysis, with the overall cannabis user sample first compared with the control group (evaluated at $P<.05$), followed by comparisons on the basis of duration of cannabis use (long- vs shorter-term users vs controls, evaluated at $P<.01$). For 2-way interactions, the Greenhouse-Geisser method was used to adjust the *df* where appropriate and for multiple comparisons, a Bonferroni adjustment controlled for type I error. Analysis of covariance was repeated on a purer sample that strictly

Table 2. Neuropsychological Tests Administered and Cognitive Functions Assessed*

Neuropsychological Test	Cognitive Functions Assessed
Wide Range Achievement Test–Revised reading subtest (WRAT-R READ)[36,37]	Premorbid IQ
Speed of Comprehension (SOC) test (Speed and Capacity of Language Processing [SCOLP])[38]	Rate of verbal information processing
Rey Auditory Verbal Learning Test (RAVLT)[39,40]	Memory span, verbal learning and retrieval efficiency, susceptibility to interference
Stroop Test[illegible] with additional interference condition[illegible]	Attention, cognitive flexibility, inhibition of distractor stimuli, suppression of habitual response
Wisconsin Card Sorting Test (WCST) computerized[44]	Problem solving, conceptual ability
Alphabet Task†	Cognitive flexibility, executive function
Omitted Numbers‡	Working memory
Time Estimation and Production§	Temporal judgment
RAVLT 20-minute delay trial (VII), Recognition test	Long-term retention, recognition memory
North American Adult Reading Test (NAART)[37]	Premorbid IQ
Auditory Consonant Trigrams (Brown-Peterson)[45]	Short-term retention under distractor conditions
Paced Auditory Serial Addition Test (PASAT)[46]	Information processing, working memory, divided and sustained attention

*Tests were administered in the order listed.
†Composed of timed loud, silent, and alternating recital trials.
‡Recognition of omitted item from a jumbled aural list of numbers from 1 to 10 (10 trials).
§Composed of 3 trials: unwarned estimation of time to complete the preceding task (mean, 1 minutes 18 seconds) (Time Estimation A), time production (1 minute 40 seconds), and warned passive estimation (2 minutes) (Time Estimation B).

excluded those participants with either a history of other drug use or possible recent use of cannabis prior to testing. Semipartial correlations examined the unique contributions of FSIQ, age, duration of cannabis use, and recency of cannabis use to the variance in cognitive test performance.

RESULTS

Results from the 9 neuropsychological tests are shown in TABLE 3 for cannabis users overall, for groups based on duration of cannabis use, and for controls. Effect sizes are calculated between long-term users and controls using the SD of the controls.

Speed of Comprehension

Cannabis user groups did not differ from controls in the number of items completed (range, 23-100) but users overall made more errors ($P = .03$) (range, 0-5). These results suggest that cannabis users are more likely to sacrifice accuracy for speed.

Rey Auditory Verbal Learning Test

Mean words recalled on each trial are depicted in the FIGURE. The learning curves of shorter-term users and controls were similar but long-term users showed a learning curve with a less steep gradient and long-term users recalled fewer words on every trial. The sum of words recalled across all trials I through VII inclusive of trial B (referred to here as RAVLT sum; range, 37-114) correlated significantly and inversely with the duration of cannabis use after controlling for age and FSIQ (partial r, −0.23; $P = .01$). When analysed by ANCOVA, there was a significant effect of group ($F_{2,127} = 8.36$, $P < .001$) whereby long-term users recalled significantly fewer words than either shorter-term users (95% confidence interval [CI] for difference, 3.84-19.18; $P = .001$) or controls (95% CI for difference, 2.83-19.93; $P = .005$) with no difference between shorter-term users and controls. When all trials were included in a repeated measures ANCOVA, a significant interaction between group and trial ($F_{14,889} = 2.84$; $P = .007$) suggested that long-term users recalled fewer words than shorter-term users or controls on every trial ($P < .05$ for each comparison) except the first, with a trend on trial B (the interference list presented only once; $P = .08$).

The proportion of subjects with a very poor learning ability (acquisition <3 words over 5 trials) was greater among long-term users (13.7%) than controls (0%) ($P = .007$) but not shorter-term users (5.9%). The proportion of long-term users recalling fewer than 10 words on trial V (27.5%) was more than among shorter-term users (8.5%) or controls (3.0%) ($P = .002$). Significantly more long-term users (23.5%) lost 3 or more words over the 20-minute delay between trials VI and VII than shorter-term users (4.3%) or controls (3.0%) ($P = .003$). Long-term users showed a smaller primacy effect in the serial position curve than either other group ($P = .02$). Groups did not differ in the recency effect or in words recalled from the middle of the list.

Users overall and long-term users recognized fewer words than controls from list A (overall, $P = .03$; long-term, $P = .01$) and list B (overall, $P = .01$; long-term, $P = .04$) but long-term users did not differ from shorter-term users. More than half of the long-term users (55%) had a recognition score for list A of 12 or less compared with 28% of shorter-term users and 21% of controls ($P = .002$). Long-term users misassigned more words (median, 2) than shorter-term users and controls (each median, 0) ($P < .001$). A greater proportion of long-term users (13.7%) compared with shorter-term users (6.4%) and controls (0%) actually identified fewer words on recognition than they had just prior during recall on trial VII ($P = .02$). Long-term users' performance was significantly poorer than published norms[47] for the general population on most measures from the RAVLT.

Stroop Test

Cannabis users did not differ significantly from controls after inclusion of covariates in any condition or on interference scores. While there were no performance differences between Color-Word (CW) and Color-Read (CR) in the control group, performance on CR was, however, poorer than on CW in both long- ($P < .001$) and shorter-term users (P = .03). Color-Read was the additional interference condition designed to increase demands on executive function.[43] There was an inverse relationship between duration of cannabis use and number of items completed on CR (partial r, −0.27; P = .003) and CW (partial r, −0.27, P = .004) after controlling for age and FSIQ. These results suggest that cannabis users are vulnerable to task complexity with increasing demands creating more sources of interference that adversely affect performance.

Wisconsin Card Sorting Test

There were no significant group differences on any Wisconsin Card Sorting Test (WCST) measure but a trend on one: long-term users failed to maintain the set more often than shorter-term users (P = .05) or controls (P = .07). Research suggests that this measure best represents attentional dysfunction.[30] There was no evidence of impaired performance with increasing years of cannabis use after controlling for covariates.

Table 3. Neuropsyc[illegible]ological Test Results

	Cannabis Users*					P Value for Comparisons			
Test	All (n = 102)	Shorter-term Users (n = 51)	Long-term Users (n = 51)	Controls (n = 33)	Effect Size	All vs Controls	Shorter-term Users vs Controls	Long-term Users vs Controls	Shorter- vs Long-term Users
SCOLP-SDC, median (range)†									
Correct	10 (3-18)	11 (6-18)	10 (3-17)	10 (6-15)		.06	.07	.10	.66
Errors	1 (0-8)	1 (0-8)	1 (0-6)	0 (0-3)		.03	.05	.06	.99
RAVLT, mean (SD)‡									
Trial I	6.3 (1.9)	6.5 (1.9)	6.1 (1.9)	7.0 (1.9)	0.47	.12	>.99	.15	.59
Trial II	9.3 (2.7)	9.9 (2.6)	8.5 (2.5)*	9.9 (2.3)	0.61	.27	>.99	.06	.004
Trial III	10.8 (2.5)	11.5 (2.3)	10.1 (2.6)*	11.4 (2.2)	0.59	.37	>.99	.07	.003
Trial IV	11.5 (2.3)	12.1 (2.2)	10.9 (2.4)*	12.4 (2.2)	0.68	.10	>.99	.02	.01
Trial V	12.2 (2.3)	12.7 (2.1)	11.5 (2.4)*	12.9 (1.6)	0.88	.19	>.99	.03	.006
Trial B	6.0 (2.3)	6.5 (2.4)	5.5 (2.2)	6.9 (2.5)	0.56	.18	>.99	.06	.07
Trial VI	10.0 (3.0)	10.9 (2.8)	9.2 (3.1)*	11.4 (2.2)	1.00	.07	>.99	.005	.002
Trial VII	9.8 (3.5)*	11.1 (3.1)	8.5 (3.5)*	11.0 (2.7)	0.93	.13	>.99	.004	<.001
RAVLT sum	75.6 (17.2)*	81.4 (15.8)	70.3 (16.8)*	82.9 (14.8)	0.85	.14	>.99	.005	<.001
Recog[illegible]	12.1 (3.1)*	13.1 (2.3)	11.1 (3.4)*	13.3 (1.7)	1.29	.03	>.99	.01	.14
Recog[illegible]d	6.1 (3.7)*	7.2 (3.7)	5.0 (3.5)*	8.2 (3.2)	1.00	.01	>.99	.04	.26
Stroop, mean (SD)§									
Word	101.3 (15.1)	100.2 (16.4)	102.2 (14.0)	107.0 (15.9)	0.30	.13	.99	.34	>.99
Color	75.6 (12.2)	75.8 (13.4)	75.4 (11.1)	74.5 (13.3)	0.07	.50	>.99	>.99	>.99
Color-Word	45.4 (9.2)*	46.8 (9.4)	44.0 (8.8)	44.4 (10.2)	0.04	.25	.55	>.99	>.99
Color-Read	40.1 (7.9)*	42.2 (9.0)	37.7 (6.2)	41.4 (7.9)	0.47	.92	>.99	>.99	.42
WCST, median (range)									
Errors	28 (16-81)	27 (16-77)	29 (17-81)	30 (15-78)		.67	.29	.77	.08
Perseverative responses	16 (7-49)	16 (7-45)	15 (6-49)	14 (8-63)		.95	.55	.49	.17
% Concept	72.7 (12.5-86.7)	73.1 (14.8-85.9)	71.9 (12.5-86.7)	71.9 (16.4-88.3)		.82	.38	.64	.12
Trials	13 (10-75)	13 (11-64)	12 (10-75)	13 (10-101)		.75	.90	.67	.74
Failures	1 (0-7)	1 (0-5)	2 (0-7)	1 (0-4)		.42	.74	.07	.05
Alphabet Task, median (range)¶									
Alternating	18.6 (10.4-52.4)*	16.8 (10.4-37.2)	19.8 (13.0-52.4)	17.5 (11.5-33.2)		.31	.91	.08	.07
Difference	11.3 (4.8-39.9)*	10.3 (5.0-29.6)	12.3 (4.8-39.9)	8.8 (3.2-24.7)		.14	.54	.04	.09
Omitted Numbers, mean (SD)#	6.7 (1.8)	7.0 (1.8)	6.4 (1.9)	6.3 (2.1)	0.05	.13	.64	.53	>.99
Time Estimation, s**									
Unwarned Task A, mean (SD)	−64.4 (53.5)*	−61.3 (54.1)*	−67.7 (53.2)*	−7.6 (88.6)	0.68	<.001	<.001	.01	>.99
Warned Task B, median (range)	−1.0 (−55 to 85)	−1.5 (−55 to 85)	−0.5 (−40 to 75)	5 (−70 to 102)		.65	.67	.70	.96
Time Production, mean (SD)	−15.6 (24.6)	−14.9 (25.7)	−16.4 (23.6)	−19.0 (26.2)	0.10	.24	>.99	.34	.79
Auditory Consonant Trigrams, mean (SD), seconds of delay††									
9	11.4 (2.7)*	12.1 (2.3)	10.7 (2.9)*	12.9 (1.9)	1.16	.03	>.99	.002	.007
18	11.3 (2.5)	11.7 (2.0)	10.9 (3.0)	11.5 (2.8)	0.21	.79	.92	>.99	.23
36	10.9 (2.9)	11.2 (2.9)	10.7 (2.9)	11.0 (2.7)	0.11	.84	>.99	>.99	.94

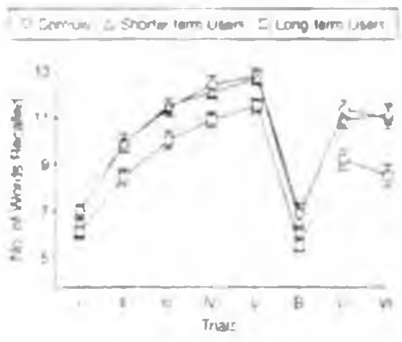
(continued)

Table 3. Neuropsychological Test Results (cont)

Test	Cannabis Users: All (n = 102)	Cannabis Users: Shorter-term Users (n = 51)	Cannabis Users: Long-term Users (n = 51)	Controls (n = 33)	Effect Size	P Value for Comparisons: All vs Controls	P Value for Comparisons: Shorter-term Users vs Controls	P Value for Comparisons: Long-term Users vs Controls	P Value for Comparisons: Shorter- vs Long-term Users
PASAT, median (range)‡‡									
PR Trial 1	2.56 (2.40-4.56)	2.51 (2.40-3.60)	2.58 (2.40-4.58)*	2.56 (2.40-3.55)	...	.92	.16	.23	.007
PR Trial 2	2.23 (2.00-3.53)	2.18 (2.00-2.83)	2.28 (2.00-3.53)	2.24 (2.00-3.05)	...	.43	.84	.10	.03
PR Trial 3	1.79 (1.60-3.56)	1.78 (1.60-3.56)	1.81 (1.60-2.52)	1.78 (1.60-2.63)	...	.20	.49	[illegible]	.36
PR Trial 4	1.36 (1.20-2.31)	1.35 (1.20-1.80)	1.38 (1.20-2.31)	1.33 (1.20-2.00)	...	[illegible]	.54	.15	.22
Total PR	8.07 (7.32-10.81)	7.90 (7.36-9.95)	8.21 (7.32-10.81)	7.85 (7.37-10.53)	...	[illegible]	.87	.06	.02
Total attempted	142.5 (74-191)	146.0 (86-191)	139.0 (74-188)	145.5 (110-190)	...	.75	.99	.56	.45
Total correct	127.0 (26.5)	132.0 (26.8)	121.9 (25.4)	131.6 (28.9)	0.34	.74	>.99	.84	.22
% Correct	64.8 (13.5)	67.3 (13.7)	62.2 (13.0)	67.1 (14.7)	0.30	.74	>.99	.84	.22
Seconds	2.78 (1.86-5.88)	2.64 (1.88-4.87)	2.94 (2.09-5.88)	2.71 (1.89-4.54)	...	.52	.97	.23	.14

*Significant correlation with the number of years of cannabis use after controlling for covariates (P < .05).
†SCOLP-SOC indicates Speed and Capacity of Language Processing Speed of Comprehension test. Median scaled scores for the number of SOC test items completed in 2 minutes and errors (n = 96 users, n = 32 controls). Ellipses indicate not applicable.
‡RAVLT indicates Rey Auditory Verbal Learning Test. Mean words recalled on each trial of the RAVLT, total recalled across all trials (RAVLTsum), and median words recognized from lists A and B (98-102 users varied on each trial).
§Mean items completed in 45 seconds for the Word, Color, and Color-Word conditions of the Stroop (age corrected, n = 100 users) and the modified Color-Read condition (n = 101 users).
‖WCST indicates Wisconsin Card Sorting Test. Median errors, perseverative responses, percentage of conceptual level responses, trials to complete the first category, and failures to maintain the set (n = 101 users, n = 32 controls).
¶Median time to recite the alphabet alternating from loud to silent and median difference between the loud and alternating trials in seconds (n = 94 users, n = 29 controls).
#Mean number of correctly identified items from the Omitted Numbers task.
**Mean difference between actual time elapsed and estimated time in unwarned Time Estimation task A (negative scores indicate underestimation) (n = 94 users, n = 31 controls), median difference in warned Time Estimation task B (n = 98 users, n = 32 controls), and mean difference between time produced and time required in the Time Production task (n = 102 users, n = 30 controls).
††Mean letters recalled with 9-, 18-, and 36-second delays (n = 31 controls).
‡‡Paced Auditory Serial Addition Test (PASAT). Median processing rates (PR) for PASAT trials 1-4, total PR, total attempted, total correct (mean [SD]), percentage correct (mean [SD]), and seconds per correct response across the 4 trials (n = 96-100 users, n = 32 controls).

Figure. Mean Number of Words Recalled on Each Trial of the Rey Auditory Verbal Learning Test by Long- and Shorter-term Cannabis Users and Controls



Error bars represent SDs.

Alphabet Task and Omitted Numbers

Groups did not differ in the time taken to complete any trial of the Alphabet Task or in the number of items correct in the Omitted Numbers task. The log time to complete the alternating trial of the Alphabet Task increased as a function of duration of cannabis use (partial r, 0.26, P = .006), as did the square root difference between times taken to complete the alternating and loud trials, an index of interference and lack of flexibility (partial r, 0.26, P = .006).

Time Estimation Tasks

Cannabis users differed from controls (P < .001) in Time Estimation Task A where they estimated the time taken to complete the preceding (Omitted Numbers) task. Both long- and shorter-term users underestimated the time by about one third of the actual time taken (64.4 seconds) and differed significantly from controls (P = .01 and P < .001, respectively). Groups did not differ in the simple and brief warned passive Time Estimation Task B or Time Production, where they could use strategies such as counting. Time estimation measures did not correlate with duration of cannabis use.

Auditory Consonant Trigrams

Long-term users recalled significantly fewer items than shorter-term users (P = .007), controls (P = .002), and published norms[46] on only the 9-second delay condition. The number of items recalled did not correlate with duration of cannabis use. In the general population, the greater the delay interval the worse the performance. In cannabis users, this general pattern was apparent, though there was greater interference at the shorter delay interval than would be expected.

Paced Auditory Serial Addition Test

Long-term users had slower processing rates than shorter-term users on trial 1 (P = .007), with trends on trial 2 (P = .03) and the total processing rate across all trials (P = .02). Group differences on all other measures failed to reach significance but the performance of the long-term users was poorer in comparison with one set of norms[49] but not another.[50]

Pure Effects Attributable to Cannabis Use and Effects of Recent vs Chronic Use

Excluding all participants with histories of regular other drug or alcohol use, dependence or treatment, and controls with any history of regular cannabis use within the past 20 years reduced the sample to 27 long-term users, 33 shorter-term users, and 26 controls. Despite the reduction in power to detect differences between groups, there remained a significant difference with α = .05 between long-term users and controls on RAVLTsum ($P = .03$), recognition of lists A ($P = .004$) and B ($P = .01$), and between users overall and controls on the unwarned Time Estimation task ($P = .02$). These results support the hypothesis that impaired memory function and time estimation are specific to chronic use of cannabis.

In a separate analysis, exclusion of users whose urinary cannabinoid metabolite levels exceeded those from the night before testing by 50 ng/mg or more ($n = 18$) still resulted in significant differences between long- and shorter-term users, and long-term users and controls on RAVLT sum ($P = .002$ and $P = .002$, respectively), on recognition of lists A ($P = .005$ and $P = .006$) and B ($P = .01$ and $P < .001$), on the 9-second delay of the Auditory Consonant Trigrams test ($P = .02$ and $P = .03$), and users still differed from controls on time estimation ($P = .005$). When the sample was split at the median for time since last use or level of urinary cannabinoid metabolite on the day of testing and analyzed by ANCOVA, there were no differences on any measure between those who had used cannabis within the past 17 hours and those who had used cannabis 17 or more hours ago, or those with high vs low levels of urinary metabolites and no interactions with duration of cannabis use. Including measures of recent use as covariates in ANCOVA did not change the significance of differences between long- and shorter-term users. These results support the hypothesis that impaired performance is not a consequence of recent use prior to testing or the extent of cannabinoid residues present.

To explore further the influences of duration of cannabis use and recency of use, semipartial correlations were calculated using the following predictors: FSIQ, age, duration of cannabis use, and hours since last use of cannabis. As shown in TABLE 4, the unique contribution of duration of cannabis use to the variance of each test variable was superior or at least equivalent to that of recency of use in all 6 test variables that had significant contributions from at least 1 cannabis use parameter. Recent use contributed only to performance on the memory tests. The fact that a minority of the sample, primarily shorter-term users, reported experiencing mild withdrawal symptoms, yet shorter-term users' performance was not impaired, supports the interpretation of the cognitive impairments observed as a long-term consequence of cannabis use and not a manifestation of overtly experienced withdrawal.

COMMENT

The results of this study have confirmed and extended previous findings of cognitive impairments among chronic heavy cannabis users. Long-term users with a mean 24 years of regular cannabis use performed significantly less well on tests of memory and attention than nonuser controls and shorter-term users with a mean of 10 years' use. The greatest impairment on almost every measure was from the RAVLT, indicating a generalized memory deficit with impaired learning, retention, and retrieval. Long-term users recalled 2.5 fewer words than controls on the delayed recall trial where 49% of the long-term users' scores were more than 1 SD, and 21.6% were more than 2 SDs, below the control mean and normative data.[47] A large proportion of long-term users' recognition scores were more than 1 SD (51%) or 2 SDs (31.4%) below the control mean and norms.[47] Effect sizes for measures that differed significantly between long-term users and controls ranged from 0.56 to 1.29 across all tests, indicating moderate to large effects.

These results do not indicate a severe memory problem but could nevertheless translate into clinically significant cognitive impairment and could impact functioning in daily life. There were significant differences between long-term users and controls on 6 of the 9 tests administered and performance on 4 tests worsened as a function of increasing years of cannabis use. Despite this and a range of up to 17 years of cannabis use in the shorter-term user group, they differed significantly from controls only on time estimation.

Table 4. Predictor Correlations Between Hypothesized Predictors and Select Test Variables*

	Full-Scale IQ			Age			Duration of Cannabis Use			Recency of Cannabis Use†		
Test Variables	**Zero-Order**	**Semipartial**	***P* Value**	**Zero-Order**	**Semipartial**	***P* Value**	**Zero-Order**	**Semipartial**	***P* Value**	**Zero-Order**	**Semipartial**	***P* Value**
SCOLP-SOC, No. correct (1-?)	0.55	**0.52**	<.001	0.12	**0.24**	.005	0.01	**−0.24**	.005	0.11	**0.05**	.53
Stroop												
Color-Word	0.27	**0.29**	.002	−0.26	**0.09**	.33	−0.34	**−0.24**	.01	0.09	**0.05**	.58
Color-Reac	0.36	**0.36**	<.001	−0.19	**0.12**	.17	−0.27	**−0.24**	.008	0.18	**0.13**	.15
RAVLT												
RAVLTsum	0.21	**0.22**	.02	−0.31	**0.06**	.54	−0.37	**−0.21**	.02	0.25	**0.21**	.02
RAVLT recency	0.11	**0.10**	.32	−0.19	**0.12**	.20	−0.27	**−0.22**	.02	0.24	**0.23**	.02
Alphabet Task Alternating, log	−0.21	**−0.21**	.03	0.12	**−0.17**	.09	0.21	**0.25**	.01	−0.04	**−0.02**	.81

*SCOLP-SOC indicates Speed and Capacity of Language Processing Speed of Comprehension; RAVLT, Rey Auditory Verbal Learning Test. *P* values are for semipartial correlations. Test variables were significantly predicted by at least 1 cannabis use parameter.
†Defined as hours since last use of cannabis.

Altered brain metabolism in shorter-term users may be detected with sensitive techniques, such as functional magnetic resonance imaging and positron emission tomography, but the clinical significance of such changes remains obscure. The strength of this study is in its assessment of overtly relevant cognitive processes; our results suggest that shorter-term cannabis users are not impaired to an extent that would interfere with cognitive functioning in their daily lives. The fact that the frequency of use was near daily among long- and shorter-term users suggests that the duration of cannabis use is a more salient contributor to the development of cognitive impairment than quantity or frequency of use.

While most cannabis users cease using in their mid-20s to late 20s, approximately 20% continue to use through their 30s and beyond.[2] This is the first study to our knowledge of a relatively large sample of long-term entrenched cannabis users seeking treatment. Concern about perceived cognitive impairment was one of many problems associated with cannabis use that led the users in this study to seek treatment. This concern is unlikely to have biased the results of this study since a slightly higher proportion of shorter-term vs long-term users reported experiencing cognitive problems, yet shorter-term users mostly did not differ from controls on the cognitive tests. Nevertheless, it is possible that long-term cannabis users in the community who are not seeking treatment may not experience impairments to the same degree as those assessed in this study.

While acknowledging the limitations of retrospective designs, if carefully controlled and analyzed, this approach is the most efficient way to evaluate the long-term cognitive effects of cannabis, given the costs and logistical difficulties in using prospective research designs. The matching of groups on measures of premorbid intellectual functioning that are resilient to brain damage, together with the observed relationships between duration of cannabis use and test performance, support the assumption that the cognitive impairments observed in the long-term users were not preexisting but developed as a result of their prolonged use of cannabis. Impairment appeared unrelated to withdrawal phenomena. The cognitive functions assessed in this study are dependent on the intact functioning of the hippocampus, prefrontal cortex, and cerebellum,[30,51-55] which are dense with cannabinoid receptors.[36] The effects that exogenous cannabinoids exert on the cannabinoid receptor system and the role of endogenous cannabinoids as suggested by animal research[6,21-24] provide a credible neurophysiological explanation for the development of cognitive impairments as the result of hypothesized long-term changes occurring over many years of exposure to the drug.

In conclusion, our results confirm that cognitive impairments develop as a result of prolonged cannabis use, they endure beyond the period of acute intoxication, and they worsen with increasing years of use. Impairments develop gradually but may only become clinically significant and detectable by standard neuropsychological tests after 1 to 2 decades of cannabis use. Nevertheless, altered brain function with subtle impairment has been shown to manifest earlier.[6,8,9,11,17,18] It is also likely that impairments would be greater among comorbid substance-dependent persons. The risk to most medical cannabis users is likely to be small, as long as they are not maintained at high doses for many years. For habitual users, the kinds of impairments observed in this study have the potential to impact academic achievements, occupational proficiency, interpersonal relationships, and daily functioning. The extent to which these cognitive impairments may recover following cessation or reduction of cannabis use will be addressed in a follow-up of this sample subsequent to treatment for cannabis dependence.

Author Contributions: *Study concept and design:* Solowij, Stephens, Roffman.
Acquisition of data: Stephens, Roffman, Kadden, Miller, Christiansen, McRee, Vendetti.
Analysis and interpretation of data: Solowij, Stephens.
Drafting of the manuscript: Solowij.
Critical revision of the manuscript for important intellectual content: Solowij, Stephens, Roffman, Babor, Kadden, Miller, Christiansen, McRee, Vendetti.
Statistical expertise: Solowij, Stephens.
Obtained funding: Solowij, Stephens, Roffman, Babor, Kadden, Miller.
Administrative, technical, or material support: Solowij, Roffman, McRee, Vendetti.
Study supervision: Solowij, Stephens, Roffman, Babor, Kadden, Miller, Christiansen, McRee, Vendetti.
Other Members of the Marijuana Treatment Project Research Group include Kathleen Carroll, PhD, Karen Steinberg, PhD (Coordinating Center, University of Connecticut Health Center, Department of Community Medicine); Mark Litt, PhD (Farmington Clinical Research Unit, University of Connecticut Health Center, Department of Psychiatry); Jean Donaldson, MA, and James Herrell, PhD (Center for Substance Abuse Treatment).
Funding/Support: This study was conducted as part of the Marijuana Treatment Project, a Cooperative Agreement for a multisite study of the effectiveness of brief treatment for cannabis dependence. It was funded by the Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Treatment (CSAT), US Department of Health and Human Services (grants UR4 TI11270, UR4 TI11273, UR4 TI11274, UR4TI11310). The research was conducted in Farmington, Conn, Miami, Fla, and Seattle, Wash, in cooperation with the following institutions: University of Connecticut Health Center, The Village South Inc, University of Washington, and Evergreen Treatment Services.
Acknowledgment: We are grateful to Aimee Balmer-Campbell, BA, Kara Brennan Dion, BA, David Duresky, MA, Dave Ghany, BA, Brian Glidden, BA, Cara Gluskoter, MS, Cher Gunby, BA, Jennifer Haley, BA, Heather Haynes, RN, Patricia Holkon, MA, Elise Kabela, PhD, Priscilla Morse, MA, Joe Picciano, MS, Sam Schwartz, MSW, Megan Swan, MA, Debbie Talamini, AS, and Anna Wulfe, BA, for input and assistance with data collection and trial management, Peter Caputi, BA, GradDip, for statistical advice, Brin Grenyer, PhD, for comments on the manuscript, Eva Congreve, DipLib, for library assistance, and to all participants in this research.

REFERENCES

1. Watson SJ, Benson JA, Joy JE. Marijuana and medicine: assessing the science base: a summary of the 1999 Institute of Medicine report. *Arch Gen Psychiatry*. 2000;57:547-552.
2. Substance Abuse and Mental Health Services Administration (SAMHSA). *National Household Survey on Drug Abuse Series: H-6 Preliminary Results from the 1997 National Household Survey on Drug Abuse*. Rockville, Md: Office on Applied Studies; 1998. DHHS publication SMA 98-3251.
3. Hall W, Babor TF. Cannabis use and public health: assessing the burden. *Addiction*. 2000;95:485-490.
4. Voelker R. "Decent research and closure" needed on medical marijuana, says head of NIH panel. *JAMA*. 1997;278:802.
5. Pope HG, Gruber AJ, Yurgelun-Todd D. The residual neuropsychological effects of cannabis: the current status of research. *Drug Alcohol Depend*. 1995;38:25-34.
6. Solowij N. *Cannabis and Cognitive Functioning*. Cambridge, England: Cambridge University Press; 1998.
7. Fried PA, Watkinson B, Gray R. Differential effects on cognitive functioning in 9- to 12-year olds prenatally exposed to cigarettes and marihuana. *Neurotoxicol Teratol*. 1998;20:293-306.

8. Solowij N, Michie PT, Fox AM. Effects of long term cannabis use on selective attention: an event-related potential study. *Pharmacol Biochem Behav*. 1991;40:683-688.

9. Solowij N, Michie PT, Fox AM. Differential impairments of selective attention due to frequency and duration of cannabis use. *Biol Psychiatry*. 1995;37:731-739.

10. Solowij N. Do cognitive impairments recover following cessation of cannabis use? *Life Sci*. 1995;56:2119-2126.

11. Pope HG, Yurgelun-Todd D. The residual cognitive effects of heavy marijuana use in college students. *JAMA*. 1996;275:521-527.

12. Pope HG, Jacobs A, Mialet JP, Yurgelun-Todd D, Gruber S. Evidence for a sex-specific residual effect of cannabis on visuospatial memory. *Psychother Psychosom*. 1997;66:179-184.

13. Fletcher JM, Page JB, Francis DJ, et al. Cognitive correlates of long-term cannabis use in Costa Rican men. *Arch Gen Psychiatry*. 1996;53:1051-1057.

14. Elwan O, Hassan AAH, Naseer MA, et al. Brain aging in a sample of normal Egyptians: cognition, education, addiction and smoking. *J Neurol Sci*. 1997;148:79-86.

15. Solowij N, Grenyer BFS, Peters R, Chesher G. Long term cannabis use impairs memory processes and frontal lobe function. In: *1997 Symposium on the Cannabinoids*. Burlington, Vt: International Cannabinoid Research Society; 1997:84.

16. Loeber RT, Yurgelun-Todd DA. Human neuroimaging of acute and chronic marijuana use: implications for frontocerebellar dysfunction. *Hum Psychopharmacol Clin Exp*. 1999;14:291-301.

17. Block RI, O'Leary DS, Hichwa RD, et al. Cerebellar hypoactivity in frequent marijuana users. *Neuroreport*. 2000;11:749-753.

18. Block RI, O'Leary DS, Hichwa RD, et al. Effects of frequent marijuana use on memory-related regional cerebral blood flow. *Pharmacol Biochem Behav*. In press.

19. Block RI, O'Leary DS, Augustinack JC, et al. Effects of frequent marijuana use on attention-related regional cerebral blood flow. *Abstr Soc Neurosci*. 2000;26:2080.

20. Lyketsos CG, Garrett E, Liang K-Y, Anthony JC. Cannabis use and cognitive decline in persons under 65 years of age. *Am J Epidemiol*. 1999;149:794-800.

21. Hampson RE, Deadwyler SA. Cannabinoids, hippocampal function and memory. *Life Sci*. 1999;65:715-723.

22. Hampson RE, Deadwyler SA. Cannabinoids reveal the necessity of hippocampal neural encoding for short-term memory in rats. *J Neurosci*. 2000;20:8932-8942.

23. Reibaud M, Obinu MC, Ledent C, et al. Enhancement of memory in cannabinoid CB1 receptor knock-out mice. *Eur J Pharmacol*. 1999;379:R1-R2.

24. Bohme GA, Laville M, Ledent C, Parmentier M, Imperato A. Enhanced long-term potentiation in mice lacking cannabinoid CB1 receptors. *Neuroscience*. 2000;95:5-7.

25. Marijuana Treatment Project Research Group. Treating marijuana dependence: findings from a multisite study. *Arch Gen Psychiatry*. In press.

26. McLellan AT, Kushner H, Metzger D, et al. The Fifth Edition of the Addiction Severity Index. *J Subst Abuse Treat*. 1992;9:199-213.

27. Sobell LC, Sobell MB. Timeline follow-back: a technique for assessing self reported alcohol consumption. In: Litten RZ, Allen JP, eds. *Measuring Alcohol Consumption: Psychological and Biochemical Methods*. Totowa, NJ: Humana Press; 1992.

28. Miller WR. *Form 90: A Structured Assessment Interview for Drinking and Related Behaviors: Test Manual. Project MATCH Monograph Series*. Vol 5. Bethesda, Md: National Institute on Alcohol Abuse and Alcoholism; 1996. NIH Publication 96-4004.

29. First MB, Gibbon M, Spitzer RL, Williams JB. *User's Guide for the Structured Clinical Interview for DSM-IV Axis I Disorders—Research Version*. New York, NY: Biometrics Research Department, New York State Psychiatric Institute; 1996.

30. Jastak S, Wilkinson G. *The Wide Range Achievement Test: Manual of Instructions*. Wilmington, Del: Jastak Associates; 1984.

31. Kareken DA, Gur RC, Saykin AJ. Reading on the Wide Range Achievement Test-Revised and parental education as predictors of IQ: comparison with the Barona formula. *Arch Clin Neuropsychol*. 1995;10:147-157.

32. Blair JR, Spreen O. Predicting premorbid IQ: a revision of the National Adult Reading Test. *Clin Neuropsychol*. 1989;3:129-136.

33. Barona A, Reynolds CR, Chastain R. A demographically based index of pre-morbid intelligence for the WAIS-R. *J Consult Clin Psychol*. 1984;52:885-887.

34. Bell R, Taylor EH, Ackerman B, Pappas AA. Interpretation of urine quantitative 11-nor-delta-9-tetrahydrocannabinol-9-carboxylic acid to determine abstinence from marijuana smoking. *Clin Toxicol*. 1989;27:109-115.

35. Dackis CA, Pottash ALC, Annitto W, Gold MS. Persistence of urinary marijuana levels after supervised abstinence. *Am J Psychiatry*. 1982;139:1196-1198.

36. Ellis GM, Mann MA, Judson BA, Schramm NT, Tashchian A. Excretion patterns of cannabinoid metabolites after last use in a group of chronic users. *Clin Pharmacol Ther*. 1985;38:572-578.

37. Fraser AD, Worth D. Urinary excretion profiles of 11-nor-9-carboxy-delta-9-tetrahydrocannabinol: a delta-9-THCCOOH to creatinine ratio study. *J Anal Toxicol*. 1999;23:531-534.

38. Baddeley A, Emslie H, Nimmo-Smith I. *The Speed and Capacity of Language Processing Test Manual*. Bury St Edmonds, England: Thames Valley Test Co; 1992.

39. Lezak MD. *Neuropsychological Assessment*. 3rd ed. New York, NY: Oxford University Press; 1995.

40. Rey A. *L'examen clinique en psychologie*. Paris, France: Presse Universitaire de France; 1964.

41. Spreen O, Strauss E. *A Compendium of Neuropsychological Tests: Administration, Norms and Commentary*. 2nd ed. New York, NY: Oxford University Press; 1998.

42. Golden CJ. *Stroop Color and Word Test: A Manual for Clinical and Experimental Uses*. Wood Dale, Ill: Stoelting; 1978.

43. Bohnen N, Jolles J, Twijnstra A. Modification of the Stroop Color Word Test improves differentiation between patients with mild head injury and matched controls. *Clin Neuropsychol*. 1992;6:178-184.

44. *The Wisconsin Card Sorting Test: Computer Version*. Alpharetta, Ga: Psychological Assessment Resources Inc, CyberMetrics Testing Software Services; 1989.

45. Stuss DT, Stethem LL, Poirier CA. Comparison of three tests of attention and rapid information processing across six age groups. *Clin Neuropsychol*. 1987;1:139-152.

46. Levin HS, Mattis S, Ruff RM, et al. Neurobehavioral outcome following minor head injury: a three-center study. *J Neurosurg*. 1987;66:234-243.

47. Geffen G, Moar KJ, O'Hanlon AP, Clark CR, Geffen LB. Performance measures of 16- to 86-year old males and females on the Auditory Verbal Learning Test. *Clin Neuropsychol*. 1990;4:45-63.

48. Stuss DT, Stethem L, Pelchat G. Three tests of attention and rapid information processing: an extension. *Clin Neuropsychol*. 1988;2:246-250.

49. Roman DD, Edwall GE, Buchanan RJ, Patton JH. Extended norms for the Paced Auditory Serial Addition Task. *Clin Neuropsychol*. 1991;5:33-40.

50. Brittain JL, La Marche JA, Reeder KP, Roth DL, Boll TJ. Effects of age and IQ on Paced Auditory Serial Addition Task (PASAT) performance. *Clin Neuropsychol*. 1991;5:163-175.

51. Levy R, Goldman-Rakic PS. Segregation of working memory functions within the dorsolateral prefrontal cortex. *Exp Brain Res*. 2000;133:23-32.

52. Herman BP, Seidenberg M, Wyler A, et al. The effects of human hippocampal resection on the serial position curve. *Cortex*. 1996;32:323-334.

53. Middleton FA, Strick PL. Anatomical evidence for cerebellar and basal ganglia involvement in higher cognitive function. *Science*. 1994;266:458-461.

54. Schacter DL. Memory and awareness. *Science*. 1998;280:59-60.

55. Schmahmann JD, ed. *The Cerebellum and Cognition*. San Diego, Calif: Academic Press; 1997.

56. Herkenham M, Lynn AB, Little MD, et al. Cannabinoid receptor localization in brain. *Proc Natl Acad Sci U S A*. 1990;87:1932-1936.

Table. Relative Risk of Parkinson Disease Among Patients With Polio Compared With a Nonexposed Cohort Matched by Age and Sex

	Persons, No.		Observed Parkinson Cases, No.		
Patient Group	Patients With Polio	Age-/Sex-Matched Cohort	Patients With Polio	Age-/Sex-Matched Cohort	RR (95% CI)*
Total	5421	21626	29	60	2.3 (1.4-3.6)
Paralytic	2003	7979	13	23	2.2 (1.1-4.3)
Nonparalytic	2335	9317	7	14	1.9 (0.7-4.7)
Primary lymphocytic meningitis	592	2367	7	7	4.1 (1.4-11.9)
Suspected polio	491	1963	2	6	1.3 (0.2-5.7)

*Relative risk (RR) calculated according to person-years at risk. CI indicates confidence interval.

CI, 0.7-4.7) and in patients only suspected of having poliomyelitis (RR, 1.3; 95% CI, 0.2-5.7).

Comment. Although it has long been hypothesized that poliomyelitis is associated with an increased risk of PD,[1] to our knowledge this has never been empirically demonstrated. The observed increased PD risk does not necessarily imply that poliovirus is directly implicated in PD pathogenesis. Rather, we speculate that by reducing the number of neurons essential to normal neuronal functions, the virally induced damage may enhance the effect of normal age-related neuronal degeneration and thus precipitate PD.[1,4]

We acknowledge possible limitations of our data. Because patients with poliomyelitis may be admitted to hospitals or may attend outpatient clinics more often than other persons, detection bias could arise. However, in Denmark, the diagnosis, evaluation, and treatment of PD normally take place at neurological departments or neurological outpatient clinics. Moreover, although patients with PD initially may consult private neurologists or general practitioners, the vast majority of patients with PD will at some point undergo clinical evaluation or hospitalization at specialized hospital departments because of the complexity of the disease. Therefore, we think that most Danish patients with PD would be registered in the NHDR, and we consider detection bias to be an unlikely explanation for our findings.

Patients with polio may present a wide range of neurological symptoms, which could cause diagnostic ambiguity. If diagnostic misclassification would explain our observations we would have expected the risk of PD to be particularly increased in patients with paralytic polio. However, an increased risk of PD was also observed in patients with nonparalytic polio. Moreover, the likely inclusion of patients with nonpolio virus-related meningitis in the group of patients with primary lymphocytic meningitis may indicate that the observed PD risk is not particular to the poliovirus but also applies to other viruses infecting the central nervous system.

Nete Munk Nielsen, MD, PhD
Klaus Rostgaard, MSc
Henrik Hjalgrim, MD, PhD
Peter Aaby, MSc, DMSc
Department of Epidemiology Research
Danish Epidemiology Science Centre
Statens Serum Institut
Copenhagen, Denmark
Dorthe Askgaard, MD
Department of Infectious Diseases M
National University Hospital
Copenhagen

Funding/Support: This study was supported by the Danish Medical Research Council, the Danish Development Research Council, the Danish National Research Foundation, the Wedell-Wedelsborg's Foundation, and the National Polio Society (PTU).
Acknowledgment: We are grateful to the staff at Copenhagen City Archives, who helped us identify the polio patients' records.

1. Calne DB, Eisen A, McGeer E, Spencer P. Alzheimer's disease, Parkinson's disease, and motoneurone disease: abiotrophic interaction between ageing and environment? *Lancet*. 1986;2:1067-1070.
2. Scott WK, Nance MA, Watts RL, et al. Complete genomic screen in Parkinson disease: evidence for multiple genes. *JAMA*. 2001;286:2239-2244.
3. Bodian D. Histopathologic basis of clinical findings in poliomyelitis. *Am J Med*. 1949;6:563-577.
4. Vincent FM, Myers WG. Poliomyelitis and parkinsonism. *N Engl J Med*. 1978;298:688-689.
5. Munk NM, Wohlfahrt J, Aaby P, et al. Cancer risk in a cohort of polio patients. *Int J Cancer*. 2001;92:605-608.
6. Lassen HCA. Sammenlignende undersøgelser over primær serøs meningitis og paralytisk poliomyelitis [Comparative studies of primary lymphocytic menigitis and paralytic polio]. *Ugeskr Læg*. 1939;3:73-80.

CORRECTION

Incorrect Measure. In the Original Contribution entitled "Cognitive Functioning of Long-term Heavy Cannabis Users Seeking Treatment" published in the March 6, 2002, issue of THE JOURNAL (2002;287:1123-1131), the legend for the Figure should indicate that error bars represent SEM, not SD.

Cognitive Functioning of Long-term Heavy Cannabis Users Seeking Treatment

Nadia Solowij, PhD
Robert S. Stephens, PhD
Roger A. Roffman, DSW
Thomas Babor, PhD, MPH
Ronald Kadden, PhD
Michael Miller, PhD
Kenneth Christiansen, PsyD
Bonnie McRee, MPH
Janice Vendetti, MPH
for the Marijuana Treatment Project Research Group

Context Cognitive impairments are associated with long-term cannabis use, but the parameters of use that contribute to impairments and the nature and endurance of cognitive dysfunction remain uncertain.

Objective To examine the effects of duration of cannabis use on specific areas of cognitive functioning among users seeking treatment for cannabis dependence.

Design, Setting, and Participants Multisite retrospective cross-sectional neuropsychological study conducted in the United States (Seattle, Wash; Farmington, Conn; and Miami, Fla) between 1997 and 2000 among 102 near-daily cannabis users (51 long-term users: mean, 23.9 years of use; 51 shorter-term users: mean, 10.2 years of use) compared with 33 nonuser controls.

Main Outcome Measures Measures from 9 standard neuropsychological tests that assessed attention, memory, and executive functioning, and were administered prior to entry to a treatment program and following a median 17-hour abstinence.

Results Long-term cannabis users performed significantly less well than shorter-term users and controls on tests of memory and attention. On the Rey Auditory Verbal Learning Test, long-term users recalled significantly fewer words than either shorter-term users ($P = .001$) or controls ($P = .005$); there was no difference between shorter-term users and controls. Long-term users showed impaired learning ($P = .007$), retention ($P = .003$), and retrieval ($P = .002$) compared with controls. Both user groups performed poorly on a time estimation task ($P < .001$ vs controls). Performance measures often correlated significantly with the duration of cannabis use, being worse with increasing years of use, but were unrelated to withdrawal symptoms and persisted after controlling for recent cannabis use and other drug use.

Conclusions These results confirm that long-term heavy cannabis users show impairments in memory and attention that endure beyond the period of intoxication and worsen with increasing years of regular cannabis use.

JAMA. 2002;287:1123-1131 www.jama.com

In the current climate of debate about marijuana laws and interest in marijuana as medicine,[1] one issue remains unresolved: Does heavy, frequent, or prolonged use of cannabis lead to a deterioration in cognitive function that persists well beyond any period of acute intoxication? Is the functioning of the brain altered in the long term? With over 7 million people using cannabis weekly or more often in the United States alone[2] and the potential for increased physician recommendations for select patients to use cannabis therapeutically,[1] answers to these questions are of significant public health concern.[3,4] Scientific evidence from past research clearly showed that gross impairment related to chronic cannabis use did not occur but was inconclusive with regard to the presence of more specific deficits.[5,6] Recent studies with improved methods have demonstrated changes in cognition and brain function associated with long-term or frequent use of cannabis. Specific impairments of attention, memory, and executive function have been found in cannabis users in the unintoxicated state (and in children exposed to cannabis in utero[7]) in controlled studies using brain event-related potential techniques[6,8-10] and neuropsychological assessments[11-15] including complex tasks.

Brain imaging studies of cannabis users have demonstrated altered function, blood flow, and metabolism in prefrontal and cerebellar regions.[16-19] Studies failing to detect cognitive decline associated with cannabis use[20] may reflect insufficient heavy or chronic use of cannabis in the sample or the use of insensitive assessment instruments. Impairments appear to increase with duration and frequency of cannabis use; however, the parameters of use that are associated with short- or long-lasting cognitive and brain dysfunction have not

For editorial comment see p 1172.

Author Affiliations: National Drug and Alcohol Research Centre, University of New South Wales, Sydney, and Department of Psychology, University of Wollongong, Wollongong (Dr Solowij), New South Wales, Australia; Department of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va (Dr Stephens); Innovative Programs Research Group, School of Social Work, University of Washington, Seattle (Dr Roffman); Department of Community Medicine (Dr Babor and Mss McRee and Vendetti) and Department of Psychiatry (Dr Kadden), University of Connecticut Health Center, Farmington, and The Village South Inc, Miami, Fla (Drs Miller and Christiansen).
Other Members of the Marijuana Treatment Project Research Group are listed at the end of this article.
Corresponding Author and Reprints: Nadia Solowij, PhD, National Drug and Alcohol Research Centre, University of New South Wales, Sydney, NSW 2052, Australia (e-mail: n.solowij@unsw.edu.au).

been fully elucidated. The attribution of deficits to lingering acute effects, drug residues, abstinence effects, or lasting changes caused by chronic use continues to be debated.[18] Animal research suggests an important role for the cannabinoid receptor in regulating the neural activity critical for memory processing.[21-24] Long-term use of cannabis may result in altered functioning of the cannabinoid receptor and its associated neuromodulator systems.

This study investigated the nature of cognitive impairments associated with long-term cannabis use employing data collected from a large clinical trial of chronic users seeking treatment for cannabis dependence. The study compared 102 cannabis users assessed prior to treatment on carefully selected neuropsychological tests with 33 nonuser controls. The parameters of cannabis use that contribute to impairment were examined. It was hypothesized that performance would deteriorate as the number of years of regular use increased.

METHODS

Design

A multisite, retrospective, cross-sectional comparison-group design was used to compare (1) long-term users with a mean of 23.9 years of regular cannabis use; (2) shorter-term users with a mean of 10.2 years of regular use, and (3) nonusers of cannabis. Key confounding variables (age, IQ, other drug use) were controlled through matching or statistical methods. The sample size required for this study was determined by estimating a 94% chance of detecting a moderate effect size of 0.5 SD units at a 2-tailed α of .05.

Recruitment Procedure and Assessment of Drug Use

Sixty-five of the 102 cannabis users were delayed-treatment participants from the Marijuana Treatment Project, a multisite US study (Seattle, Wash; Farmington, Conn; and Miami, Fla) conducted between 1997 and 2000 of the effectiveness of brief treatments for cannabis dependence.[25] The remainder were recruited through the Marijuana Treatment Project specifically for this study. Participants provided written informed consent as approved by the ethics committees of the participating institutions and were paid $75 for completing the cognitive assessments. Controls (n = 33) were recruited from the general population through media advertisements at only 1 site. The controls were told that the researchers were studying the effects of exposure to drugs and alcohol on cognitive functioning, and that at present only individuals at the lighter end of the spectrum of drug experience were required. The aim was to minimize cannabis use among controls while approximating the other characteristics of the cannabis-using sample. Assessors were not blinded with regard to group assignment. Self-reported drug and alcohol use were assessed by the Addiction Severity Index,[26] a separate structured interview, and the Time Line Follow Back procedure.[27,28] The Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV)* Axis I Disorders (SCID)[29] assessed cannabis dependence. Duration of regular (at least twice per month) cannabis use was an averaged composite measure derived from the Addiction Severity Index, SCID, and the structured interview. Current frequency of cannabis use was calculated from the Time Line Follow Back procedure.

Inclusion/Exclusion Criteria

Cannabis users were included if they had used cannabis regularly for at least 3 years, were currently using at least once a week, were seeking treatment to assist them to cease or reduce their use of cannabis, and were willing to participate in the treatment program offered. Participants were excluded if they had ever had a serious illness or injury that may have affected the brain, any psychotic disorder, met a current *DSM-IV* diagnosis of dependence on any other drug or alcohol, or had a poor command of the English language.

Sample Characteristics

TABLE 1 provides demographic information and cannabis use parameters

Table 1. Demographic and Cannabis Use Details of the Sample*

	Cannabis Users			
	All	Shorter-term Users	Long-term Users	Controls
No.	102	51	51	33
Sex, male (%)	75 (74)	36 (71)	39 (76)	22 (67)
Age, mean (SD) [range], y	35.4 (8.6) [19-55]	28.7 (5.5) [19-45]†	42.1 (5.2) [34-55]†	34.8 (11.1) [19-65]
Education, mean (SD) [range], y‡	14.3 (2.3) [10-22]	14.1 (2.5) [10-22]	14.5 (2.0) [11-20]	14.8 (1.8) [12-18]
Full-scale IQ, mean (SD) [range]§	105.4 (6.7) [87.4-118.5]‖	105.1 (7.4) [87.4-118.5]	105.7 (5.9) [92.7-118.3]	107.9 (4.7) [94.5-117.2]
Duration of use, mean (SD) [range], y¶	17.1 (7.9) [2.7-31.7]	10.2 (3.8) [2.7-17.0]	23.9 (4.1) [17.3-31.7]	
Frequency of use, median (range), d/mo#	27.9 (3.5-30)	28.3 (5.2-30)	27.4 (3.5-30)	

*Ellipses indicate not applicable.
†Significantly different from controls at $P<.001$.
‡The self-reported number of years of formal education completed.
§Estimated from a combination of North American Adult Reading Test, Wide Range Achievement Test–Revised reading subtest scores, and the Barona index.
‖Significantly different from controls at $P<.05$.
¶The number of years that cannabis had been used since regular use commenced (at least twice per month), composite from self-report, Addiction Severity Index, and Structured Clinical Interview Axis 1 Disorders assessments.
#The median number of days per month that cannabis was used at entry to the study, based on average use per 30 days from self-reported use during the past 14 weeks.

The user group was split at the median for duration of cannabis use to enable comparisons of long-term users, shorter-term users, and controls. No meaningful division of groups could be achieved on the basis of frequency of cannabis use, which was almost daily for the majority of the sample. Sex distribution and years of education did not differ between groups. The majority of users (66.6%) and controls (63.6%) were white. Overall, users and controls did not differ in age, but long-term users were significantly older and shorter-term users were significantly younger than controls ($P<.001$). Premorbid intelligence was estimated by several methods and averaged: the Wide Range Achievement Test—Revised reading subtest (WRAT-R READ)[30,31]; the North American Adult Reading Test (NAART)[32]; and the Barona Index.[33] The mean estimated full-scale IQ (FSIQ) did not differ between the 3 groups based on duration of cannabis use. The majority of the sample (82.4% long-term, 88.2% shorter-term users) reported experiencing problems with memory, attention, or concentration, which they attributed to their use of cannabis.

Cannabis Use, Required Abstinence, and Urinalysis

Users first tried cannabis at a mean age of 15.3 (SD, 2.6) years with regular use (at least twice a month) commencing at age 17.5 (SD, 3.2) years. Cannabis had been used on a median 29 of the past 30 days (range, 1-30). Almost the entire sample (98%) met the *DSM-IV* criteria for cannabis dependence. The median amount of cannabis smoked per week was 1 quarter of an ounce (range, 0.01-2.00 oz) with 2 average-sized joints typically smoked per day (range, 0.12-20.00). None of these cannabis-use parameters differed between the long- and shorter-term user groups. Twenty-two controls had either never tried cannabis or used it 10 or fewer times in their lives and 11 had used cannabis weekly to monthly while at school or college between 4 and 30 years ago. Controls with a history of cannabis use were excluded from "pure sample" analyses.

Participants were required to abstain from cannabis for at least 12 hours prior to testing and to provide 2 urine samples (1 the night before testing, another during the test session). The median self-reported time since last use of cannabis was 17 hours (range, 7-240 hours); this did not differ between long- and shorter-term users. At the time of testing, 70% of the sample reported that they were not experiencing any discomfort after abstaining from cannabis. Twice as many shorter-term users than long-term users ($P=.03$) reported mild withdrawal symptoms such as cravings, irritability, depression, anxiety, sleep, or appetite disturbances. In 78.3% of cases, creatinine-normalized urinary cannabinoid metabolite (THC-COOH) levels on the day of testing were less than or equivalent to those from the night before.[34-37] Abstinence from cannabis was supported by significant correlations between the level of normalized urinary cannabinoid metabolite on the day of testing and the self-reported time since last use (bivariate correlation coefficient [r], −0.46; $P<.001$), and the quantity used on the last occasion divided by the time since last use (r, 0.39; $P<.001$). The effects of these measures of recent use were examined in relation to test performance. "Pure sample" analyses excluded users with higher metabolites in the second urine sample. No cannabinoid metabolites were detected in the urine of the control participants.

Other Drug Use

No other drug metabolites were detected in any urine sample. Tobacco and alcohol use was minimal. Alcohol was consumed on a median of 3.4 and 1.7 days per month among users and controls, respectively. Almost one third of users and 46.8% of controls drank less than once a month or not at all. Forty-eight percent of the cannabis users had only tried drugs other than cannabis a few times or never; 52% had used other drugs socially/recreationally primarily during high school and college. Past histories of regular drug use included cocaine ($n=24$), amphetamines ($n=11$), hallucinogens ($n=17$), and sedatives/hypnotics or minor tranquilizers ($n=7$). Current use of other drugs was less than once a month or not at all for 93.1% of the sample. More than half of the controls (51.5%) had never tried any other drug and the remainder had only tried other drugs experimentally. "Pure sample" analyses excluded all participants with histories of regular or heavy use of alcohol or other drugs.

Neuropsychological Tests and Procedures

Nine neuropsychological tests were administered in the order listed in TABLE 2,[38-48] along with the 2 tests used to assess premorbid IQ.[30-32] A 10-minute rest break was given after the Rey Auditory Verbal Learning Test (RAVLT) Recognition test. Tests were administered by trained assistants and took approximately 2 hours to complete. Quality assurance procedures were adopted to ensure that procedures were standardized at each site with ongoing supervision and review of audiotaped assessments by centralized staff throughout the course of the study.

Data Analysis

Each cognitive test was analysed using SPSS version 10.0 (SPSS Institute, Chicago, Ill) with analysis of covariance (ANCOVA) for normally distributed variables or nonparametric tests of group differences for skewed data. The FSIQ and age were included as covariates in analyses where they correlated with test performance. All participants were initially included in analysis, with the overall cannabis user sample first compared with the control group (evaluated at $P<.05$), followed by comparisons on the basis of duration of cannabis use (long- vs shorter-term users vs controls, evaluated at $P<.01$). For 2-way interactions, the Greenhouse-Geisser method was used to adjust the *df* where appropriate and for multiple comparisons, a Bonferroni adjustment controlled for type 1 error. Analysis of covariance was repeated on a purer sample that strictly

Table 2. Neuropsychological Tests Administered and Cognitive Functions Assessed*

Neuropsychological Test	Cognitive Functions Assessed
Wide Range Achievement Test–Revised reading subtest (WRAT-R READ)[36,37]	Premorbid IQ
Speed of Comprehension (SOC) test (Speed and Capacity of Language Processing [SCOLP])[38]	Rate of verbal information processing
Rey Auditory Verbal Learning Test (RAVLT)[39-41]	Memory span, verbal learning and retrieval efficiency, susceptibility to interference
Stroop Test[42] with additional interference condition[43]	Attention, cognitive flexibility, inhibition of distractor stimuli, suppression of habitual response
Wisconsin Card Sorting Test (WCST), computerized[44]	Problem solving, conceptual ability
Alphabet Task†	Cognitive flexibility, executive function
Omitted Numbers‡	Working memory
Time Estimation and Production§	Temporal judgment
RAVLT 20-minute delay trial (VII), Recognition test	Long-term retention, recognition memory
North American Adult Reading Test (NAART)[35]	Premorbid IQ
Auditory Consonant Trigrams (Brown-Peterson)[45]	Short-term retention under distractor conditions
Paced Auditory Serial Addition Test (PASAT)[46]	Information processing, working memory, divided and sustained attention

*Tests were administered in the order listed.
†Composed of timed loud, silent, and alternating recital trials.
‡Recognition of omitted item from a jumbled aural list of numbers from 1 to 10 (10 trials).
§Composed of 3 trials: unwarned estimation of time to complete the preceding task (mean, 3 minutes 18 seconds) (Time Estimation A), time production (1 minute 40 seconds), and warned passive estimation (2 minutes) (Time Estimation B).

excluded those participants with either a history of other drug use or possible recent use of cannabis prior to testing. Semipartial correlations examined the unique contributions of FSIQ, age, duration of cannabis use, and recency of cannabis use to the variance in cognitive test performance.

RESULTS

Results from the 9 neuropsychological tests are shown in TABLE 3 for cannabis users overall, for groups based on duration of cannabis use, and for controls. Effect sizes are calculated between long-term users and controls using the SD of the controls.

Speed of Comprehension

Cannabis user groups did not differ from controls in the number of items completed (range, 23-100) but users overall made more errors ($P=.03$) (range, 0-5). These results suggest that cannabis users are more likely to sacrifice accuracy for speed.

Rey Auditory Verbal Learning Test

Mean words recalled on each trial are depicted in the FIGURE. The learning curves of shorter-term users and controls were similar but long-term users showed a learning curve with a less steep gradient and long-term users recalled fewer words on every trial. The sum of words recalled across all trials I through VII inclusive of trial B (referred to here as RAVLT sum; range, 37-114) correlated significantly and inversely with the duration of cannabis use after controlling for age and FSIQ (partial r, −0.23; $P=.01$). When analysed by ANCOVA, there was a significant effect of group ($F_{2,137}=8.35$; $P<.001$) whereby long-term users recalled significantly fewer words than either shorter-term users (95% confidence interval [CI] for difference, 3.84-19.18; $P=.001$) or controls (95% CI for difference, 2.83-19.93; $P=.005$) with no difference between shorter-term users and controls. When all trials were included in a repeated measures ANCOVA, a significant interaction between group and trial ($F_{14,980}=2.84$; $P=.007$) suggested that long-term users recalled fewer words than shorter-term users or controls on every trial ($P<.05$ for each comparison) except the first, with a trend on trial B (the interference list presented only once; $P=.08$).

The proportion of subjects with a very poor learning ability (acquisition <3 words over 5 trials) was greater among long-term users (13.7%) than controls (0%) ($P=.007$) but not shorter-term users (5.9%). The proportion of long-term users recalling fewer than 10 words on trial V (27.5%) was more than among shorter-term users (8.5%) or controls (3.0%) ($P=.002$). Significantly more long-term users (23.5%) lost 3 or more words over the 20-minute delay between trials VI and VII than shorter-term users (4.3%) or controls (3.0%) ($P=.003$). Long-term users showed a smaller primacy effect in the serial position curve than either other group ($P=.02$). Groups did not differ in the recency effect or in words recalled from the middle of the list.

Users overall and long-term users recognized fewer words than controls from list A (overall, $P=.03$; long-term, $P=.01$) and list B (overall, $P=.01$; long-term, $P=.04$) but long-term users did not differ from shorter-term users. More than half of the long-term users (55%) had a recognition score for list A of 12 or less compared with 28% of shorter-term users and 21% of controls ($P=.002$). Long-term users misassigned more words (median, 2) than shorter-term users and controls (each median, 0) ($P<.001$). A greater proportion of long-term users (13.7%) compared with shorter-term users (6.4%) and controls (0%) actually identified fewer words on recognition than they had just prior during recall on trial VII ($P=.02$). Long-term users' performance was significantly poorer than published norms[47] for the general population on most measures from the RAVLT.

Stroop Test

Cannabis users did not differ significantly from controls after inclusion of covariates in any condition or on interference scores. While there were no performance differences between Color-Word (CW) and Color-Read (CR) in the control group, performance on CR was, however, poorer than on CW in both long- ($P<.001$) and shorter-term users ($P = .03$). Color-Read was the additional interference condition designed to increase demands on executive function.[43] There was an inverse relationship between duration of cannabis use and number of items completed on CR (partial r, −0.27; $P = .003$) and CW (partial r, −0.27; $P = .004$) after controlling for age and FSIQ. These results suggest that cannabis users are vulnerable to task complexity with increasing demands creating more sources of interference that adversely affect performance.

Wisconsin Card Sorting Test

There were no significant group differences on any Wisconsin Card Sorting Test (WCST) measure but a trend on one: long-term users failed to maintain the set more often than shorter-term users ($P = .05$) or controls ($P = .07$). Research suggests that this measure best represents attentional dysfunction.[39] There was no evidence of impaired performance with increasing years of cannabis use after controlling for covariates.

Table 3. Neuropsychological Test Results

	Cannabis Users*					P Value for Comparisons			
Test	All (n = 102)	Shorter-term Users (n = 51)	Long-term Users (n = 51)	Controls (n = 33)	Effect Size	All vs Controls	Shorter-term Users vs Controls	Long-term Users vs Controls	Shorter- vs Long-term Users
SCOLP-SDC, median (range)†									
Correct	10 (3-18)	11 (6-18)	10 (3-17)	10 (6-15)	…	.06	.07	.10	.65
Errors	1 (0-8)	1 (0-8)	1 (0-6)	0 (0-3)	…	.03	.05	.05	.99
RAVLT, mean (SD)‡									
Trial I	6.3 (1.9)	6.5 (1.9)	6.1 (1.9)	7.0 (1.9)	0.47	.12	>.99	.15	.59
Trial II	9.3 (2.7)	9.9 (2.6)	8.5 (2.5)*	9.9 (2.3)	0.61	.27	>.99	.06	.004
Trial III	10.8 (2.5)	11.5 (2.3)	10.1 (2.6)*	11.4 (2.2)	0.59	.37	>.99	.07	.003
Trial IV	11.5 (2.3)	12.1 (2.2)	10.9 (2.4)*	12.4 (2.2)	0.68	.10	>.99	.02	.01
Trial V	12.2 (2.3)	12.7 (2.1)	11.5 (2.4)*	12.9 (1.6)	0.88	.19	>.99	.03	.005
Trial B	6.0 (2.3)	6.5 (2.4)	5.5 (2.2)	6.9 (2.5)	0.50	.16	>.99	.06	.07
Trial VI	10.0 (3.0)	10.9 (2.8)	9.2 (3.1)*	11.4 (2.2)	1.00	.07	>.99	.005	.002
Trial VII	9.8 (3.5)*	11.1 (3.1)	8.5 (3.5)*	11.0 (2.7)	0.93	.13	>.99	.004	<.001
RAVLTsum	75.6 (17.2)*	81.4 (15.8)	70.3 (16.8)*	82.9 (14.8)	0.85	.14	>.99	.005	<.001
Recog_A	12.1 (3.1)*	13.1 (2.3)	11.1 (3.4)*	13.3 (1.7)	1.29	.03	>.99	.01	.14
Recog_B	6.1 (3.7)*	7.2 (3.7)	5.0 (3.5)*	8.2 (3.2)	1.00	.01	>.99	.04	.26
Stroop, mean (SD)§									
Word	101.3 (15.1)	100.2 (16.4)	102.2 (14.0)	107.0 (15.9)	0.30	.13	.99	.34	>.99
Color	75.6 (12.2)	75.8 (13.4)	75.4 (11.1)	74.5 (13.3)	0.07	.50	>.99	>.99	>.99
Color-Word	45.4 (9.2)*	46.8 (9.4)	44.0 (8.8)	44.4 (10.2)	0.04	.25	.55	>.99	>.99
Color-Read	40.1 (7.9)*	42.2 (9.0)	37.7 (6.2)	41.4 (7.9)	0.47	.92	>.99	>.99	.42
WCST, median (range)‖									
Errors	28 (15-81)	27 (16-77)	29 (17-81)	30 (15-78)		.67	.29	.77	.08
Perseverative responses	16 (7-49)	16 (7-45)	15 (6-49)	14 (8-63)		.86	.55	.49	.17
% Concept	72.7 (12.5-86.7)	73.1 (14.8-85.9)	71.9 (12.5-86.7)	71.9 (16.4-86.3)		.83	.38	.64	.12
Trials	13 (10-75)	13 (11-64)	12 (10-75)	13 (10-101)		.75	.90	.67	.74
Failures	1 (0-7)	1 (0-5)	2 (0-7)	1 (0-4)		.42	.74	.07	.05
Alphabet Task, median (range)¶									
Alternating	18.6 (10.4-52.4)*	16.8 (10.4-37.2)	19.8 (13.0-52.4)	17.5 (11.5-33.2)	…	.31	.91	.06	.07
Difference	11.3 (4.8-39.9)*	10.3 (5.0-29.6)	12.3 (4.8-39.9)	8.8 (3.2-24.7)	…	.14	.54	.04	.09
Omitted Numbers, mean (SD)#	6.7 (1.8)	7.0 (1.8)	6.4 (1.9)	6.3 (2.1)	0.05	.13	.64	.53	>.99
Time Estimation, s**									
Unwarned Task A, mean (SD)	−64.4 (53.5)*	−61.3 (54.1)*	−67.7 (53.2)*	−7.6 (88.6)	0.66	<.001	<.001	.01	>.99
Warned Task B, median (range)	−1.0 (−55 to 85)	−1.5 (−55 to 85)	−0.5 (−40 to 75)	5 (−70 to 102)		.65	.67	.70	.96
Time Production, mean (SD)	−15.6 (24.6)	−14.9 (25.7)	−16.4 (23.6)	−19.0 (26.2)	0.10	.24	>.99	.34	.79
Auditory Consonant Trigrams, mean (SD), seconds of delay††									
9	11.4 (2.7)*	12.1 (2.3)	10.7 (2.9)*	12.9 (1.9)	1.16	.03	>.99	.002	.007
18	11.3 (2.5)	11.7 (2.0)	10.9 (3.0)	11.5 (2.8)	0.21	.79	.92	>.99	.23
36	10.9 (2.9)	11.2 (2.9)	10.7 (2.9)	11.0 (2.7)	0.11	.84	>.99	>.99	.94

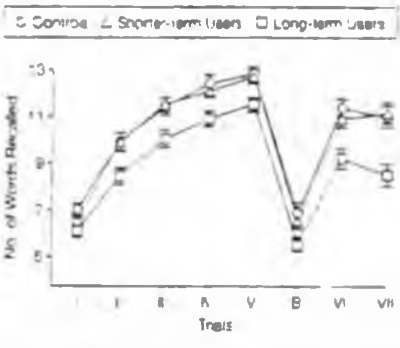
(continued)

Table 3. Neuropsychological Test Results (cont)

Test	Cannabis Users: All (n = 102)	Cannabis Users: Shorter-term Users (n = 51)	Cannabis Users: Long-term Users (n = 51)	Controls (n = 33)	Effect Size	P Value for Comparisons: All vs Controls	P Value for Comparisons: Shorter-term Users vs Controls	P Value for Comparisons: Long-term Users vs Controls	P Value for Comparisons: Shorter- vs Long-term Users
PASAT, median (range)‡‡									
PR Trial 1	2.56 (2.40-4.56)	2.51 (2.40-3.60)	2.58 (2.40-4.56)*	2.56 (2.40-3.55)	. . .	.92	.16	.23	.007
PR Trial 2	2.23 (2.00-3.53)	2.18 (2.00-2.83)	2.28 (2.00-3.53)	2.24 (2.00-3.06)	. . .	.43	.84	.10	.03
PR Trial 3	1.79 (1.60-3.56)	1.78 (1.60-3.56)	1.81 (1.60-2.52)	1.76 (1.60-2.63)	. . .	.20	.49	.11	.35
PR Trial 4	1.36 (1.20-2.31)	1.35 (1.20-1.80)	1.38 (1. -2.31)	1.33 (1.20-2.00)	. . .	.25	.54	.15	.22
Total PR	8.07 (7.32-10.81)	7.90 (7.36-9.95)	8.21 (7.32-10.81)	7.85 (7.37-10.53)	. . .	.32	.87	.06	.02
Total attempted	142.5 (74-191)	146.0 (96-191)	139.0 (74-188)	145.5 (116-190)	. . .	.75	.99	.56	.45
Total correct	127.0 (26.5)	132.0 (26.8)	121.9 (25.4)	131.6 (26.9)	0.34	.74	>.99	.84	.22
% Correct	64.8 (13.5)	67.3 (13.7)	62.2 (13.0)	67.1 (14.7)	0.33	.74	>.99	.84	.22
Seconds	2.76 (1.86-5.88)	2.64 (1.86-4.57)	2.94 (2.05-5.88)	2.71 (1.89-4.54)	. . .	.53	.97	.23	.14

*Significant correlation with the number of years of cannabis use after controlling for covariates ($P<.05$).
†SCOLP-SOC indicates Speed and Capacity of Language Processing-Speed of Comprehension test. Median scaled scores for the number of SOC test items completed in 2 minutes and errors (n = 96 users, n = 32 controls). Ellipses indicate not applicable.
‡RAVLT indicates Rey Auditory Verbal Learning Test. Mean words recalled on each trial of the RAVLT, total recalled across all trials (RAVLTsum), and median words recognized from lists A and B (96-102 users varied on each trial).
§Mean items completed in 45 seconds for the Word, Color, and Color-Word conditions of the Stroop (age-corrected, n = 100 users) and the modified Color-Read condition (n = 101 users).
‖WCST indicates Wisconsin Card Sorting Test. Median errors, perseverative responses, percentage of conceptual level responses, trials to complete the first category, and failures to maintain the set (n = 101 users, n = 32 controls).
¶Median time to recite the alphabet alternating from loud to silent and median difference between the loud and alternating trials in seconds (n = 94 users, n = 29 controls).
#Mean number of correctly identified items from the Omitted Numbers task.
**Mean difference between actual time elapsed and estimated time in unwarned Time Estimation task A, negative scores indicate underestimation (n = 94 users, n = 31 controls); median difference in warned Time Estimation task B (n = 98 users, n = 32 controls), and mean difference between time produced and time required in the Time Production task (n = 102 users, n = 30 controls).
††Mean letters recalled with 9-, 18-, and 36-second delays (n = 31 controls).
‡‡Paced Auditory Serial Addition Test (PASAT). Median processing rates (PR) for PASAT trials 1-4, total PR, total attempted, total correct (mean [SD]), percentage correct (mean [SD]), and seconds per correct response across the 4 trials (n = 96-100 users, n = 32 controls).

Figure. Mean Number of Words Recalled on Each Trial of the Rey Auditory Verbal Learning Test by Long- and Shorter-term Cannabis Users and Controls



Error bars represent SDs.

Alphabet Task and Omitted Numbers

Groups did not differ in the time taken to complete any trial of the Alphabet Task or in the number of items correct in the Omitted Numbers task. The log time to complete the alternating trial of the Alphabet Task increased as a function of duration of cannabis use (partial r, 0.26; $P=.006$), as did the square root difference between times taken to complete the alternating and loud trials, an index of interference and lack of flexibility (partial r, 0.26; $P=.006$).

Time Estimation Tasks

Cannabis users differed from controls ($P<.001$) in Time Estimation Task A where they estimated the time taken to complete the preceding (Omitted Numbers) task. Both long- and shorter-term users underestimated the time by about one third of the actual time taken (64.4 seconds) and differed significantly from controls ($P=.01$ and $P<.001$, respectively). Groups did not differ in the simple and brief warned passive Time Estimation Task B or Time Production, where they could use strategies such as counting. Time estimation measures did not correlate with duration of cannabis use.

Auditory Consonant Trigrams

Long-term users recalled significantly fewer items than shorter-term users ($P=.007$), controls ($P=.002$), and published norms[46] on only the 9-second delay condition. The number of items recalled did not correlate with duration of cannabis use. In the general population, the greater the delay interval the worse the performance. In cannabis users, this general pattern was apparent, though there was greater interference at the shorter-delay interval than would be expected.

Paced Auditory Serial Addition Test

Long-term users had slower processing rates than shorter-term users on trial 1 ($P=.007$), with trends on trial 2 ($P=.03$) and the total processing rate across all trials ($P=.02$). Group differences on all other measures failed to reach significance but the performance of the long-term users was poorer in comparison with one set of norms[49] but not another.[50]

Pure Effects Attributable to Cannabis Use and Effects of Recent vs Chronic Use

Excluding all participants with histories of regular other drug or alcohol use, dependence or treatment, and controls with any history of regular cannabis use within the past 20 years reduced the sample to 27 long-term users, 33 shorter-term users, and 26 controls. Despite the reduction in power to detect differences between groups, there remained a significant difference with α = .05 between long-term users and controls on RAVLTsum (P = .03), recognition of lists A (P = .004) and B (P = .01), and between users overall and controls on the unwarned Time Estimation task (P = .02). These results support the hypothesis that impaired memory function and time estimation are specific to chronic use of cannabis.

In a separate analysis, exclusion of users whose urinary cannabinoid metabolite levels exceeded those from the night before testing by 50 ng/mg or more (n = 18) still resulted in significant differences between long- and shorter-term users, and long-term users and controls on RAVLT sum (P = .002 and P = .002, respectively), on recognition of lists A (P = .005 and P = .006) and B (P = .01 and P<.001), on the 9-second delay of the Auditory Consonant Trigrams test (P = .02 and P = .03), and users still differed from controls on time estimation (P = .005). When the sample was split at the median for time since last use or level of urinary cannabinoid metabolite on the day of testing and analyzed by ANCOVA, there were no differences on any measure between those who had used cannabis within the past 17 hours and those who had used cannabis 17 or more hours ago, or those with high vs low levels of urinary metabolites and no interactions with duration of cannabis use. Including measures of recent use as covariates in ANCOVA did not change the significance of differences between long- and shorter-term users. These results support the hypothesis that impaired performance is not a consequence of recent use prior to testing or the extent of cannabinoid residues present.

To explore further the influences of duration of cannabis use and recency of use, semipartial correlations were calculated using the following predictors: FSIQ, age, duration of cannabis use, and hours since last use of cannabis. As shown in TABLE 4, the unique contribution of duration of cannabis use to the variance of each test variable was superior or at least equivalent to that of recency of use in all 6 test variables that had significant contributions from at least 1 cannabis use parameter. Recent use contributed only to performance on the memory tests. The fact that a minority of the sample, primarily shorter-term users, reported experiencing mild withdrawal symptoms, yet shorter-term users' performance was not impaired, supports the interpretation of the cognitive impairments observed as a long-term consequence of cannabis use and not a manifestation of overtly experienced withdrawal.

COMMENT

The results of this study have confirmed and extended previous findings of cognitive impairments among chronic heavy cannabis users. Long-term users with a mean 24 years of regular cannabis use performed significantly less well on tests of memory and attention than nonuser controls and shorter-term users with a mean of 10 years' use. The greatest impairment on almost every measure was from the RAVLT, indicating a generalized memory deficit with impaired learning, retention, and retrieval. Long-term users recalled 2.5 fewer words than controls on the delayed recall trial where 49% of the long-term users' scores were more than 1 SD, and 21.6% were more than 2 SDs, below the control mean and normative data.[47] A large proportion of long-term users' recognition scores were more than 1 SD (51%) or 2 SDs (31.4%) below the control mean and norms.[47] Effect sizes for measures that differed significantly between long-term users and controls ranged from 0.56 to 1.29 across all tests, indicating moderate to large effects.

These results do not indicate a severe memory problem but could nevertheless translate into clinically significant cognitive impairment and could impact functioning in daily life. There were significant differences between long-term users and controls on 6 of the 9 tests administered and performance on 4 tests worsened as a function of increasing years of cannabis use. Despite this and a range of up to 17 years of cannabis use in the shorter-term user group, they differed significantly from controls only on time estimation.

Table 4. Predictor Correlations Between Hypothesized Predictors and Select Test Variables*

	Full-Scale IQ			Age			Duration of Cannabis Use			Recency of Cannabis Use†		
Test Variables	Zero-Order	Semipartial	P Value	Zero-Order	Semipartial	P Value	Zero-Order	Semipartial	P Value	Zero-Order	Semipartial	P Value
SCOLP-SOC, No. correct	0.55	**0.52**	<.001	0.12	**0.24**	.005	0.01	**−0.24**	.005	0.11	**0.05**	.53
Stroop												
Color-Word	0.27	**0.29**	.002	−0.26	**0.09**	.33	−0.34	**−0.24**	.01	0.09	**0.05**	.56
Color-Read	0.36	**0.36**	<.001	−0.19	**0.12**	.17	−0.27	**−0.24**	.008	0.18	**0.13**	.15
RAVLT												
RAVLTsum	0.2[illegible]	**0.22**	.02	−0.31	**0.06**	.54	−0.37	**−0.21**	.02	0.25	**0.21**	.02
RAVLT recency	0.11	**0.10**	.32	−0.19	**0.12**	.20	−0.27	**−0.22**	.02	0.24	**0.23**	.02
Alphabet Task Alternating, log	−0.21	**−0.21**	.03	0.12	**−0.17**	.09	0.21	**0.25**	.01	−0.04	**−0.02**	.81

*SCOLP-SOC indicates Speed and Capacity of Language Processing-Speed of Comprehension; RAVLT, Rey Auditory Verbal Learning Test. P values are for semipartial correlations. Test variables were significantly predicted by at least 1 cannabis use parameter.
†Defined as hours since last use of cannabis.

Altered brain metabolism in shorter-term users may be detected with sensitive techniques, such as functional magnetic resonance imaging and positron emission tomography, but the clinical significance of such changes remains obscure. The strength of this study is in its assessment of overtly relevant cognitive processes; our results suggest that shorter-term cannabis users are not impaired to an extent that would interfere with cognitive functioning in their daily lives. The fact that the frequency of use was near daily among long- and shorter-term users suggests that the duration of cannabis use is a more salient contributor to the development of cognitive impairment than quantity or frequency of use.

While most cannabis users cease using in their mid-20s to late 20s, approximately 20% continue to use through their 30s and beyond.[2] This is the first study to our knowledge of a relatively large sample of long-term entrenched cannabis users seeking treatment. Concern about perceived cognitive impairment was one of many problems associated with cannabis use that led the users in this study to seek treatment. This concern is unlikely to have biased the results of this study since a slightly higher proportion of shorter-term vs long-term users reported experiencing cognitive problems, yet shorter-term users mostly did not differ from controls on the cognitive tests. Nevertheless, it is possible that long-term cannabis users in the community who are not seeking treatment may not experience impairments to the same degree as those assessed in this study.

While acknowledging the limitations of retrospective designs, if carefully controlled and analyzed, this approach is the most efficient way to evaluate the long-term cognitive effects of cannabis, given the costs and logistical difficulties in using prospective research designs. The matching of groups on measures of premorbid intellectual functioning that are resilient to brain damage, together with the observed relationships between duration of cannabis use and test performance, support the assumption that the cognitive impairments observed in the long-term users were not preexisting but developed as a result of their prolonged use of cannabis. Impairment appeared unrelated to withdrawal phenomena. The cognitive functions assessed in this study are dependent on the intact functioning of the hippocampus, prefrontal cortex, and cerebellum,[39,51-55] which are dense with cannabinoid receptors.[56] The effects that exogenous cannabinoids exert on the cannabinoid receptor system and the role of endogenous cannabinoids as suggested by animal research[6,2-24] provide a credible neurophysiological explanation for the development of cognitive impairments as the result of hypothesized long-term changes occurring over many years of exposure to the drug.

In conclusion, our results confirm that cognitive impairments develop as a result of prolonged cannabis use; they endure beyond the period of acute intoxication, and they worsen with increasing years of use. Impairments develop gradually but may only become clinically significant and detectable by standard neuropsychological tests after 1 to 2 decades of cannabis use. Nevertheless, altered brain function with subtle impairment has been shown to manifest earlier.[6,8,9,11,17,18] It is also likely that impairments would be greater among comorbid substance-dependent persons. The risk to most medical cannabis users is likely to be small, as long as they are not maintained at high doses for many years. For habitual users, the kinds of impairments observed in this study have the potential to impact academic achievements, occupational proficiency, interpersonal relationships, and daily functioning. The extent to which these cognitive impairments may recover following cessation or reduction of cannabis use will be addressed in a follow-up of this sample subsequent to treatment for cannabis dependence.

Author Contributions: *Study concept and design:* Solowij, Stephens, Roffman.
Acquisition of data: Stephens, Roffman, Kadden, Miller, Christiansen, McRee, Vendetti.
Analysis and interpretation of data: Solowij, Stephens.
Drafting of the manuscript: Solowij.
Critical revision of the manuscript for important intellectual content: Solowij, Stephens, Roffman, Babor, Kadden, Miller, Christiansen, McRee, Vendetti.
Statistical expertise: Solowij, Stephens.
Obtained funding: Solowij, Stephens, Roffman, Babor, Kadden, Miller.
Administrative, technical, or material support: Solowij, Roffman, McRee, Vendetti.
Study supervision: Solowij, Stephens, Roffman, Babor, Kadden, Miller, Christiansen, McRee, Vendetti.

Other Members of the Marijuana Treatment Project Research Group include Kathleen Carroll, PhD, Karen Steinberg, PhD, (Coordinating Center, University of Connecticut Health Center, Department of Community Medicine), Mark Litt, PhD (Farmington Clinical Research Unit, University of Connecticut Health Center, Department of Psychiatry), Jean Donaldson, MA, and James Herrell, PhD (Center for Substance Abuse Treatment).

Funding/Support: This study was conducted as part of the Marijuana Treatment Project, a Cooperative Agreement for a multisite study of the effectiveness of brief treatment for cannabis dependence. It was funded by the Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Treatment (CSAT), US Department of Health and Human Services (grants UR4 TI11270, UR4 TI11273, UR4 TI11274, UR4TI11310). The research was conducted in Farmington, Conn, Miami, Fla, and Seattle, Wash, in cooperation with the following institutions: University of Connecticut Health Center, The Village South Inc, University of Washington, and Evergreen Treatment Services.

Acknowledgment: We are grateful to Aimee Balmer-Campbell, BA, Kara Brennan Dion, BA, David Duresky, MA, Dave Ghany, BA, Brian Glidden, BA, Cara Gluskoter, MS, Cher Gunby, BA, Jennifer Haley, BA, Heather Haynes, RN, Patricia Holkon, MA, Elise Kabela, PhD, Priscilla Morse, MA, Joe Picciano, MS, Sam Schwartz, MSW, Megan Swan, MA, Debbie Talamini, AS, and Anna Wolfe, BA, for input and assistance with data collection and trial management; Peter Caputi, BA, GradDip, for statistical advice; Brin Grenyer, PhD, for comments on the manuscript; Eva Congreve, DipLib, for library assistance; and to all participants in this research.

REFERENCES

1. Watson SJ, Benson JA, Joy JE. Marijuana and medicine: assessing the science base: a summary of the 1999 Institute of Medicine report. *Arch Gen Psychiatry.* 2000;57:547-552.
2. Substance Abuse and Mental Health Services Administration (SAMHSA). *National Household Survey on Drug Abuse Series: H-6. Preliminary Results from the 1997 National Household Survey on Drug Abuse.* Rockville, Md: Office on Applied Studies; 1998. DHHS publication SMA 98-3251.
3. Hall W, Babor TF. Cannabis use and public health: assessing the burden. *Addiction.* 2000;95:485-490.
4. Voelker R. "Decent research and closure" needed on medical marijuana, says head of NIH panel. *JAMA.* 1997;278:802.
5. Pope HG, Gruber AJ, Yurgelun-Todd D. The residual neuropsychological effects of cannabis: the current status of research. *Drug Alcohol Depend.* 1995;38:25-34.
6. Solowij N. *Cannabis and Cognitive Functioning.* Cambridge, England: Cambridge University Press; 1998.
7. Fried PA, Watkinson B, Gray R. Differential effects on cognitive functioning in 9- to 12-year olds prenatally exposed to cigarettes and marihuana. *Neurotoxicol Teratol.* 1998;20:293-306.

8. Solowij N, Michie PT, Fox AM. Effects of long-term cannabis use on selective attention: an event-related potential study. *Pharmacol Biochem Behav*. 1991;40:683-688.

9. Solowij N, Michie PT, Fox AM. Differential impairments of selective attention due to frequency and duration of cannabis use. *Biol Psychiatry*. 1995;37:731-739.

10. Solowij N. Do cognitive impairments recover following cessation of cannabis use? *Life Sci*. 1995;56:2119-2126.

11. Pope HG, Yurgelun-Todd D. The residual cognitive effects of heavy marijuana use in college students. *JAMA*. 1996;275:521-527.

12. Pope HG, Jacobs A, Mialet JP, Yurgelun-Todd D, Gruber S. Evidence for a sex-specific residual effect of cannabis on visuospatial memory. *Psychother Psychosom*. 1997;66:179-184.

13. Fletcher JM, Page JB, Francis DJ, et al. Cognitive correlates of long-term cannabis use in Costa Rican men. *Arch Gen Psychiatry*. 1996;53:1051-1057.

14. Elwan O, Hassan AAH, Naseer MA, et al. Brain aging in a sample of normal Egyptians: cognition, education, addiction and smoking. *J Neurol Sci*. 1997;148:79-86.

15. Solowij N, Grenyer BFS, Peters R, Chesher G. Long-term cannabis use impairs memory processes and frontal lobe function. In: *1997 Symposium on the Cannabinoids*. Burlington, Vt: International Cannabinoid Research Society; 1997:84.

16. Loeber RT, Yurgelun-Todd DA. Human neuroimaging of acute and chronic marijuana use: implications for frontocerebellar dysfunction. *Hum Psychopharmacol Clin Exp*. 1999;14:291-304.

17. Block RI, O'Leary DS, Hichwa RD, et al. Cerebellar hypoactivity in frequent marijuana users. *Neuroreport*. 2000;11:749-753.

18. Block RI, O'Leary DS, Hichwa RD, et al. Effects of frequent marijuana use on memory-related regional cerebral blood flow. *Pharmacol Biochem Behav*. In press.

19. Block RI, O'Leary DS, Augustinack JC, et al. Effects of frequent marijuana use on attention-related regional cerebral blood flow. *Abstr Soc Neurosci*. 2000;26:2080.

20. Lyketsos CG, Garrett E, Liang K-Y, Anthony JC. Cannabis use and cognitive decline in persons under 65 years of age. *Am J Epidemiol*. 1999;149:794-800.

21. Hampson RE, Deadwyler SA. Cannabinoids, hippocampal function and memory. *Life Sci*. 1999;65:715-723.

22. Hampson RE, Deadwyler SA. Cannabinoids reveal the necessity of hippocampal neural encoding for short-term memory in rats. *J Neurosci*. 2000;20:8932-8942.

23. Reibaud M, Obinu MC, Ledent C, et al. Enhancement of memory in cannabinoid CB1 receptor knock-out mice. *Eur J Pharmacol*. 1999;379:R1-R2.

24. Bohme GA, Laville M, Ledent C, Parmentier M, Imperato A. Enhanced long-term potentiation in mice lacking cannabinoid CB1 receptors. *Neuroscience*. 2000;95:5-7.

25. Marijuana Treatment Project Research Group. Treating marijuana dependence: findings from a multisite study. *Arch Gen Psychiatry*. In press.

26. McLellan AT, Kushner H, Metzger D, et al. The Fifth Edition of the Addiction Severity Index. *J Subst Abuse Treat*. 1992;9:199-213.

27. Sobell LC, Sobell MB. Timeline follow-back: a technique for assessing self reported alcohol consumption. In: Litten RZ, Allen JP, eds. *Measuring Alcohol Consumption: Psychological and Biochemical Methods*. Totowa, NJ: Humana Press; 1992.

28. Miller WR. *Form 90: A Structured Assessment Interview for Drinking and Related Behaviors: Test Manual: Project MATCH Monograph Series*. Vol 5. Bethesda, Md: National Institute on Alcohol Abuse and Alcoholism; 1996. NIH Publication 96-4004.

29. First MB, Gibbon M, Spitzer RL, Williams JB. *User's Guide for the Structured Clinical Interview for DSM-IV Axis I Disorders—Research Version*. New York, NY: Biometrics Research Department, New York State Psychiatric Institute; 1996.

30. Jastak S, Wilkinson G. *The Wide Range Achievement Test: Manual of Instructions*. Wilmington, Del: Jastak Associates; 1984.

31. Kareken DA, Gur RC, Saykin AJ. Reading on the Wide Range Achievement Test-Revised and parental education as predictors of IQ: comparison with the Barona formula. *Arch Clin Neuropsychol*. 1995;10:147-157.

32. Blair JR, Spreen O. Predicting premorbid IQ: a revision of the National Adult Reading Test. *Clin Neuropsychol*. 1989;3:129-136.

33. Barona A, Reynolds CR, Chastain R. A demographically based index of pre-morbid intelligence for the WAIS-R. *J Consult Clin Psychol*. 1984;52:885-887.

34. Bell R, Taylor EH, Ackerman B, Pappas AA. Interpretation of urine quantitative 11-nor-delta-9-tetrahydrocannabinol-9-carboxylic acid to determine abstinence from marijuana smoking. *Clin Toxicol*. 1989;27:109-115.

35. Dackis CA, Pottash ALC, Annitto W, Gold MS. Persistence of urinary marijuana levels after supervised abstinence. *Am J Psychiatry*. 1982;139:1196-1198.

36. Ellis GM, Mann MA, Judson BA, Schramm NT, Tashchian A. Excretion patterns of cannabinoid metabolites after last use in a group of chronic users. *Clin Pharmacol Ther*. 1985;38:572-578.

37. Fraser AD, Worth D. Urinary excretion profiles of 11-nor-9-carboxy-delta-9-tetrahydrocannabinol: a delta-9-THCCOOH to creatinine ratio study. *J Anal Toxicol*. 1999;23:531-534.

38. Baddeley A, Emslie H, Nimmo Smith I. *The Speed and Capacity of Language-Processing Test Manual*. Bury St Edmonds, England: Thames Valley Test Co; 1992.

39. Lezak MD. *Neuropsychological Assessment*. 3rd ed. New York, NY: Oxford University Press; 1995.

40. Rey A. *L'examen clinique en psychologie*. Paris, France: Presse Universitaire de France; 1964.

41. Spreen O, Strauss E. *A Compendium of Neuropsychological Tests: Administration, Norms and Commentary*. 2nd ed. New York, NY: Oxford University Press; 1998.

42. Golden CJ. *Stroop Color and Word Test: A Manual for Clinical and Experimental Uses*. Wood Dale, Ill: Stoelting; 1978.

43. Bohnen N, Jolles J, Twijnstra A. Modification of the Stroop Color Word Test improves differentiation between patients with mild head injury and matched controls. *Clin Neuropsychol*. 1992;6:178-184.

44. *The Wisconsin Card Sorting Test: Computer Version*. Alpharetta, Ga: Psychological Assessment Resources Inc, CyberMetrics Testing Software Services; 1989.

45. Stuss DT, Stethem LL, Poirier CA. Comparison of three tests of attention and rapid information processing across six age groups. *Clin Neuropsychol*. 1987;1:139-152.

46. Levin HS, Mattis S, Ruff RM, et al. Neurobehavioral outcome following minor head injury: a three-center study. *J Neurosurg*. 1987;66:234-243.

47. Geffen G, Moar KJ, O'Hanlon AP, Clark CR, Geffen LB. Performance measures of 16- to 86-year old males and females on the Auditory Verbal Learning Test. *Clin Neuropsychol*. 1990;4:45-63.

48. Stuss DT, Stethem L, Pelchat G. Three tests of attention and rapid information processing: an extension. *Clin Neuropsychol*. 1988;2:246-250.

49. Roman DD, Edwall GE, Buchanan RJ, Patton JH. Extended norms for the Paced Auditory Serial Addition Task. *Clin Neuropsychol*. 1991;5:33-40.

50. Brittain JL, La Marche JA, Reeder KP, Roth DL, Boll TJ. Effects of age and IQ on Paced Auditory Serial Addition Task (PASAT) performance. *Clin Neuropsychol*. 1991;5:163-175.

51. Levy R, Goldman-Rakic PS. Segregation of working memory functions within the dorsolateral prefrontal cortex. *Exp Brain Res*. 2000;133:23-32.

52. Hermann BP, Seidenberg M, Wyler A, et al. The effects of human hippocampal resection on the serial position curve. *Cortex*. 1996;32:323-334.

53. Middleton FA, Strick PL. Anatomical evidence for cerebellar and basal ganglia involvement in higher cognitive function. *Science*. 1994;266:458-461.

54. Schacter DL. Memory and awareness. *Science*. 1998;280:59-60.

55. Schmahmann JD, ed. *The Cerebellum and Cognition*. San Diego, Calif: Academic Press; 1997.

56. Herkenham M, Lynn AB, Little MD, et al. Cannabinoid receptor localization in brain. *Proc Natl Acad Sci U S A*. 1990;87:1932-1936.

Table. Relative Risk of Parkinson Disease Among Patients With Polio Compared With a Nonexposed Cohort Matched by Age and Sex

	Persons, No.		Observed Parkinson Cases, No.		
Patient Group	Patients With Polio	Age-/Sex-Matched Cohort	Patients With Polio	Age-/Sex-Matched Cohort	RR (95% CI)*
Total	5421	21626	29	50	2.3 (1.4-3.6)
Paralytic	2003	7979	13	23	2.2 (1.1-4.3)
Nonparalytic	2335	9317	7	14	1.9 (0.7-4.7)
Primary lymphocytic meningitis	592	2367	7	7	4.1 (1.4-11.9)
Suspected polio	491	1963	2	6	1.3 (0.2-5.7)

*Relative risk (RR) calculated according to person-years at risk. CI indicates confidence interval.

CI, 0.7-4.7) and in patients only suspected of having poliomyelitis (RR, 1.3; 95% CI, 0.2-5.7).

Comment. Although it has long been hypothesized that poliomyelitis is associated with an increased risk of PD,[4] to our knowledge this has never been empirically demonstrated. The observed increased PD risk does not necessarily imply that poliovirus is directly implicated in PD pathogenesis. Rather, we speculate that by reducing the number of neurons essential to normal neuronal functions, the virally induced damage may enhance the effect of normal age-related neuronal degeneration and thus precipitate PD.[1,4]

We acknowledge possible limitations of our data. Because patients with poliomyelitis may be admitted to hospitals or may attend outpatient clinics more often than other persons, detection bias could arise. However, in Denmark, the diagnosis, evaluation, and treatment of PD normally take place at neurological departments or neurological outpatient clinics. Moreover, although patients with PD initially may consult private neurologists or general practitioners, the vast majority of patients with PD will at some point undergo clinical evaluation or hospitalization at specialized hospital departments because of the complexity of the disease. Therefore, we think that most Danish patients with PD would be registered in the NHDR, and we consider detection bias to be an unlikely explanation for our findings.

Patients with polio may present a wide range of neurological symptoms, which could cause diagnostic ambiguity. If diagnostic misclassification would explain our observations we would have expected the risk of PD to be particularly increased in patients with paralytic polio. However, an increased risk of PD was also observed in patients with nonparalytic polio. Moreover, the likely inclusion of patients with nonpolio virus-related meningitis in the group of patients with primary lymphocytic meningitis may indicate that the observed PD risk is not particular to the poliovirus but also applies to other viruses infecting the central nervous system.

Nete Munk Nielsen, MD, PhD
Klaus Rostgaard, MSc
Henrik Hjalgrim, MD, PhD
Peter Aaby, MSc, DMSc
Department of Epidemiology Research
Danish Epidemiology Science Centre
Statens Serum Institut
Copenhagen, Denmark
Dorthe Askgaard, MD
Department of Infectious Diseases M
National University Hospital
Copenhagen

Funding/Support: This study was supported by the Danish Medical Research Council, the Danish Development Research Council, the Danish National Research Foundation, the Wedell-Wedellsborg's Foundation, and the National Polio Society (PTU).
Acknowledgment: We are grateful to the staff at Copenhagen City Archives, who helped us identify the polio patients' records.

1. Calne DB, Eisen A, McGeer E, Spencer P. Alzheimer's disease, Parkinson's disease, and motoneurone disease: abiotrophic interaction between ageing and environment? *Lancet*. 1986;2:1067-1070.
2. Scott WK, Nance MA, Watts RL, et al. Complete genomic screen in Parkinson disease: evidence for multiple genes. *JAMA*. 2001;286:2239-2244.
3. Bodian D. Histopathologic basis of clinical findings in poliomyelitis. *Am J Med*. 1949;6:563-577.
4. Vincent FM, Myers WC. Poliomyelitis and parkinsonism. *N Engl J Med*. 1978;298:688-689.
5. Munk NM, Wohlfahrt J, Aaby P, et al. Cancer risk in a cohort of polio patients. *Int J Cancer*. 2001;92:605-608.
6. Lassen HCA. Sammenlignende undersøgelser over primær serøs meningitis og paralytisk poliomyelitis [Comparative studies of primary lymphocytic menigitis and paralytic polio]. *Ugeskr Læg*. 1939;3:73-80.

CORRECTION

Incorrect Measure: In the Original Contribution entitled "Cognitive Functioning of Long-term Heavy Cannabis Users Seeking Treatment" published in the March 6, 2002, issue of THE JOURNAL (2002;287:1123-1131), the legend for the Figure should indicate that error bars represent SEM, not SD.

ORIGINAL CONTRIBUTION

Escalation of Drug Use in Early-Onset Cannabis Users vs Co-twin Controls

Michael T. Lynskey, PhD

Andrew C. Heath, DPhil

Kathleen K. Bucholz, PhD

Wendy S. Slutske, PhD

Pamela A. F. Madden, PhD

Elliot C. Nelson, MD

Dixie J. Statham, MA

Nicholas G. Martin, PhD

Context Previous studies have reported that early initiation of cannabis (marijuana) use is a significant risk factor for other drug use and drug-related problems.

Objective To examine whether the association between early cannabis use and subsequent progression to use of other drugs and drug abuse/dependence persists after controlling for genetic and shared environmental influences.

Design Cross-sectional survey conducted in 1996-2000 among an Australian national volunteer sample of 311 young adult (median age, 30 years) monozygotic and dizygotic same-sex twin pairs discordant for early cannabis use (before age 17 years).

Main Outcome Measures Self-reported subsequent nonmedical use of prescription sedatives, hallucinogens, cocaine/other stimulants, and opioids; abuse or dependence on these drugs (including cannabis abuse/dependence); and alcohol dependence.

Results Individuals who used cannabis by age 17 years had odds of other drug use, alcohol dependence, and drug abuse/dependence that were 2.1 to 5.2 times higher than those of their co-twin, who did not use cannabis before age 17 years. Controlling for known risk factors (early-onset alcohol or tobacco use, parental conflict/separation, childhood sexual abuse, conduct disorder, major depression, and social anxiety) had only negligible effects on these results. These associations did not differ significantly between monozygotic and dizygotic twins.

Conclusions Associations between early cannabis use and later drug use and abuse/dependence cannot solely be explained by common predisposing genetic or shared environmental factors. The association may arise from the effects of the peer and social context within which cannabis is used and obtained. In particular, early access to and use of cannabis may reduce perceived barriers against the use of other illegal drugs and provide access to these drugs.

JAMA. 2003;289:427-433

www.jama.com

Over the past decade there has been a steady increase both in the prevalence of cannabis (marijuana) use among young people and in the number of people entering treatment for cannabis-related problems. In 1999 there were 220000 cannabis-related admissions to publicly funded substance abuse treatment programs in the United States. This represented 14% of all such treatment admissions, with admissions occurring primarily among youth: approximately a third of all cannabis-related admissions were among people 12 to 17 years of age and a further third were among those 18 to 25 years of age. These increases in treatment seeking have been paralleled by heightened concerns about the long-term consequences of chronic cannabis use and a recognition of the need for treatment and other interventions to ameliorate the effects of drug dependence, which is best characterized as a chronic, recurring condition.

The majority of cannabis-related admissions among youth result from referrals either from the justice or educational systems, and it is probable that at least some of these referrals were motivated more by concern over the future consequences of early initiation to cannabis use than by apparent negative effects of current cannabis use. A major focus of concern is the extent to which early cannabis use may increase the risks for escalation to other drug use and drug dependence. Stage theory posits that there is an invariant sequence in initiation and use of drugs, with use of cannabis preceding the use of "hard" drugs such as cocaine and heroin.[8-10] This theory has been highly influential in drug policy debates and has provided a major rationale for sustaining prohibition against cannabis,[11] as it is assumed that delaying or preventing early cannabis use may reduce risks of other illicit drug use.

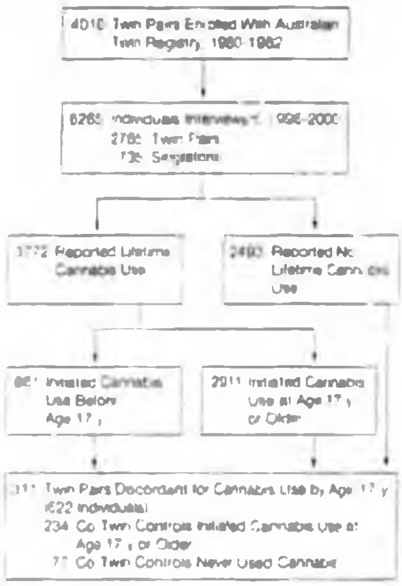
While this broad theory has found some empirical support,[8,10,12-14] such data on temporal sequencing do not establish that the use of one drug *causes* the

For editorial comment see p 482.

Author Affiliations: Queensland Institute of Medical Research, Brisbane, Queensland, Australia (Drs Lynskey and Martin and Ms Statham); Missouri Alcoholism Research Center and Department of Psychiatry, Washington University School of Medicine, St Louis (Drs Lynskey, Heath, Bucholz, Madden, and Nelson); and Missouri Alcoholism Research Center and Department of Psychology, University of Missouri, Columbia (Dr Slutske).

Corresponding Author and Reprints: Michael T. Lynskey, PhD, Missouri Alcoholism Research Center, Department of Psychiatry, Washington University School of Medicine, 40 N Kingshighway, Suite One, St Louis, MO 63108 (e-mail: mlynskey@matlock.wustl.edu).

Figure. Sample Size and Sample Selection Criteria



use of drugs higher up the sequence.[11,12] Rather, the observed pattern of initiation and use may reflect other factors such as availability and access.[1] Nonetheless, several studies using event history analysis[17] and regression analyses[18,19] have reported that early initiation to cannabis use remains a significant risk factor for both the use of other drugs and experiencing drug-related problems.

We are unaware of any studies that have controlled for genetic influences on the association between earlier initiation of cannabis use and other drug use and drug-related problems. Nonetheless, one viable hypothesis to explain this apparent association is that it arises from the joint influence of genetic and/or shared environmental factors on both risks of early initiation to cannabis use and, independently of this, on increased risks of subsequent drug use and dependence. This hypothesis is supported by evidence that cannabis and other drug use and drug abuse/dependence are moderately to highly heritable.[20-22]

The examination of other drug use and drug abuse/dependence in twin pairs discordant for early cannabis use provides a powerful test of the hypothesis that the association between early cannabis use and later outcomes can be explained by common predisposing genetic and/or shared environmental risk factors. Since these predisposing factors are shared by twin pairs raised together, if the association between early cannabis use and later drug use can be explained by shared environmental factors, then in twin pairs discordant for early cannabis use, individuals who do not initiate early cannabis use should be at equal risk of developing drug-related problems as their co-twin who initiates cannabis use early. If correlated genetic effects explain these associations, then monozygotic pairs discordant for early use should still have equal risks. In contrast, if the association is causal or explained by environmental factors for which twin pairs are discordant, we would expect to find higher rates of other drug use and abuse/dependence in the early cannabis user than in his or her co-twin. In this article, this issue is explored using data from a large community sample of young adult Australian monozygotic and dizygotic twins.

METHODS

Interviewees were members of the young adult cohort of the Australian Twin Register, a volunteer twin panel born between 1964-1971.[20,23,24] The data presented in this report are derived from responses to a single telephone interview during the period 1996-2000 when the median age of the sample was 30 years (range, 24-36 years). Informed consent was obtained from participants prior to administering the interviews, as approved by the institutional review boards of Washington University School of Medicine and the Queensland Institute of Medical Research.

An overview of the study design is shown in the FIGURE. Of 4010 pairs that could be traced, interviews were completed with both members of 2765 pairs (69% pair-wise response rate) and 1 member of another 735 pairs (78% individual response rate). A total of 861 members of the sample (13.7%) reported initiating cannabis use before age 17 years, 311 of these (36.1%) were from same-sex twin pairs in which their co-twin had not used cannabis by age 17 years. The analyses in this article are based on this subset of 622 same-sex twins from pairs discordant for early cannabis use. There were 74 female and 62 male monozygotic twin pairs and 84 female and 91 male same-sex dizygotic twin pairs. Zygosity was determined on the basis of responses to standard questions about physical similarity and confusion of the twins by parents, teachers, and strangers, methods that have been found to give better than 95% agreement with results of genotyping.[25,26]

Assessments

A structured diagnostic interview designed for genetic studies on alcoholism, the Semi-Structured Assessment for the Genetics of Alcoholism,[28] was adapted for telephone use with an Australian sample and updated for *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) diagnostic criteria.[29] The interview also included assessments of sociodemographic factors, childhood family environment, and experiencing childhood sexual abuse.[31] These measures are described below.

Measures of Subsequent Drug Involvement

Lifetime Drug Use. Respondents were asked whether they had ever engaged in nonmedical use of other drugs. In the analysis sample of 622 individuals from same-sex pairs discordant for early cannabis use, the following results were found: (1) sedative use (ie, benzodiazepines, barbiturates) was reported by 12.7% of women and 14.8% of men; (2) hallucinogen use was reported by 18.7% of women and 35.2% of men; (3) cocaine or other stimulant use was reported by 32.4% of women and 42.4% of men; and (4) opioid use was reported by 6.7% of women and 13.5% of men.

Lifetime Drug Abuse/Dependence. Individuals reporting using cannabis, sedatives, cocaine/other stimulants, or opioids on at least a monthly basis were asked additional questions concern-

Table 1. Men, Women, and the Total Sample of Discordant Twins Who Met Criteria for Drug Abuse and Dependence*

	Men (n = 306)			Women (n = 316)			Total (N = 622)		
Drug	Abuse	Dependence	Abuse/ Dependence	Abuse	Dependence	Abuse/ Dependence	Abuse	Dependence	Abuse/ Dependence
Cannabis	57 (18.6)	96 (31.4)	153 (50.0)	23 (7.3)	65 (20.6)	88 (27.9)	80 (12.9)	161 (25.9)	241 (38.7)
Sedatives	2 (0.7)	4 (1.3)	6 (2.0)		5 (1.6)	5 (1.6)	2 (0.3)	9 (1.5)	11 (1.8)
Cocaine/stimulants	13 (4.2)	23 (7.5)	36 (11.8)	4 (1.3)	13 (4.1)	17 (5.4)	17 (2.7)	36 (5.8)	53 (8.5)
Opioids	2 (0.7)	6 (2.0)	8 (2.6)		6 (1.9)	6 (1.9)	2 (0.3)	12 (1.9)	14 (2.3)
Any illicit drug	56 (18.3)	101 (33.0)	157 (51.3)	22 (7.0)	71 (22.5)	93 (29.4)	78 (12.5)	172 (27.7)	250 (40.2)
Alcohol		137 (44.8)			88 (27.9)			225 (36.2)	

*Data are presented as No. (%). Ellipses indicate not applicable.

ing the extent to which they may have experienced symptoms of drug abuse (use in physically hazardous situations; use interfering with major role obligations) or dependence (using more frequently or for longer periods than intended, needing larger amounts to achieve an effect [tolerance], continued use despite use causing emotional problems, recurrent desire to cut down on use). Abuse was operationalized by endorsement of either abuse symptom; dependence was operationalized by endorsement of 2 or more dependence symptoms. While the dependence measure did not provide formal *DSM-IV* criteria, previous analyses exploring the validity of these modified criteria for cannabis dependence indicated that they had both excellent sensitivity (96.7%) and specificity (94.6%) when compared with *DSM-IV* criteria.[26]

Given the relatively low prevalence of drug abuse and dependence, measures of abuse and dependence for each drug class were combined. We assessed abuse/dependence for the following drug classes: (1) cannabis; (2) sedatives (ie, benzodiazepines, barbiturates); (3) cocaine/other stimulants; and (4) opioids. Additionally, these drug classes were combined to form a measure of any drug abuse or dependence. The prevalence of these outcomes is summarized separately by sex in TABLE 1.

Lifetime Alcohol Dependence. Lifetime alcohol dependence was assessed using full *DSM-IV*[14] criteria: 27.9% of women and 44.8% of men met criteria for alcohol dependence.

Family, Social, and Individual Factors

A number of family, social, and individual factors were included in the analysis as control variables. These were selected on the basis of a previous analysis with this sample that identified risk factors associated with cannabis dependence.[20]

Psychiatric Disorders. Criteria for conduct disorder and major depression from the *DSM-IV*[14] were assessed using the modified Semi-Structured Assessment for the Genetics of Alcoholism, and diagnoses were assigned by computer algorithm. A nondiagnostic measure of social anxiety was also defined.[21]

Early Tobacco Use. A measure of early tobacco use was constructed by classifying subjects who reported smoking at least 1 day a week for a period of 3 weeks or more before age 17 years as early tobacco users (36.6% of twins from pairs discordant for early cannabis use reported such use).

Early Regular Alcohol Use. A measure of early alcohol use was constructed by classifying subjects who reported that they started drinking alcohol at least once a month for a period of 6 months or more before age 17 years as early regular alcohol drinkers (11.6% of twins from pairs discordant for early cannabis use reported such use).

Statistical Analyses

All statistical analyses were conducted using SAS[31] and STATA.[32] As an initial test of heritability of onset of cannabis use, rates of concordance for early (before age 17 years) cannabis use were compared between monozygotic and dizygotic twin pairs. Differences in concordance rates were tested using the Breslow-Day test of heterogeneity of odds ratios (ORs), and separate tests were conducted for males and females. Conditional logistic regression models were then fitted to test for excess risk to early-onset cannabis users from same-sex discordant pairs, compared with their co-twin controls. The significance of the interactions between early cannabis use and both twin pair zygosity and sex were tested and, as these were nonsignificant ($P > .10$ in all cases), data were pooled across zygosity and sex. Analyses were repeated including the family and individual control variables described above. Stepwise regression with backward selection was conducted with the measure of early cannabis use forced into the model. These analyses were used to estimate conditional ORs for drug use and drug abuse/dependence in twins discordant for early cannabis use with control for other significant predictors.

Power was estimated using computer simulation. For example, for cocaine/stimulant abuse or dependence, we first obtained estimates of the prevalence ($p_E = 12.5\%$, exposed twin; $p_U = 4.5\%$, unexposed co-twin) and of the twin-pair tetrachoric correlation ($r = 0.47$). We then estimated the minimum $OR = p_E(1 - p_E)/p_U(1 - p_U)$, such that a difference between the prevalence in the exposed twin and the unexposed co-twin would be detected with 80% power given a sample of 311 twin pairs at the .01 significance level, with

Table 2. Drug Use Outcomes in Twin Pairs Discordant for Cannabis Use Before Age 17 Years (N = 311 Pairs)

	Lifetime Prevalence			Conditional OR Adjusted for Covariates	
	Early Cannabis Users, No. (%)	Co-twins, No. (%)	Unadjusted Conditional OR (95% CI)	OR (95% CI)	Significant Covariates*
Use					
Sedatives	59 (19.0)	26 (8.[illegible])	2.83 (1.66-4.65)	2.28 (1.20-4.31)	1, 3, 4
Hallucinogens	110 (35.4)	56 (1[illegible])	5.15 (2.85-9.33)	5.15 (2.85-9.33)	
Cocaine/stimulants	149 (47.9)	82 (26.4)	4.19 (2.60-6.75)	4.06 (2.30-7.17)	1, 2, 4
Opioids	42 (13.5)	20 (6.4)	2.57 (1.39-4.77)	2.34 (1.13-4.85)	4
Illicit drug abuse/dependence					
Cannabis	142 (45.7)	99 (31.8)	2.13 (1.45-3.13)	1.96 (1.25-3.09)	1, 2, 5
Sedatives	8 (2.6)	3 (1.0)	2.67 (0.71-10.05)	2.67 (0.71-10.05)	
Cocaine/stimulants	39 (12.5)	14 (4.5)	4.13 (1.91-8.93)	3.98 (1.73-9.17)	3
Opioids	11 (3.5)	3 (1.0)	3.67 (1.02-13.14)	3.67 (1.02-13.14)	
Any illicit drug abuse/dependence	148 (47.6)	102 (32.8)	2.24 (1.52-3.30)	1.98 (1.26-3.10)	1, 2, 5
Alcohol dependence	133 (42.8)	92 (29.6)	2.17 (1.46-3.24)	1.85 (1.21-2.83)	3, 4

Abbreviations: CI, confidence interval; OR, odds ratio.
*For significant covariates, 1 indicates early (before age 17 years) regular use of tobacco; 2, early (before age 17 years) regular use of alcohol; 3, conduct disorder; 4, major depression; and 5, social anxiety. Ellipses indicate that there were no significant covariates for the outcome.

p_i and r fixed at their observed values. Our results indicate that power would be 80% or better for an OR greater than 1.7 for 5 measures (hallucinogen use, cocaine/stimulant use, cannabis abuse/dependence, any abuse or dependence, and alcohol dependence). Power was over 80% for an OR greater than 2.5 for the measures sedative use, opioid use, and cocaine/stimulant abuse or dependence. Power was low under the reasonable range of OR for the measures sedative abuse/dependence and opioid abuse/dependence.

RESULTS

Rates of concordance for early cannabis use (before age 17 years) among the full interview sample (2765 pairs; see Figure) were significantly higher in monozygotic than dizygotic twin pairs for both men (65 concordant and 88 discordant monozygotic pairs vs 59 concordant and 110 discordant dizygotic pairs; $\chi^2_1 = 7.92$, $P = .005$) and women (61 concordant and 98 discordant monozygotic pairs vs 44 concordant and 111 discordant dizygotic pairs; $\chi^2_1 = 7.80$, $P = .005$), indicating heritable influences on age of initiation of cannabis use. The first 2 columns of TABLE 2 show estimates of the lifetime prevalence of drug use and drug abuse/dependence for those initiating cannabis use before age 17 years and for their co-twins (who either reported no lifetime cannabis use or who reported initiating cannabis use at age 17 years or older). The majority of subjects reporting both cannabis and other illicit drug use reported initiating cannabis use before initiating the use of other drugs. Three individuals reported initiating sedative use before cannabis use, 6 individuals initiated hallucinogen use, 5 initiated stimulant use, and 3 initiated opioid use before the use of cannabis. These individuals were excluded from the analyses. Table 2 also shows the conditional ORs, both unadjusted and adjusted for major risk factors, for the drug use outcomes. The results in Table 2 can be summarized as follows.

1. Relative to their co-twins who had not used cannabis by age 17 years, those who had used cannabis by this age had elevated lifetime rates of other drug use, illicit drug abuse/dependence, and alcohol dependence.

2. The unadjusted conditional ORs indicated that in individuals who initiated cannabis use before age 17 years, the odds of other drug use, alcohol dependence, and other drug abuse/dependence were 2.1 to 5.2 times higher than in their co-twins who did not report early cannabis use. In all but 1 comparison (sedative abuse/dependence), these associations were statistically significant.

3. Controlling for known risk factors for later drug use and drug abuse/dependence had only negligible effects. Specifically, after such adjustment, relative to their discordant co-twins, those who had used cannabis before age 17 years had significantly elevated rates of 9 of the 10 outcomes. The nonsignificant association between early cannabis use and sedative abuse/dependence is likely to be a reflection of reduced statistical power due to the low base rate of this outcome.

The final column of Table 2 shows the significant or marginally significant ($P < .10$) predictors of each outcome. While covariates differed between equations, early regular use of tobacco and alcohol emerged as the 2 factors most consistently associated with later illicit drug use and abuse/dependence. While early regular alcohol use did not emerge as a significant independent predictor of alcohol dependence, this finding should be treated with considerable caution, as our study did not provide an optimal strategy for assessing the effects of early alcohol use.

Analyses Restricted to Those Reporting Lifetime Cannabis Use

Our analysis found that 24.8% of twins in pairs discordant for early cannabis use in fact reported no lifetime cannabis use. To examine the extent to which the asso-

Table 3. Drug Use Outcomes in Twin Pairs Discordant for Cannabis Use Before Age 17 Years With Sample Restricted to Those Reporting Lifetime Cannabis Use (N = 234 Pairs)

	Lifetime Prevalence			Conditional OR Adjusted for Covariates	
	Early Cannabis Users, No. (%)	Co-twins, No. (%)	Unadjusted Conditional OR (95% CI)	OR (95% CI)	Significant Covariates*
Use					
Sedatives	46 (19.7)	20 (8.5)	3.00 (1.60-5.62)	3.33 (1.53-7.23)	1, 4
Hallucinogens	94 (40.2)	56 (23.9)	3.92 (2.13-7.21)	3.92 (2.13-7.21)	...
Cocaine/stimulants	123 (52.6)	81 (34.6)	3.00 (1.83-4.92)	3.05 (1.75-5.33)	1, 2
Opioids	33 (14.1)	17 (7.3)	2.33 (1.19-4.59)	2.40 (1.05-5.49)	4
Illicit drug abuse/dependence					
Cannabis	121 (51.7)	99 (42.3)	1.58 (1.05-2.37)	1.57 (0.96-2.52)	1, 2, 5
Sedatives	6 (2.6)	1 (0.4)	6.00 (0.72-49.83)	6.00 (0.72-49.83)	...
Cocaine/stimulants	36 (15.4)	13 (5.6)	4.29 (1.88-9.78)	3.79 (1.60-9.01)	3
Opioids	10 (4.3)	2 (0.9)	5.00 (1.10-22.82)	5.00 (1.10-22.82)	...
Any illicit drug abuse/dependence	127 (54.3)	100 (42.7)	1.75 (1.16-2.64)	1.76 (1.08-2.84)	1, 2, 5
Alcohol dependence	109 (46.6)	79 (33.8)	2.03 (1.30-3.17)	1.85 (1.21-2.83)	3, 4

Abbreviations: CI, confidence interval; OR, odds ratio.
*For significant covariates, 1 indicates early (before age 17 years) regular use of tobacco; 2, early (before age 17 years) regular use of alcohol; 3, conduct disorder; 4, major depression; and 5, social anxiety. Ellipses indicate that there were no significant covariates for the outcome.

ciations in Table 2 may have been related to risks associated with *any* cannabis use rather than *early* cannabis use, these analyses were replicated with the sample restricted to those who reported lifetime cannabis use (54 monozygotic female pairs, 53 monozygotic male pairs, 56 dizygotic female pairs, 71 dizygotic male pairs). The results of these analyses, shown in TABLE 3, were broadly consistent with the previous results. In particular, before adjustment for covariates, early use remained a significant predictor of all but 1 of the outcomes (sedative abuse/dependence) among twin pairs concordant for lifetime cannabis use but where 1 twin reported initiation of cannabis use before age 17 years and the other did not. After statistical control for measured risk factors, early use was not a significant predictor of sedative abuse/dependence, and there was only a marginally significant association ($P = .06$) between early initiation of cannabis use and subsequent abuse/dependence on cannabis.

Subsidiary Analyses

Separate analyses of monozygotic- and dizygotic-discordant pairs were conducted in which early cannabis use was defined as use before age 15 years, before age 16 years, and before age 18 years. The results of these analyses confirmed the previous conclusions. For all definitions of early cannabis use, individuals who initiated cannabis use at an early age had elevated odds of later drug use and abuse/dependence relative to their discordant co-twin.

COMMENT

The results of our co-twin control analyses indicated that early initiation of cannabis use was associated with significantly increased risks for other drug use and abuse/dependence and were consistent with early cannabis use having a causal role as a risk factor for other drug use and for any drug abuse or dependence. Individuals who used cannabis before age 17 years had a 2.3- to 3.9-fold increase in odds of other drug use and a 1.6- to 6.0-fold increase in odds of alcohol dependence and other drug abuse/dependence, relative to their co-twin who had not used cannabis by age 17 years, regardless of whether or not the pair were monozygotic. Alternatively, there may be unmeasured environmental influences not shared by members of a twin pair that increase risks both of early cannabis use and of other drug use or abuse/dependence. We consider this less plausible, since twin pairs, having been reared in the same household, would be expected to be highly concordant for environmental experiences. Unmeasured family background risk factors or heritable risk factors cannot explain the observed association, since twin pairs will share the same family background, and monozygotic pairs the same genetic risk factors.

Potential limitations of this study include the reliance on self-report and retrospective data, and the lack of data about ages at progression to more frequent use or onset of problems. Age of first use was obtained earlier in our interview than the assessment of drug use problems to minimize recall biases, and the associations with early cannabis use that we observed in this twin pair sample have previously been reported in prospective studies.[15-18] An association due to underreporting of drug use by 1 twin seems implausible, since cannabis use, even by self-report, was highly prevalent and some use at least would be considered normative for this birth cohort in Australia, and since significant associations remained when analyses were limited to pairs concordant for lifetime cannabis use. It is also unlikely that we are observing only delayed onset of other drug use or drug abuse/dependence, rather than lower lifetime rates in the co-twins, since the median age of the sample (30 years) is considerably higher than typical ages of onset of drug use and drug abuse/

dependence.[11] For example, more than 95% of cannabis users in our total sample reported onset of marijuana use by age 24 years, the youngest age represented in the sample. Our estimates of the lifetime use of cannabis and other drugs are high but are consistent with those reported by other large-scale epidemiological surveys of drug use in Australia. Further, a recent study of cannabis use in a US national twin sample concluded that twin studies of substance use are unlikely to be biased and that findings from such studies can be generalized to other (nontwin) family relationships. The relative crudeness of our measure of exposure (any use before age 17 years as opposed to frequent, heavy, or problem use) makes the findings of an association even more remarkable.

If the association with early cannabis use is indeed causal, the mechanisms by which this association arises remain unclear. Pharmacological mechanisms might be hypothesized in which it is assumed that exposure to cannabis induces subtle biochemical changes that encourage drug-taking behavior. This hypothesis is supported to some extent by recent findings that Δ^9-tetrahydrocannabinol and heroin have similar effects on dopamine transmission through a common μ_1 opioid receptor mechanism and that chronic treatment with Δ^9-tetrahydrocannabinol induces cross-tolerance to amphetamine and opioids in rats. However, an argument against such biological hypotheses is that the levels of cannabis use at the beginning of drug-using careers are substantially lower than the equivalents used in laboratory-based research and perhaps too low to induce long-term biochemical changes.

Other mechanisms that might mediate a causal association between early cannabis use and subsequent drug use and drug abuse/dependence include the following:

1. Initial experiences with cannabis, which are frequently rated as pleasurable, may encourage continued use of cannabis and also broader experimentation.

2. Seemingly safe early experiences with cannabis may reduce the perceived risk of, and therefore barriers to, the use of other drugs. For example, as the vast majority of those who use cannabis do not experience any legal consequences of their use, such use may act to diminish the strength of legal sanctions against the use of all drugs.

3. Alternatively, experience with and subsequent access to cannabis use may provide individuals with access to other drugs as they come into contact with drug dealers. This argument provided a strong impetus for the Netherlands to effectively decriminalize cannabis use in an attempt to separate cannabis from the hard drug market. This strategy may have been partially successful as rates of cocaine use among those who have used cannabis are lower in the Netherlands than in the United States.

While the findings of this study indicate that early cannabis use is associated with increased risks of progression to other illicit drug use and drug abuse/dependence, it is not possible to draw strong causal conclusions solely on the basis of the associations shown in this study. Further research in other cultures and using a range of innovative research designs (including evaluation of prevention efforts aimed at delaying the onset of cannabis use) is needed to explore whether there is a causal link between early cannabis use and progression to other drug use and, if so, to elucidate the mechanisms that may underlie any such causal association.

Regardless of the mechanisms underlying these associations, it is apparent that young people who initiate cannabis use at an early age are at heightened risk for progressing to other drug use and drug abuse/dependence. In addition to cannabis dependence, the health risks associated with chronic cannabis use may include chronic bronchitis, impaired lung function, and increased risks of cancers of the aerodigestive tract. Given historical increases in the use of cannabis and other drugs, it is probable that more individuals will experience these adverse consequences and there will be an increasing need to develop strategies both to prevent and to ameliorate the adverse consequences of chronic drug use. Given that early initiation of use may be associated with increased risks both for progressing to the use of other drugs and for developing drug abuse/dependence, there is a need for greater physician awareness of those risks associated with early use. There is also a need to develop focused interventions to prevent escalation to use of other drugs among young people identified as being at risk due to their early initiation of cannabis use.

Author Contributions: *Study concept and design:* Heath, Martin.
Acquisition of data: Heath, Bucholz, Slutske, Madden, Statham, Martin.
Analysis and interpretation of data: Lynskey, Heath, Nelson, Slutske.
Drafting of the manuscript: Lynskey, Heath.
Critical revision of the manuscript for important intellectual content: Bucholz, Slutske, Madden, Nelson, Statham, Martin.
Statistical expertise: Lynskey, Heath, Martin.
Obtained funding: Heath, Martin.
Administrative, technical, or material support: Heath, Slutske, Statham, Martin.
Study supervision: Heath, Madden.

Funding/Support: This work was supported by National Institutes of Health grants AA07728, AA09022, AA10249, AA11998 (Dr Heath), AA 12640, DA 14363, DA 14632 (Dr Bucholz), DA00272, DA12854 (Dr Madden), and AA00277 (Dr Nelson), as well as grants 951023 and 981351 from the National Health and Medical Research Council (Dr Martin).
Acknowledgment: We thank the Australian Twin Registry and the twins themselves for participating in this research.

REFERENCES

1. Bachman JG, Johnston LD, O'Malley PM. Explaining recent increases in students' marijuana use: impacts of perceived risks and disapproval, 1976 through 1996. *Am J Public Health*. 1998;88:887-892.
2. Reid A, Lynskey MT, Copeland J. Cannabis use among Australian youth. *Aust N Z J Public Health*. 2000;24:596-602.
3. Substance Abuse and Mental Health Services Administration. The DASIS Report: Marijuana treatment admissions increase: 1993-1999. Available at: http://www.samhsa.gov/oas/2k2/MJtx.pdf. Accessed May 17, 2002.
4. Hall W, Solowij N. Adverse effects of cannabis. *Lancet*. 1998;352:1611-1616.
5. Solowij N, Stephens RS, Roffman RA, et al. Cognitive functioning of long-term heavy cannabis users seeking treatment. *JAMA*. 2002;287:1123-1131.
6. McLellan AT, Lewis DC, O'Brien CP, Kleber HD. Drug dependence, a chronic medical illness: implications for treatment, insurance, and outcomes evaluation. *JAMA*. 2000;284:1689-1695.
7. Substance Abuse and Mental Health Services Administration. The DASIS Report: Treatment referral sources for adolescent marijuana users. Available at: http://www.samhsa.gov/oas/2k2/YouthMJtx/YouthMJtx.pdf. Accessed May 17, 2002.
8. Kandel DB. Stages in adolescent involvement in drug use. *Science*. 1975;190:912-914.

9. Kandel DB, Faust R. Sequences and stages in patterns of adolescent drug use. *Arch Gen Psychiatry*. 1975;32:923-932.

10. Kandel DB, Yamaguchi K, Chen K. Stages of progression in drug involvement from adolescence to adulthood: further evidence for the gateway theory. *J Stud Alcohol*. 1992;53:447-457.

11. MacCoun R. In what sense (if any) is marijuana a gateway drug? FAS Drug Policy Analysis Bulletin. 1998; issue 4. Available at: http://www.fas.org/drugs/issue4.htm#gateway. Accessed May 17, 2002.

12. Ellickson PL, Hays RD, Bell RM. Stepping through the drug use sequence: longitudinal scalogram analysis of initiation and regular use. *J Abnorm Psychol*. 1992;101:441-451.

13. Graham JW, Collins LM, Wugalter SE, Chung NK, Hansen WB. Modeling transitions in latent stage-sequential processes: a substance use prevention example. *J Consult Clin Psychol*. 1991;59:48-57.

14. Baumrind D. Specious causal attribution in the social sciences: the reformulated steeping stone hypothesis as exemplar. *J Pers Soc Psychol*. 1983;45:1289-1298.

15. Yamaguchi K, Kandel DB. Patterns of drug use from adolescence to young adulthood: III: predictors of progression. *Am J Public Health*. 1984;74:673-681.

16. Fergusson DM, Horwood LJ. Early onset cannabis use and psychosocial adjustment in young adults. *Addiction*. 1997;92:279-296.

17. Fergusson DM, Horwood LJ. Does cannabis use encourage other forms of illicit drug use? *Addiction*. 2000;95:505-520.

18. Grant BF, Dawson DA. Age of onset of drug use and its association with DSM-IV drug abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *J Subst Abuse*. 1998;10:163-173.

19. Kosterman R, Hawkins JD, Guo J, Catalano RF, Abbott RD. The dynamics of alcohol and marijuana initiation: patterns and predictors of first use in adolescence. *Am J Public Health*. 2000;90:360-366.

20. Lynskey MT, Heath AC, Nelson EC, et al. Genetic and environmental contributions to cannabis dependence in a national young adult twin sample. *Psychol Med*. 2002;32:195-207.

21. Kendler KS, Karkowski LM, Neale MC, Prescott CA. Illicit psychoactive substance use, heavy use, abuse, and dependence in a US population-based sample of male twins. *Arch Gen Psychiatry*. 2000;57:261-269.

22. Tsuang MT, Lyons MJ, Meyer JM, et al. Co-occurrence of abuse of different drugs in men: the role of drug-specific and shared vulnerabilities. *Arch Gen Psychiatry*. 1998;55:967-972.

23. Nelson EC, Heath AC, Madden PAF, et al. The consequences and correlates of childhood sexual abuse—a retrospective examination using the twin study design. *Arch Gen Psychiatry*. 2002;59:139-145.

24. Heath AC, Howells W, Kirk KM, et al. Predictors of non-response to a questionnaire survey of a volunteer twin panel: findings from the Australian 1989 twin cohort. *Twin Res*. 2001;4:73-80.

25. Cederlof R, Friberg L, Jonsson E, Kaij L. Studies on similarity diagnosis in twins with the aid of a mailed questionnaire. *Acta Genetica et Statistica Medica*. 1961;11:338-362.

26. Kasriel J, Eaves LJ. The zygosity of twins: further evidence on the agreement between diagnosis by blood groups and written questionnaires. *J Biosoc Sci*. 1976;8:263-266.

27. Nichols RC, Bilbro WC Jr. The diagnosis of twin zygosity. *Acta Genet Stat Med*. 1966;16:265-275.

28. Sarna S, Kaprio J, Sistonen P, Koskenvuo M. Diagnosis of twin zygosity by mailed questionnaire. *Hum Hered*. 1978;28:241-254.

29. Bucholz KK, Cloninger CR, Dinwiddie SH, et al. A new, semi-structured psychiatric interview for use in genetic linkage studies: a report of the reliability of the SSAGA. *J Stud Alcohol*. 1994;55:149-158.

30. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*. Washington, DC: American Psychiatric Association; 1994.

31. SAS Institute Inc. *SAS/STAT Software: Changes and Enhancements for Release 6.12*. Cary, NC: SAS Institute Inc; 1996.

32. StataCorp. *Stata Statistical Software: Release 6.0*. College Station, Tex: Stata Corp; 1999.

33. Chen K, Kandel DB. The natural history of drug use from adolescence to the mid thirties in a general population sample. *Am J Public Health*. 1995;85:41-47.

34. Australian Institute of Health and Welfare. *1998 National Drug Strategy Household Survey: First Results*. Canberra: Australian Institute of Health and Welfare; 1999.

35. Kendler KS, Neale MC, Thornton LM, Aggen SH, Gilman SE, Kessler RC. Cannabis use in the last year in a US national sample of twin and sibling pairs. *Psychol Med*. 2002;32:551-554.

36. Nahas G. *Keep Off the Grass*. Middlebury, Vt: Paul Eriksson; 1990.

37. Tanda G, Pontieri F, Di Chiara G. Cannabinoid and heroin activation of mesolimbic dopamine transmission by a common mu 1 opioid receptor mechanism. *Science*. 1997;276:2048-2050.

38. Lamarque S, Taghzouti K, Simon H. Chronic treatment with Δ^9-tetrahydrocannabinol enhances the locomotor response to amphetamine and heroin: implications for vulnerability to drug addiction. *Neuropharmacology*. 2001;41:118-129.

39. Cadoni C, Pisanu A, Solinas M, Acquas E, Di Chiara G. Behavioural sensitization after repeated exposure to Δ^9-tetrahydrocannabinol and cross-sensitization with morphine. *Psychopharmacology*. 2001;158:259-266.

40. Fergusson DM, Lynskey MT, Horwood LJ. Patterns of cannabis use among 13-14 year old New Zealanders. *N Z Med J*. 1993;106:247-250.

41. Cohen H. Multiple drug use considered in the light of the stepping-stone hypothesis. *Int J Addict*. 1972;7:27-55.

42. MacCoun R, Reuter P. Evaluating alternative cannabis regimes. *Br J Psychiatry*. 2001;178:123-128.

A new self-report survey documents the deviant and delinquent behaviors of U.S. youth ages 12–16

A new survey will follow a cohort of youth as they make the transition from school to work

The first wave of the 1997 National Longitudinal Survey of Youth (NLSY97) interviewed a nationally representative sample of 9,000 youth who were between the ages of 12 and 16 at year-end 1996. The survey asked youth to report whether they had engaged in a variety of deviant and delinquent behaviors. Plans are to interview members of this cohort every 2 years to track changes in delinquent and criminal activity over the life course.

Youth who had ever used or sold drugs were more likely to engage in other problem behavior

One of the strengths of the survey is its ability to assess which delinquent behaviors cluster together. Members of the NLSY97 cohort were asked a variety of questions regarding drugs, guns, and gangs, including whether and how recently they had engaged in these activities. Analysis of these items demonstrates the connection between drug use or sale and other problem behaviors, such as carrying handguns, belonging to a gang, and consuming alcohol.

The proportion of youth engaging in deviant and delinquent behaviors varied significantly by age, sex, and race/ethnicity

Behavior	Total	Ages 12–13	Ages 14–15	Age 16	Male	Female	White	Nonwhite	Rural	Urban
Had sex										
Ever	29%	—	23%	43%	30%	28%	26%	37%	29%	30%
Last 12 months	21	—	16	32	22	21	19	27	21	22
Became pregnant										
Ever	6	—	4	10	—	6	5	9	5	7
Smoked cigarettes										
Ever	42	27	48	58	42	42	45	34	43	41
Last 30 days	20	10	23	33	20	20	22	14	21	19
Drank alcohol										
Ever	39	26	52	68	46	44	48	26	45	45
Last 30 days	21	8	25	37	21	21	23	16	20	21
Before or during school or work in the last 30 days	5	2	6	9	6	4	5	5	5	5
Used marijuana										
Ever	21	8	25	38	22	20	22	19	19	22
Last 30 days	9	4	11	17	10	9	10	8	8	10
Before or during school or work in the last 30 days	4	1	5	7	4	3	4	3	4	4
Ran away from home										
Ever	11	6	12	17	10	11	10	11	10	12
Carried a handgun										
Ever	10	8	11	12	16	3	10	9	11	9
Last 12 months	6	4	6	7	9	2	6	5	6	5
Last 30 days	3	2	3	3	5	1	3	3	3	3
To school in last 30 days	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Belonged to a gang										
Ever	5	3	6	6	6	3	4	7	5	5
Last 12 months	2	2	2	3	3	1	2	3	2	2
Purposely destroyed property										
Ever	28	25	31	30	37	20	30	25	29	28
Last 12 months	16	14	17	15	20	11	16	14	15	16
Stole something worth over $50*										
Ever	8	4	10	11	10	5	7	9	7	9
Last 12 months	5	3	6	7	7	3	5	6	4	6

- Youth who had ever used marijuana were more likely to have sold marijuana (24% vs. <1%), carried a handgun (21% vs. 7%), or been in a gang (14% vs. 2%) at some point than youth who never used marijuana.
- Youth who had ever sold marijuana were more likely to have sold hard drugs (i.e., cocaine, LSD, or heroin) (40% vs. 1%), carried a handgun (35% vs. 8%), or been in a gang (24% vs. 4%) than youth who never sold marijuana.
- Active marijuana users (i.e., youth who used marijuana during the month prior to the survey) were more likely to have consumed alcohol (78% vs. 14%) or carried a handgun (12% vs. 2%) during that period than youth who did not use marijuana.
- Youth who had carried a handgun in the last 12 months were also more likely to have been in a gang than youth who did not carry a handgun during this period (15% vs. 1%).

Behavior	Total	Ages 12–13	Ages 14–15	Age 16	Male	Female	White	Nonwhite	Rural	Urban
Stole a vehicle for use or sale										
Ever	1%	< 0.5%	2%	2%	2%	1%	1%	1%	1%	1%
Sold any drugs										
Ever	7	2	9	12	9	5	8	5	7	7
Last 12 months	5	2	7	9	7	4	6	4	5	6
Sold hard drugs (e.g., cocaine, LSD, or heroin)										
Ever	3	1	3	6	3	2	3	3	3	3
Sold marijuana										
Ever	5	2	7	10	7	4	6	4	5	6
Committed assault										
Ever	18	15	19	22	23	12	16	21	17	18
Last 12 months	12	10	13	13	16	8	11	14	12	12
Was arrested										
Ever	8	4	10	12	10	5	7	9	6	9
Number of times										
Once	5	2	6	7	6	3	4	5	4	5
2 or more	3	1	4	5	4	2	3	4	2	4

- Of all youth, 3% had carried a handgun in the month prior to the interview, and fewer than 1 in 200 had carried a handgun to school during that time.
- With a few exceptions, urban and rural youth reported participation in problem behaviors in equal proportions; however, urban youth were significantly more likely than rural youth to have run away from home (12% vs. 10%), ever used marijuana (22% vs. 19%), or ever been arrested (9% vs. 6%).
- Of all youth, 9% used marijuana in the last 30 days, and less than 4% used marijuana before or during school or work hours during this time. Similarly, 21% of all youth drank alcohol in the last 30 days, and 5% drank alcohol before or during school or work hours during this time.
- The proportion of youth who had ever used marijuana increased dramatically with age, from 8% of youth ages 12 and 13 to 25% of youth ages 14 and 15. The proportion of youth ages 14 and 15 who had ever used alcohol (52%) was double that of youth ages 12 and 13 (26%).

Note: Only youth 14 and older were asked about their sexual activity and pregnancy. Only females were asked about pregnancy.

* Includes stealing a vehicle for use or sale.

Source: Authors' analysis of the Bureau of Labor Statistics' *The National Longitudinal Survey of Youth 1997* [machine-readable data file].

National Household Survey on Drug Abuse

The NHSDA Report

July 19, 2002

Marijuana Use among Youths

The National Household Survey on Drug Abuse (NHSDA) asks respondents to report on past year use and age at first use of marijuana. Respondents aged 12 to 17 were also asked to report whether they had been enrolled in any type of school at any time during the year before the survey. Youths enrolled in school were asked to report their average letter grade for the last semester or grading period they completed.

In Brief

- In 2000, over 3 million youths aged 12 to 17 used marijuana at least once during the past year
- White youths were more likely to use marijuana than Hispanic, black, or Asian youths
- Youths with an average grade of D or below were more than 4 times as likely to have used marijuana in the past year as youths who reported an average grade of A

Prevalence of Marijuana Use among Youths

In 2000, the NHSDA estimated that over 3 million, or 13 percent, of the 23 million youths aged 12 to 17 used marijuana during the year prior to the survey. The rate of past year marijuana use was lower for youths compared with the rate for young adults aged 18 to 25 (24 percent), but it was higher than the rate for adults aged 26 or older (5 percent).

Trends in Initiation of Marijuana Use among Youths

Between 1996 and 1999, the number of youths aged 12 to 17 trying marijuana for the first time each year was greater than during the prior 20 years (Figure 1). Approximately 1,690,000 youths first used marijuana during 1996, more than during any other year since 1978. However, the number of youths trying marijuana for the first time decreased to 1,392,000 by 1999.

The NHSDA Report is published periodically by the Office of Applied Studies, Substance Abuse and Mental Health Services Administration (SAMHSA). All material appearing in this report is in the public domain and may be reproduced or copied without permission from SAMHSA. Additional copies of this report may be downloaded from http://www.samhsa.gov/oas/nhsda.htm. Citation of the source is appreciated. Other reports from the Office of Applied Studies are also available on-line: http://www.DrugAbuseStatistics.samhsa.gov/.

Figure 1. Estimated Numbers of Youths Aged 12 to 17 Who First Used Marijuana During the Years 1965 to 1999

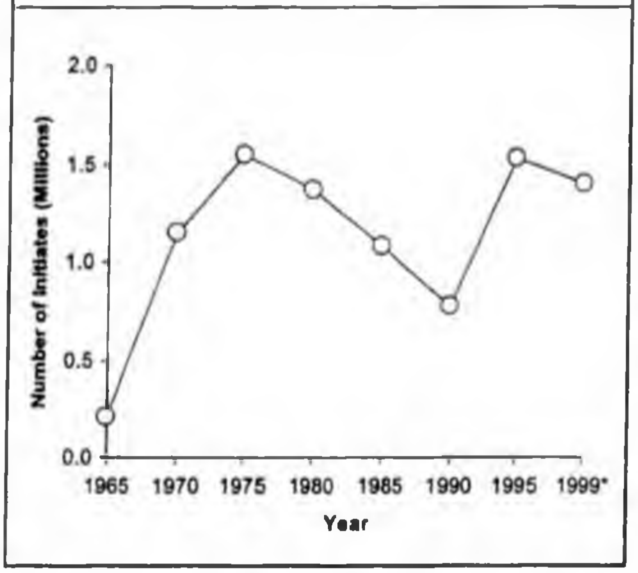
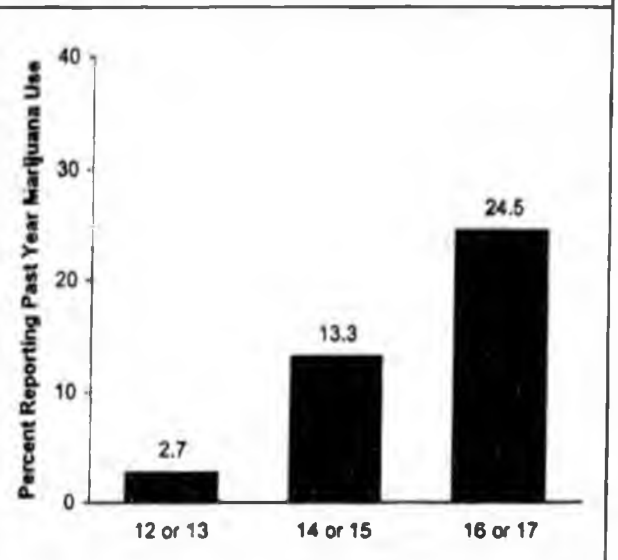


Figure 2. Percentages of Youths Aged 12 to 17 Reporting Past Year Marijuana Use, by Age Group: 2000



Demographic Differences in Prevalence

Older youths were more likely to have used marijuana during the past year than younger youths (Figure 2). Almost 25 percent of youths aged 16 or 17 reported past year marijuana use compared with 3 percent of 12 or 13 year olds. White youths were more likely to have used marijuana during the past year (15 percent) than Hispanic (13 percent), black (9 percent), or Asian youths (6 percent) (Figure 3).

Although males were more likely than females to have used marijuana during the past year among adults aged 18 or older, there were no gender differences in past year marijuana use among youths. For example, among 18 to 25 year olds, males were more likely to have used marijuana during the past year than females (28 percent of males vs. 20 percent of females), but among youths, rates of past year marijuana use were similar (14 percent of males, 13 percent of females).

Youths living in the South (12 percent) were less likely than youths living in the Northeast (14 percent) and West (15 percent) to report past year marijuana use (Figure 4).[1] Youths living in small metropolitan areas were more likely to have used marijuana during the past year (14 percent) than youths living in large metropolitan (13 percent) or nonmetropolitan areas (13 percent).[2]

Academic Performance and Marijuana Use among Youths

In 2000, almost 30 percent of youths aged 12 to 17 enrolled in school earned an A average during the last semester or grading period they completed, 41 percent earned a B average, 23 percent earned a C average, and 7 percent earned an average of D or below.[3] Prior research has associated poor grades with substance use among youths.[4,5] Rates of past year marijuana use were higher among youths with lower grades than among those with higher grades (Figure 5). For example, youths with an average grade of D or below were more than 4 times as likely to have used marijuana in the past year (33 percent) as youths who reported an average grade of A (7 percent).

End Notes

1. Regions include the following groups of States: **Northeast Region:** Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania. **Midwest Region:** Wisconsin, Illinois, Michigan, Indiana, Ohio, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri. **South Region:** West Virginia, Virginia, Maryland, Delaware, District of Columbia, North Carolina, South Carolina, Georgia, Florida, Mississippi, Tennessee, Kentucky, Alabama, Texas, Oklahoma, Arkansas, Louisiana. **West Region:** Idaho, Nevada, Arizona, New Mexico, Utah, Colorado, Wyoming, Montana, California, Oregon, Washington, Hawaii, Alaska.
2. Large metropolitan areas have a population of 1 million or more. Small metropolitan areas have a population of less than 1 million. Nonmetropolitan areas are outside of metropolitan statistical areas (MSAs), as defined by the Office of Management and Budget.
3. Approximately 69 percent of surveyed youths aged 12 to 17 were included in these analyses. The remaining 31 percent of youths either attended schools that did not give letter grades, left the question blank, did not attend school, or were not asked about letter grades. Unpub-

Figure 3. Percentages of Youths Aged 12 to 17 Reporting Past Year Marijuana Use, by Race/Ethnicity: 2000**

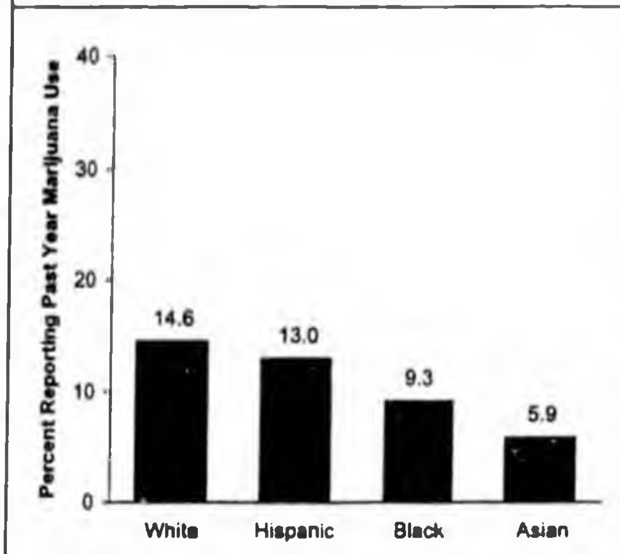
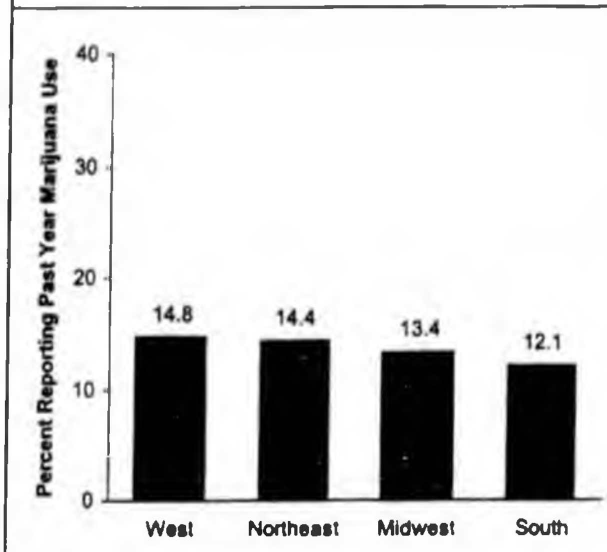


Figure 4. Percentages of Youths Aged 12 to 17 Reporting Past Year Marijuana Use, by Geographic Region: 2000



The National Household Survey on Drug Abuse (NHSDA) is an annual survey sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA). The 2000 data are based on information obtained from nearly 72,000 persons aged 12 or older, including more than 25,000 youths aged 12 to 17. The survey collects data by administering questionnaires to a representative sample of the population through face-to-face interviews at their place of residence.

The NHSDA Report is prepared by the Office of Applied Studies (OAS), SAMHSA, and by RTI in Research Triangle Park, North Carolina. Information and data for this issue are based on the following publication and statistics:

Substance Abuse and Mental Health Services Administration. (2001). *Summary of findings from the 2000 National Household Survey on Drug Abuse* (NHSDA Series: H-13, DHHS Publication No. SMA 01-3549). Rockville, MD: Author.

Also available on-line: www.DrugAbuseStatistics.samhsa.gov.

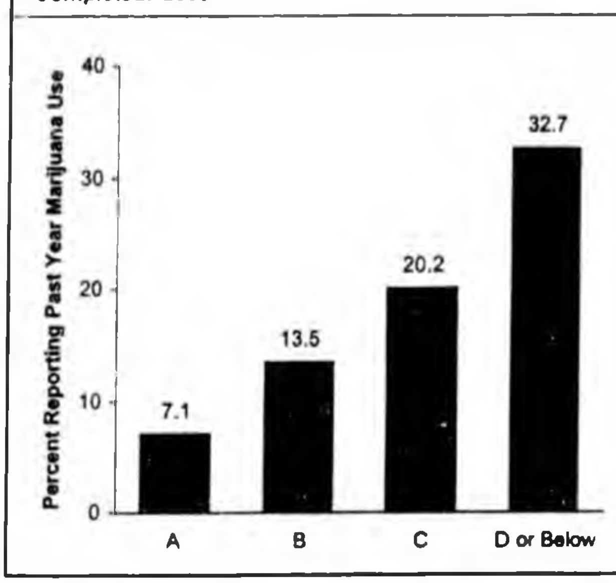
Additional Tables 1.2A, 1.2B, 1.3B, 1.4B, 1.5B, 1.6B, 1.7B, 1.32B, 1.77B, 1.78B, and 1.79B from http://www.samhsa.gov/oas/nhsda/2kdetailedtabs/Vol_1_Part_1/V1P1.htm and

Table 4.1A from http://www.samhsa.gov/oas/nhsda/2kdetailedtabs/Vol_1_Part_3/V1P3a.htm.

Additional tables available upon request.

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Substance Abuse & Mental Health Services Administration
Office of Applied Studies
www.samhsa.gov

Figure 5. Percentages of Youths Aged 12 to 17 Enrolled in School Reporting Past Year Marijuana Use, by Average Grades for the Last Semester or Grading Period Completed: 2000



lished analyses of 1999 NHSDA data using revised sample weights specific to youths who were asked about letter grades indicated that any differences in demographics between those who were asked about grades and the full sample did not have a marked effect on the distribution of letter grades or on the association between letter grades and past year marijuana use.

4. Hawkins, J.D., Catalano, R.F., & Miller, J.Y. (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin, 112*, 64-105.

5. Lane, J., Gerstein, D., Huang, L., & Wright, D. (2001). *Risk and protective factors for adolescent drug use: Findings from the 1997 National Household Survey on Drug Abuse* (Analytic Series: A-12, DHHS Publication No. SMA 01-3499). Rockville, MD: Substance Abuse and Mental Health Services Administration.

Figure Notes

*Estimated using 2000 data only.

**American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander, and multiracial youths are not included in these analyses.

Source (Figure 1): SAMHSA 1999 and 2000 NHSDAs.

Source (Figures 2–5): SAMHSA 2000 NHSDA.

CME

Dose-related neurocognitive effects of marijuana use

K.I. Bolla, PhD; K. Brown, MPH; D. Eldreth, BA; K. Tate, BA; and J.L. Cadet, MD

Abstract—*Background:* Although about 7 million people in the US population use marijuana at least weekly, there is a paucity of scientific data on persistent neurocognitive effects of marijuana use. *Objective:* To determine if neurocognitive deficits persist in 28-day abstinent heavy marijuana users and if these deficits are dose-related to the number of marijuana joints smoked per week. *Methods:* A battery of neurocognitive tests was given to 28-day abstinent heavy marijuana abusers. *Results:* As joints smoked per week increased, performance decreased on tests measuring memory, executive functioning, psychomotor speed, and manual dexterity. When dividing the group into light, middle, and heavy user groups, the heavy group performed significantly below the light group on 5 of 35 measures and the size of the effect ranged from 3.00 to 4.20 SD units. Duration of use had little effect on neurocognitive performance. *Conclusions:* Very heavy use of marijuana is associated with persistent decrements in neurocognitive performance even after 28 days of abstinence. It is unclear if these decrements will resolve with continued abstinence or become progressively worse with continued heavy marijuana use.

NEUROLOGY 2002;59:1337–1343

Marijuana is the most widely used illicit drug in the United States and the western hemisphere. In 2000, an estimated 76% of America's 14.8 million illicit drug users used marijuana alone (59%) or in conjunction with other illicit drugs (17%).[1] About 7 million people in the US population use marijuana at least weekly.[1] Because of debate about medicinal uses and legalization of marijuana, knowing whether marijuana has persistent effects on the brain is of interest.

Studies of residual cognitive effects of marijuana following a brief period of abstinence show that heavy marijuana use is associated with deficits in executive cognitive functioning, sustained attention, and memory.[2-5] These studies have some methodologic limitations. First, marijuana users were only monitored for abstinence for 17 to 72 hours before testing. Because marijuana has an apparent half-life of 4.1 ± 1.1 days,[6] it is difficult to determine if the these observations[2-5] were due to drug residues in the body or to withdrawal symptoms such as anxiety or irritability.[7] Second, the quantification of heavy versus light users may be problematic. Marijuana users have been grouped by frequency of use[2] and duration of use.[3,4] When marijuana users are separated by duration of use, it is troublesome to separate the effects of marijuana from differences in age and education (a cohort effect). Third, no structured psychiatric interview was used to exclude disorders like depression,[3] which is associated with poor cognitive performance.[8]

Until 2001, there were no published reports of the residual effects of marijuana use on cognitive functioning after a period of abstinence longer than 12 to 72 hours. In a carefully designed study, marijuana users were grouped by frequency of use and neurocognitive testing was repeated over 28 days of abstinence (0, 1, 7, and 28 days).[9] Decrements in memory for word lists were found at 7 days of abstinence but not after 28 days of abstinence. The authors thus concluded that cognitive deficits are reversible after 7 days of abstinence and are related to recent, not cumulative, cannabis use. Knowledge about the cognitive effects of marijuana could also provide a basis for determining the relative contribution of marijuana when used in combination with other drugs such as methylenedioxymethamphetamine (MDMA).[10,11]

The current study was conducted to determine whether neurocognitive deficits persist in 28-day abstinent heavy marijuana users and if these deficits are dose-related (joints smoked/week). Based on our previous work in cocaine and MDMA users,[12,13] we hypothesized that deficits in cognitive performance would be observed only in the heaviest users of marijuana.

Additional material related to this article can be found on the *Neurology* Web site. Go to www.neurology.org and scroll down the Table of Contents for the November 12 issue to find the title link for this article.

Methods. *Participants.* This protocol was approved by the National Institute on Drug Abuse–Intramural Re-

From the Department of Neurology (Dr. Bolla and D. Eldreth), Johns Hopkins University School of Medicine, Hopkins Bayview Research Campus; and Molecular Neuropsychiatry Section (K. Brown, K. Tate, and Dr. Cadet), NIH/NIDA-IRP, Baltimore, MD.

Supported by the Intramural Research Program of NIDA.

Received May 6, 2002. Accepted in final form July 11, 2002.

Address correspondence and reprint requests to Dr. Karen I. Bolla, Johns Hopkins Bayview Medical Center, Department of Neurology, 4940 Eastern Ave., Baltimore, MD 21224; e-mail: kbolla@jhmi.edu

search Program (NIDA-IRP), the Joint Committee on Clinical Investigation, and the Johns Hopkins Bayview Medical Institutional Review Boards. All participants gave written informed consent and were compensated for their time. Marijuana abusers were recruited using newspaper advertisements. Participant selection was based on drug use history obtained using structured interviews including the Drug Use Survey Questionnaire (DUSQ),[14] the Addiction Severity Index (ASI,)[15] and the Diagnostic Interview Schedule (DIS).[16]

Marijuana group. The marijuana group consisted of nontreatment-seeking individuals claiming marijuana as their drug of choice who used marijuana for at least 2 years, smoked marijuana at least three times per week, reported alcohol consumption of less than 14 alcoholic drinks per week, and had a urine toxicology screen that was positive for cannabis metabolites at the time of admission to the study. This ensured that all participants were abstinent for a uniform period of time. Participants were still eligible for inclusion if dependent on caffeine or tobacco. Participants were excluded if they met the Diagnostic and Statistical Manual of Mental Disorders–IV (DSM-IV) criteria gleaned from the DIS for current or past dependence on any other psychoactive substance other than marijuana, including alcohol, or if their urine toxicology screen was positive for substances other than marijuana and its metabolites. The ASI and DUSQ were used to estimate the number of joints smoked per week and the duration of marijuana use.

Exclusion criteria for all participants. Volunteers were excluded for past or current psychiatric disorder by DSM-IV criteria using the DIS (i.e., anxiety disorder, posttraumatic stress disorder, and major depressive disorder). Volunteers were also excluded for a past or current history of neurologic illness (e.g., head trauma resulting in loss of consciousness, seizure disorder, stroke), an abnormal neurologic examination, or pregnancy.

Data collection. At the initial visit to the Clinical Inpatient Research Unit (CIRU) at NIDA-IRP, all participants had a medical evaluation, a neurologic examination, urine toxicology screen, and pregnancy test for women. Participants were then admitted to the CIRU for approximately 30 days. This allowed us to examine persistent effects of marijuana on the brain, rather than acute effects. Random drug screens were performed during the inpatient stay to ensure abstinence. No treatment or medications were given over the 30-day stay.

Neuropsychological measures. The neurocognitive test battery was administered by a trained psychometrician under the supervision of a neuropsychologist (K.I.B.). The neurocognitive battery consisted of tests that assess a variety of cognitive domains. General intelligence was estimated using the Shipley Institute of Living Scale.[17] The Shipley estimated IQ correlates with the Wechsler Adult Intelligence Scale–Revised (WAIS-R) full-scale IQ (r = 0.79). Measures of IQ are believed to be good estimates of native intellectual abilities (premorbid intelligence) and are resistant to the effects of brain injury. Language skills were assessed using Controlled Oral Verbal Fluency.[18] Verbal memory was assessed by the Logical Memory from the Wechsler Memory Scales–Revised (WMS-R)[19] and the Rey Auditory Verbal Learning Test (RAVLT),[20] whereas visual memory was assessed using the Rey Osterreith Complex Figure[21] and the Symbol Digit Paired Associate Learning Test.[22] Attention and concentration were assessed using the Verbal and Non-Verbal Cancellation Test[23] for both randomly placed letters and symbols. Executive functioning was measured with the Digit Symbol Substitution from the WAIS-R,[24] Trails A, Trails B,[25] Stroop,[26] and the Wisconsin Card Sorting Test (WCST).[27] The Rey Complex Figure (copy), Block Design (WAIS-R),[24] and Judgment of Line Orientation[28] assessed visuoperception/visuoconstruction. The California Computerized Assessment Package (CALCAP)[29] was used to assess both simple and

Table 1 Demographic characteristics of marijuana users by amount used

Characteristic	All, n = 22	Light group, n = 7	Middle group, n = 8	Heavy group, n = 7
Age, y	22.4 ± 4.9 (18–37)	24.6 ± 6.1 (18–37)	21.9 ± 5.3 (18–34)	20.7 ± 2.4 (18–25)
Education, y	11.4 ± 1.5 (8–14)	12.7 ± 0.7* (12–14)	10.9 ± 1.5 (8–12)	10.7 ± 1.5 (8–12)
Shipley IQ	95.9 ± 10.9 (78–115)	101.9 ± 9.9 (86–115)	95.0 ± 11.2 (80–114)	91 ± 10 (78–101)
Sex, M/F	19/3	5/2	7/1	7/0
Ethnicity, W/AA/other	1/18/3	1/5/1	0/6/2	0/7/0
Handedness, R/L	19/3	7/0	6/2	6/1
Marijuana use				
Joints/wk	48.5 ± 36.9 (2–117)	10.5 ± 4 (2–14)	42.1 ± 18.2 (18–70)	93.9 ± 15.4 (78–117)
Days/wk	5.8 ± 1.7	4.4 ± 1.0	5.9 ± 1.9	7.0 ± 0.2
Duration, y	4.8 ± 3.1 (2–15)	3.4 ± 1.6 (2–6)	5.4 ± 4.2 (2–15)	5.3 ± 2.4 (3–10)
Alcohol use				
Days/wk	1.1 ± 1.3 (0–5)	1.0 ± 1.4 (0–3)	0.6 ± 0.7 (0–2)	1.5 ± 1.7 (0–5)
Drinks/wk	3.2 ± 4.2 (0–13)	2.4 ± 4.1 (0–11)	3.1 ± 4.6 (0–13)	4.1 ± 4.3 (0–13)
Duration, y	3.8 ± 6.1 (0–26)	2.3 ± 3.9 (0–10)	2.0 ± 2.1 (0–5)	3.0 ± 2.7 (0–7)

Values are mean ± SD (range).

* $p < 0.05$; Mean difference is between the light and middle and light and heavy groups.

Light group = 2–14 joints/wk; middle group = 18–70 joints/wk; heavy group = 78–117 joints/wk. W = white; AA = African American.

choice reaction times (psychomotor speed). Manual dexterity was assessed using Finger Tapping[29] and Grooved Pegboard.[30] Participants were tested on the 27th or 28th day after admission to the inpatient research unit. This eliminated any acute drug effects and possible confounding effects on neurocognitive performance from the physical or psychological symptoms associated with drug or alcohol withdrawal. All testing was performed in the morning to reduce diurnal fluctuations in performance. The examiner was blind to the intensity and duration of drug use.

Data analyses. Multiple linear regression models were used for data analyses. Neurocognitive variables were log transformed if not normally distributed. Exploratory analyses examined the possible effects of age, education, Shipley IQ, depression score (Center for Epidemiologic Studies–Depression), and sex on the neurocognitive performance measures. An independent variable was retained in the model if associated ($p < 0.05$) with the neurocognitive outcome variable. A separate multiple regression analysis was performed for each of the neurocognitive tests. As with our previous studies that found dose-related effects of cocaine[13] and MDMA[12] on neurocognitive performance predominately at higher doses, it was desirable to establish a dose-related relationship between quantity and duration of marijuana use and possible neurocognitive decrements. Therefore, models included either joints per week, duration of use, or a cross-product of joints per week × duration. A joints per week squared term was also included in the models to test for nonlinear effects that would indicate a threshold effect. We did not examine the association between frequency of use and neurocognitive performance because 82% of our sample smoked marijuana 20 or more days a month. Interaction terms (i.e., Shipley IQ × joints/week) were also examined. All analyses were performed with SPSS statistical software program (Chicago, IL).

Results. Table 1 shows the demographic and drug use characteristics of the marijuana users. When taken as a whole, the entire group consisted of predominantly heavy marijuana users (median joints per week = 35; range 2 to 117). The group was also divided into light, middle, and heavy users by dividing the group using terciles of joints per week smoked (see table 1). Except for years of education, there were no significant differences for any of the subject characteristics listed in table 1 (see also below).

Table 2 summarizes significant dose-related effects on key outcome variables for the regression analyses. The R^2 total reflects the overall proportion of the variance accounted for by the model after the last significant variable was entered in the equation. The results show both linear and nonlinear dose-response effects (i.e., as joints per week increase, neurocognitive performance declines; $p < 0.05$). This was found for tests of verbal memory (RAVLT, delayed recall, $F[1,21] = 7.30$), visual learning and memory (Symbol-Digit Paired Associate Learning, $F[1,21] = 6.57$), executive functioning (WCST categories completed, $F[1,20] = 7.09$), psychomotor speed (simple reaction time [CALCAP], $F[1,21] = 8.32$; complex reaction time–number correct, $F[1,21] = 11.96$), and manual dexterity (Grooved pegboard–nondominant hand, $F[1,21] = 6.55$). A significant dose-related effect in the opposite direction (i.e., as joints per week increased, performance increased) was found for the CALCAP–numbers in sequence, false positive responses ($F[1,21] = 4.87$). Moreover, the models accounted for a moderate to a large amount of variance (19 to 57%) in neurocognitive performance. Duration of use was associated only with a decrease in perfor-

Table 2 Linear regression analyses of outcome variables, demonstrating a significant dose-related effect with marijuana use

Dependent variable	Independent variable*	Exposure variable	p Value	Total R^2
RAVLT—delayed recall		Joints/wk	0.01	0.27
Symbol–digit paired associate learning	Joints/wk^2 × Shipley IQ (p = 0.01)	Joints/wk^2	0.02	0.45
Stroop	Joints/wk × Shipley IQ (p = 0.01)	Joints/wk	0.01	0.45
WCST—categories completed		Joints/wk	0.02	0.28
Rey complex figure—copy		Duration	0.05	0.19
RT—simple		Joints/wk^2	0.01	0.52
RT—repetition of numbers, number correct	Joints/wk^2 × Shipley IQ (p = 0.03)	Joints/wk^2	0.01	0.57
RT—numbers in sequence, false positives†	Shipley IQ (p = 0.01)	Joints/wk	0.04	0.32
Grooved Pegboard—nondominant hand	Joints/wk^2 × Shipley IQ (p = 0.01)	Joints/wk^2	0.02	0.44

* To control for possible confounding effects, these variables were retained in the model if a significant association ($p < 0.05$) was found with performance.

† For this variable, as marijuana use increases, performance improves; for all the other variables, as marijuana use increases, performance declines.

RAVLT = Rey Auditory Verbal Learning Test; WCST = Wisconsin Card Sorting Test; RT = reaction time from the California Computerized Assessment Package.

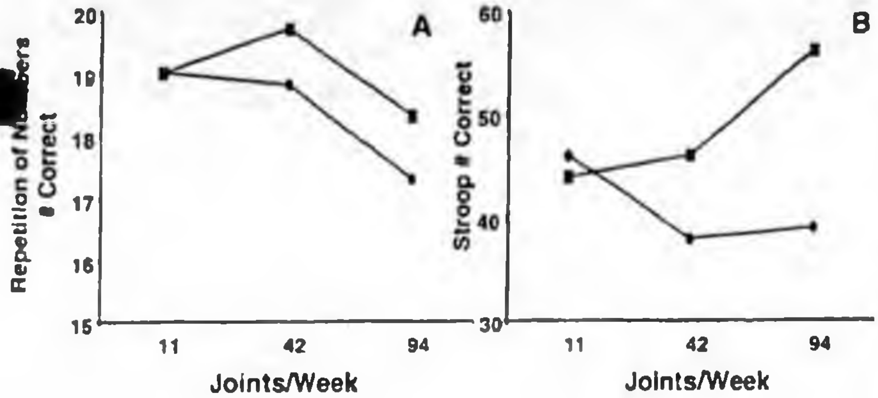


Figure. (A) Relation between amount of marijuana smoked^2 and Repetition of Numbers Task, number correct for the high Shipley IQ group (squares) and the low Shipley IQ group (circles). (B) Relation between amount of marijuana smoked^2 and performance on the Stroop task for the high Shipley IQ group (squares) and the low Shipley IQ group (circles). The lower the IQ score the worse the performance. Both A and B reveal a significant joints per week × Shipley IQ interaction.

mance on one test, a test of visuoperception/visuoconstruction (Rey Osterreith Complex Figure–copy, $F[1,21] = 4.38$). Finally, the combination of amount and duration was not related to performance on any of the tests.

To illustrate differences in neurocognitive performance between the lightest and heaviest marijuana users, the group was divided into three groups based on the amount of marijuana smoked as noted above (see table 1). The light group smoked a mean of 11 ± 4 joints/week (range 2 to 14), the middle group reported smoking a mean of 42 ± 18 joints/week (range 18 to 70), and the heavy marijuana group reported smoking a mean of 94 ± 15 joints/week (range 78 to 117) (see table 1). The groups did not differ significantly on age, Shipley IQ score, number of women and men, duration of marijuana use, and alcohol use (see table 1). However, because the mean Shipley IQ score was different for the light (102), middle (95), and heavy (91) users, we elected to take a conservative approach and analyze the group differences using an analysis of covariance (ANCOVA) with Shipley IQ score as a covariate. The mean performance scores, adjusted for differences in Shipley IQ, are presented in the online supplementary table (available at www.neurology.org). Differences among the three groups were examined with post-hoc t-tests. Comparison of group means shows the heavy users performing worse than the light users on 24/35 (69%) of the neurocognitive performance measurements; this difference was significant on five of the neurocognitive measures. Significant group differences were also found between the light and middle users on four of the tests, and between the middle and heavy users on two of the tests. When the scores of the heavy users were compared to published age-appropriate normative values for each of the tests, scores considered to be clinically relevant (below the ninth percentile for the general population) were found for the WCST–categories completed, Rey Complex Figure (copy and delayed recall), and Finger Tapping (dominant hand).

Interaction effects. There were four significant interactions involving joints/week and Shipley IQ. A Shipley IQ × joints per week interaction was found for the Stroop ($F[1,21] = 10.31$). A Shipley IQ × joints per week^2 interaction was found for Symbol-Digit Paired Associate Learning ($F[1,21] = 8.67$), reaction time repetition of numbers-correct ($F[1,21] = 5.89$), and Grooved Pegboard–nondominant hand ($F[1,21] = 8.25$) (see table 2). In general, individuals with lower Shipley IQ scores (less than 96) showed decreasing cognitive performance with increasing number of joints smoked/week whereas individuals with higher Shipley IQ scores had fewer decrements and better performance with increasing marijuana use. To visualize the joints smoked × Shipley IQ interaction, joints smoked/week was divided into terciles and the mean for each tercile was used for the joints/week × Shipley IQ adjusted plots (figure, A and B). Shipley IQ groups were formed by splitting the group by the median Shipley IQ score of 96.

Discussion. In very heavy marijuana users, persistent, negative dose-related effects are found on tests measuring verbal and visual memory, executive functioning, visuoperception, psychomotor speed, and manual dexterity. This effect was nonlinear for some tests, suggesting a threshold effect. Although we find a dose-related association between joints per week smoked of marijuana and cognitive decline, duration of use is only associated with performance on one test and a combination of joints/week × duration is not associated with performance on any test. In contrast to previous findings,[4] duration is not strongly related to performance. This is probably because our marijuana group has shorter duration of use (4.8 ± 3.1 years, range 2 to 15 years) compared to other samples of marijuana users (7.1 ± 7.9 years, range 2.7 to 31.7 years).[4] Additionally, our findings do not confirm previous reports showing resolution of cognitive effects after 24 days of marijuana abstinence.[9] This discrepancy may be due to our approach to estimating marijuana use (i.e., joints per week) in contrast to those of other investigators (i.e., duration and frequency).[2-5,9] Indeed, joints smoked per week may be a better estimate of total marijuana intake than frequency or duration of use because a marijuana user smoking 10 joints/day for 10 years would probably show greater neurocognitive effects than a marijuana user smoking one joint/day for 10 years.

Heavy marijuana use was associated with lower performance on tests of memory, executive functioning, and manual dexterity. These findings are similar to the findings of others.[2,4] The RAVLT delayed memory test shows a significant association with the amount of marijuana smoked and there is a trend showing that heavy users performed below the light users on all measures of verbal learning and memory. In fact, the magnitude of the difference in mean performance between the heavy and light users is substantial (1.0 to 3.3 SD units). However, because the heavy marijuana group can recognize previously learned material (RAVLT–Recognition), this pattern suggests difficulty with information recall, not problems with acquisition or retention of information. This pattern of memory performance is characteristic of subcortical, prefrontal lobe involvement, and normal aging. Visual learning and memory (Symbol-Digit Paired Associate Learning) are also affected by heavy marijuana use.

There was also an association between increasing marijuana use and decreasing executive cognitive functioning. This is apparent on the WCST and the effect sizes are large (4.1 to 4.2 SD units). Poor performance on the WCST indicates difficulty incorporating feedback to guide and change incorrect response selection. The Stroop test requires suppression of a more habitual response in favor of an atypical one (response inhibition) and involves performance monitoring. Performance on the Stroop is affected by marijuana use but only in individuals with lower cognitive reserves, as illustrated by the significant joints per week × Shipley IQ interaction (see the figure, B). This is consistent with the suggestion that individuals with higher intellectual functions, or cognitive reserve, demonstrate a higher threshold for developing neurocognitive deficits after insults to the brain.[31] This argument is supported by observations that individuals exposed to solvents,[32] aluminum,[33] and MDMA (Ecstasy)[12] show similar interactions. Difficulties with executive functions indicate a prefrontal lobe dysfunction. The prefrontal lobe is suspected to play an important role in substance abuse/addiction and dysfunction of this region may be associated with perpetuation of self-destructive drug using behavior and resistance to treatment.[34]

The heavy marijuana users also showed slower reaction times on a simple reaction time test (CALCAP). However, when presented with more complex reaction time tests, the difference between the heavy and light marijuana users became less pronounced. The reason for this is unclear. In addition, heavier use of marijuana is not associated with less accurate performance except for the Repetition of Numbers task but only for those with lower Shipley IQ (see the figure, A). No dose-related association is found for false positive responses, a measure of impulsivity. Thus, heavy marijuana use appears to be unrelated to decrements in response time, accuracy, or impulsive performance on complex psychomotor speed/reaction time tests. Heavy marijuana use is also associated with lower performance on both manual dexterity measures (Finger Tapping and Grooved Pegboard).

This study has a number of limitations. Despite making multiple comparisons, we used a p value of 0.05 in order to detect small adverse effects of marijuana on neurocognitive functioning. More adverse associations were found than could be accounted for by chance alone. In addition, although our ability to detect more effects might have been limited by the relatively small sample size, significant effects were found on several measures. Moreover, in the regression analyses, the sizes of the effects were moderate to large (R^2 = 0.22 to 0.57). Likewise, the heavy users performed two standard deviations or more below the light users on 8/35 (23%) of the measures; this is not a trivial effect. Furthermore, heavy users showed clinically abnormal scores on four of our test measures. Although we use a different estimate of marijuana use (i.e., joints per week) in general, our findings show decrements on similar tests of neuropsychological functioning.[4] Those decrements are not secondary to concomitant use of other drugs because participants were excluded for a current or past history of significant use of other substances including alcohol. Although the presence of a dose-related response strengthens the ability to make causal inferences, no definitive statements about causality can be made. This can only be determined with a prospective study of controlled marijuana administration, an approach that would be ethically untenable. Finally, because our primary interest is the determination of a dose-related effect of marijuana on neurocognitive function, we did not include a group of nonusers. We agree with others that a comparison between light users and heavy users is less influenced by confounding variables (i.e., background differences) than a comparison between marijuana users and nonusers.[2]

It may be difficult to generalize these findings to all users of marijuana because of our strict selection criteria. For example, comorbid psychiatric disorders (i.e., anxiety disorders, major depression) and heavy alcohol use are common in substance abusers. However, we excluded individuals with these disorders to avoid any possible confounding effects on neurocognitive functioning. Finally, it could be argued that the self-reports of marijuana use are inaccurate. The finding of a biologically plausible dose-response suggests that the estimates of drug use were accurate, although this cannot be proven definitively.

The neurocognitive functions most negatively affected were memory, executive function, and manual dexterity. The hippocampus, prefrontal cortex, and cerebellum play a major role in these functions. All of these regions are dense with cannibinoid receptors,[35] and these results are biologically plausible because tetrahydrocannabinol (THC) has been shown to cause deleterious effects on these brain regions. Our observations in humans are consistent with studies in laboratory animals that find learning and memory impairments after administration of Δ^9-THC.[36] In rats, morphologic changes are found in the CA1 region of the hippocampus with acute administration of a synthetic THC analogue.[37] Damage to the CA1 is also seen after ischemia,[38] toxin exposure,[39] or traumatic brain injury.[40] Therefore, cannabinoids may exert changes in the hippocampus that are similar to those found with other types of brain injury. Changes in CB1 receptors in the hippocampus are also observed in rats after THC administration and are associated with selective deficits in working memory.[41] These animal studies provide strong evidence that hippocampal changes might indeed underlie the memory deficits in the current report.

Following marijuana administration, brain images show lower rCBF in the human motor cortex and superior temporal gyrus and higher rCBF in paralimbic brain regions during a dichotic listening task.[42] The authors suggest that the increases in rCBF may modulate the intoxicating and mood-related effects of marijuana whereas reductions in task-related rCBF in the temporal lobe regions may account for impaired cognition associated with marijuana intoxication. In 26-hour abstinent marijuana abusers, lower rCBF was found during a resting condition in the ventral prefrontal cortex, bilaterally.[43] Thus, when taken together with the evidence of THC-induced hippocampal damage in animals and with the THC-associated neurophysiologic alterations in humans, our current data suggest that THC may exert a significant negative impact on the human brain.

Finally, whereas heavy use of marijuana is associated with decrements in neurocognitive performance, except for a few tests, performance was not clinically abnormal. However, the average age of our group was only 22 years. Given the large extent of the effects, very heavy continuous use of marijuana could produce progressive declines in performance that might reach clinical significance. In fact, because the pattern of performance on the learning and memory tests is consistent with normal age-related declines in the elderly, continued heavy marijuana abuse might result in premature cognitive decline.

Acknowledgment

The authors thank all the nurses and staff at NIDA-IRP who contributed to this project. They especially thank Regina Hess, BA, for editorial assistance with the final manuscript and Warren Better, MA, for database support.

References

1. US Department of Health and Human Services Substance Abuse and Mental Health Services Administration Office of Applied Studies. National household survey on drug abuse. Washington, DC: US Government Printing Office, 1999.
2. Pope HG, Yurgelun-Todd D. The residual cognitive effects of heavy marijuana use in college students. JAMA 1996;275:521–527.
3. Fletcher JM, Page JB, Francis DJ, et al. Cognitive correlates of long-term cannabis use in Costa Rican men. Arch Gen Psychiatry 1996;53:1051–1057.
4. Solowij N, Stephens RS, Roffman RA, et al. Cognitive functioning of long-term heavy cannabis users seeking treatment. JAMA 2002;287:1123–1131.
5. Solowij N. Cannabis and cognitive functioning. Cambridge: Cambridge University Press, 1998.
6. Johansson E, Agurell S, Hollister LE, et al. Prolonged apparent half-life of delta1-tetrahydrocannabinol plasma of chronic marijuana users. J Pharm Pharmacol 1988;40:374–375.
7. Haney M, Ward AS, Comer SD, et al. Abstinence symptoms following smoked marijuana in humans. Psychopharmacology 1999;141:395–404.
8. Austin M-P, Mitchell P, Goodwin GM. Cognitive deficits in depression: possible implications for functional neuropathology. Br J Psychiatry 2001;178:200–206.
9. Pope HG, Gruber AJ, Hudson JI, et al. Neuropsychological performance in long-term cannabis users. Arch Gen Psychiatry 2001;58:909–915.
10. Gouzoulis-Mayfrank E, Daumann J, Tuchtenhagen F, et al. Impaired cognitive performance in drug-free recreational ecstasy (MDMA) users. J Neurol Neurosurg Psychiatry 2000;68:719–725.
11. Croft RJ, Mackay AJ, Milles ATD, et al. The relative contributions of ecstasy and cannabis to cognitive impairment. Psychopharmacology 2001;153:373–379.
12. Bolla KI, McCann RG. Memory impairment in abstinent MDMA ("ecstasy") users. Neurology 1998;51:1532–1537.
13. Bolla KI, Rothman RB, Cadet J-L. Dose-related neurobehavioral effects of chronic cocaine use. J Neuropsychiatry Clin Neurosci 1999;11:361–369.
14. Smith SS. Addictive drug survey manual. Baltimore, MD: NIDA Addiction Research Center, 1991.
15. McLellan AT, Luborsky L, Woody GE, et al. An improved evaluation instrument for substance abuse patients: the Addiction Severity Index. J Nerv Ment Disord 1980;168:26–33.
16. Robins LN, Helzer JE, Croughan J, et al. National Institute of Mental Health Diagnostic Interview Schedule: its history, characteristics, and validity. Arch Gen Psychiatry 1981;38:381–389.
17. Shipley WC. Institute of Living Scale. Los Angeles: Western Psychological Services, 1946.
18. Benton AL, Hamsher K. Multilingual Aphasia Examination manual. Iowa City: University of Iowa, 1976.
19. Wechsler D. Wechsler Memory Scale–Revised. San Antonio, TX: Psychological Corporation, 1987.
20. Rey A. L'examen clinique en psychologie. Paris: Presses Universitaires de France, 1964.
21. Taylor LB. Localization of cerebral lesions by psychological testing. Clin Neurosurg 1969;16:269–287.
22. Kapur N, Butters N. An analysis of the visuoperceptual deficits in alcoholics. J Stud Alcohol 1977;38:2025–2055.
23. Mesulam MM. Principles of behavioral neurology. Philadelphia: FA Davis, 1985.
24. Wechsler D. Wechsler Adult Intelligence Scale–Revised (WAIS-R). New York, NY: The Psychological Corporation, 1981.
25. Reitan RM. Manual for administration of neuropsychological test batteries for adults and children. Tucson, AZ: NM Neuropsychology Laboratory, 1977.
26. Stroop JR. Studies of interference in serial verbal reactions. J Exp Psychol 1935;18:643–662.
27. Heaton RK. Wisconsin Card Sorting Test Manual. Odessa, FL: Psychological Assessment Resources, 1981.
28. Benton AL, Hamsher K, Varney N, et al. Contributions to neuropsychological assessment. New York: Oxford University Press, 1983.
29. Miller EN, Satz P, Visscher BV. Computerized and conventional neuropsychological assessment of HIV-1 infected homosexual men. Neurology 1991;41:1608–1616.
30. Klove H. Clinical neuropsychology. In: Forster FM, ed. The medical clinics of North America. New York: WB Saunders, 1963;1647–1658.
31. Stern Y. What is cognitive reserve? Theory and research application of the reserve concept. J Int Neuropsychol Soc 2002;8:448–460.
32. Bolla KI, Schwartz BS, Stewart W, et al. A comparison of neurobehavioral function in workers exposed to a mixture of organic and inorganic lead and in workers exposed to solvents. Am J Ind Med 1995;27:231–246.
33. Bolla KI, Briefel G, Spector D, et al. Neurocognitive effects of aluminum. Arch Neurol 1992;49:61–64.
34. Bolla KI, Cadet J-L, London ED. The neuropsychiatry of chronic cocaine use. J Neuropsychol Clin Neurosci 1998;10:280–289.
35. Herkenham M, Lynn AB, Little MD, et al. Cannabinoid receptor localization in brain. Proc Natl Acad Sci USA 1990;87:1932–1936.
36. Presburger G, Robinson JK. Spatial signal detection in rats is differentially disrupted by delta-9-tetrahydrocannabinol, scopolamine, and MK-801. Behav Brain Res 1999;99:27–34.
37. Lawston J, Borella A, Robinson JK, et al. Changes in hippocampal morphology following chronic treatment with the synthetic cannabinoid WIN 55,212-2. Brain Res 2000;877:407–410.
38. Mazer C, Muneyyirci J, Taheny K, et al. Serotonin depletion during synaptogenesis leads to decreased synaptic density and learning deficits in the adult rat: a possible model of

neurodevelopmental disorders with cognitive deficits. Brain Res 1997;760:68–73.
39. Koczyk D. Differential response of microtubule-associated protein 2 (MAP-2) in rat hippocampus after exposure to trimethyltin (TMT): an immuncytochemical study. Acta Neurobiol Exp 1994;54:55–58.
40. Galea LA, McEwen BS, Tanapat P, et al. Sex differences in dendritic atrophy of CA3 pyramidal neurons in response to chronic restraint stress. Neuroscience 1997;81:689–697.
41. Varvel SA, Hamm RJ, Martin BR, et al. Differential effects of delta9-THC on spatial reference and working memory in mice. Psychopharmacology 2001;157:142–150.
42. O'Leary DS, Block RI, Flaum M, et al. Acute marijuana effects on rCBF and cognition: a PET study. NeuroReport 2000;11: 3835–3841.
43. Block RI, O'Leary DS, Hichwa RD, et al. Cerebellar hypoactivity in frequent marijuana users. NeuroReport 2000;11:749–753.

Abnormal brain activation on functional MRI in cognitively asymptomatic HIV patients

T. Ernst, PhD; L. Chang, MD; J. Jovicich, PhD; N. Ames, BA; and S. Arnold, MS

Abstract—*Background/Objectives:* A previous fMRI study demonstrated increased brain activation during working memory tasks in patients with HIV with mild dementia. The current study aims to determine whether patients who are HIV-1 positive and have normal cognitive function also show increased brain activation on fMRI. *Methods:* Blood oxygenation level-dependent (BOLD) fMRI was performed in 10 patients with HIV (CD <500) and 10 age-, sex-, education-, and handedness-matched seronegative subjects. Each subject performed a battery of neuropsychological tests and fMRI with three tasks (0-back, 1-back, and 2-back) that required different levels of attention for working memory. *Results:* Compared with control subjects, patients with HIV showed greater magnitude of brain activation (BOLD signal intensity changes, $p \le 0.001$) in the lateral prefrontal cortex, with normal performance during fMRI and on a battery of neuropsychological tests. The patients with HIV also showed increased activated brain volume in the lateral prefrontal cortex ($p = 0.007$) but not in other activated regions, including the posterior parietal cortex, supplementary motor area, thalamus, caudate, and occipital cortex. The increase in activated brain volume was independent of task difficulty. *Conclusion:* Increased brain activation in subjects who are positive for HIV precedes clinical signs or deficits on cognitive tests. Early injury to the neural substrate may necessitate increased usage of brain reserve to maintain normal cognitive function. BOLD fMRI appears to be more sensitive than clinical and neuropsychological evaluations for detecting early HIV-associated brain injury.

NEUROLOGY 2002;59:1343–1349

Cognitive abnormalities commonly occur in patients with HIV-1 infection.[1] Among healthy individuals who are seropositive for HIV, cognitive deficits are thought to be infrequent[2]; however, some investigators suggest that more sensitive measures may be needed to detect the mild cognitive decline during the asymptomatic stage.[3] In later stages of HIV disease, with CD4 counts <100 cells/μL, approximately 20% of patients may develop a more disabling dementia syndrome directly related to HIV infection[4]; this syndrome has been termed HIV cognitive motor complex (CMC).[5] Early diagnosis and treatment of HIV dementia are especially important because patients with early stages of the dementia may show reversal of their cognitive deficits and neurochemical abnormalities after treatment.[6,7]

Typical neuropsychological deficits in patients with HIV include decreased sustained attention, mental flexibility, general motor speed, and memory[8,9]; in particular, working memory may be affected.[10-13] However, little is known about the neuroanatomic substrate underlying these neuropsychological deficits. A variety of functional neuroimaging techniques, including PET,[14] SPECT,[15,16] and MRS,[17-19] found alterations in cerebral blood flow and metabolism in the brains of individuals infected with HIV. Although the majority of these studies were performed in patients with HIV with cognitive impairment or de-

From the Medical Department (Drs. Ernst and Chang, and S. Arnold) and Chemistry Department (Dr. Ernst), Brookhaven National Laboratory, Upton, NY, Department of Brain and Cognitive Sciences (Dr. Jovicich), Massachusetts Institute of Technology, Cambridge; and Department of Neurology (N. Ames), Harbor–University of California, Los Angeles Medical Center, Torrance.
Supported by grants from the National Institute on Drug Abuse (Scientist Development Award for Clinicians for L.C., 5 K20 DA00280), National Institute of Mental Health (1R01 61427-01), and General Clinical Reearch Center (MO1-RR00425).
Received December 3, 2001. Accepted in final form July 17, 2002.
Address correspondence and reprint requests to Dr. Thomas Ernst, Medical Department, Brookhaven National Laboratory, Bldg. 490, Upton, NY, 11973-5000; e-mail: TErnst@bnl.gov

Drug-Taking Behavior Among School-Aged Youth

The Alaska Experience and Comparisons with Lower-48 States

Bernard Segal, PhD

figures the name of each substance has been abbreviated. The following is a list of the abbreviations to help interpret the data when the findings are presented graphically: MJ = Marijuana, CK = Cocaine, CR = Crack, ST = Stimulants, HL = Hallucinogens, DP = Depressants, HR = Heroin, IN = Inhalants, TQ = Tranquilizers, AL = Alcohol, and TB = Cigarettes.

A. PREVALENCE AND PATTERNS OF DRUG-TAKING BEHAVIOR

1. Opportunity to Try Drugs

Drugs cannot be experienced unless there is an opportunity to try them. Data addressing the opportunity to try drugs convey an indication of the availability of drugs, what trends in use may be present and, by extrapolation, information about the extent which those who have a chance to try a drug do so. Figure 4-1 describes how many adolescents in the sample indicated having had an opportunity to try any of the different chemical substances, except for alcohol and tobacco. Both weighted and unweighted results are provided in the table. The sample was weighted to adjust for differences in community representation.

A comparison of the actual (unweighted) and projected (weighted) findings shows that the differences between them tend to be small, suggesting that the actual sample is representative of the population sampled, except for sampling error. The following discussion is therefore based on the unweighted or actual sample results, as is the interpretation of other findings unless noted otherwise.

What can be observed from the data in Figure 4-1 is that opportunity to try different chemical substances is pervasive, but with some variations. Marijuana is the drug most in evidence (70.1 percent), followed by inhalants (44.9 percent). Just less than two-fifths (39.3 percent) of the sample reported an opportunity to try cocaine. Stimulants are next, with 36.4 percent of the sample having indicated an opportunity to try them. Reports on the opportunity to try the remaining substances are less extensive, but over a quarter of the sample had an opportunity to try hallucinogens (23.1 percent), and

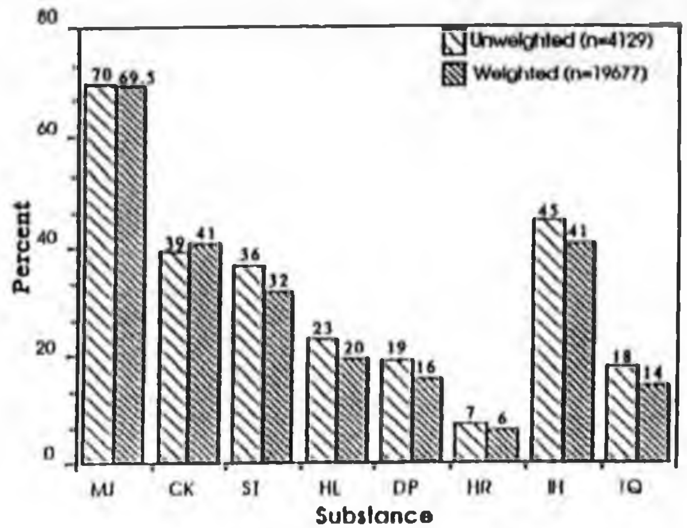


FIGURE 4-1. Opportunity to Try Chemical Substances Weighted and U weighted Comparison, Total Sample, 1988 (Figures are rounded to neare whole.)

less than a fifth indicated a chance to try depressants (18.6 percen or tranquilizers (17.6 percent). Last among the opportunity to t was heroin, with 7.4 percent of the sample noting an opportunity try it.

2. Opportunity to Try and Trying a Drug

An important piece of information related to the opportunity try a drug is the number of students who did try a substance whe the chance arose. Table 4-1 reports the percent of students wh indicated that they tried a substance when they had an opportunit As noted from the data, except for crack and heroin, over half th students tried one of the substances when an opportunity occurre Consistent with its level of apparent availability, three-quarte (75.9 percent) of those who had an opportunity to try marijuana d so. Stimulants are the next highest tried substance, with two-thir (66 percent) of the sample showing that they tried it when a chan arose. Over half of those who had a chance to try cocaine (52 pe

United States Department of Health & Human Services

News Release

FOR IMMEDIATE RELEASE
Thursday, September 9, 2004

Contact: SAMHSA Press Office
(240) 276-2130

Nation's Youth Turning Away from Marijuana, as Perceptions of Risk Rise; Most Adults with Substance Abuse Problems Are Employed

HHS Secretary Tommy G. Thompson announced today that there is a five percent decline in lifetime use of marijuana among American youth between the ages of 12 and 17. Current use of marijuana plummeted nearly 30 percent among 12 and 13 year olds. The findings were included in the 2003 National Survey on Drug Use and Health released today at the annual Recovery Month press conference.

The findings, released by HHS' Substance Abuse and Mental Health Services Administration (SAMHSA), show that while overall, the change in the category "current use of any illicit drug" was not statistically significant, the use of some drugs decreased sharply. For youth, 12-17, past year use of Ecstasy and LSD dropped precipitously, by 41 percent for Ecstasy and 54 percent for LSD. Overall, 19.5 million Americans ages 12 and older, 8 percent of this population, currently use illicit drugs. The data indicate that of the 16.7 million adult users (18 and older) of illicit drugs in 2003, about 74 percent were employed either full time or part time.

"It is encouraging news that more American youths are getting the message that drugs are dangerous," Secretary Thompson said. "But President Bush recognizes that we as a nation must do more to ensure that our children don't use drugs in the first place and to help Americans get the treatment for alcohol and drug addiction that they need."

President Bush's fiscal year 2005 budget request includes a 5 percent increase for substance abuse treatment, prevention and research, including a doubling of the funding for the Access to Recovery treatment program. President Bush is requesting $200 million for Access to Recovery, which provides vouchers to individuals to access drug- and alcohol-abuse treatment programs. With the doubling of the budget, Access to Recovery would help 100,000 people who want to obtain drug and alcohol treatment services but can't afford them.

"The prevention efforts of millions of parents, educators, and community leaders are working. Young people are getting the message that marijuana, which is substantially more potent today than it was 20 years ago, is a dangerous drug, and they are increasingly staying away from it," said John Walters, Director of National Drug Control Policy. "These new data reaffirm the critical roles parents and anti-drug advertising play in keeping our children safer, healthier, and drug-free."

SAMHSA Administrator Charles Curie said: "Employers who think alcohol and drug abuse will never be a problem in their workplace need to consider that more than three quarters of adults who have serious drug and or alcohol problems are employed. Encouraging employees to find help when they need

it can result in fewer accidents and fewer workers absent on Monday morning. It may even save an employee's life, family, or job. Creating a drug-free workplace program or enhancing an existing

program can lead to a healthier, more productive work force and be an important part of solving one of our nation's most persistent problems."

The survey found that of the 19.4 million adults (age 18 and over) characterized with abuse of or dependence on alcohol or drugs (19.4 million) in 2003, 14.9 million (77 percent) were employed either full or part time. This amounts to over ten percent of full-time workers as well as over ten percent of part-time workers.

Marijuana

Marijuana continues to be the most commonly used illicit drug, with 14.6 million current users (6.2 percent of the population). The study shows that there were an estimated 2.6 million new marijuana users in 2002. About two thirds of these new users were under age 18, and about half were female.

An important positive change detected by the survey was an increase in the perception of risk in using marijuana once a month or more frequently. Both youth and young adults reported a significant increase in their awareness of the risks of smoking marijuana. Particularly striking was the 20 percent decline between 2002 and 2003 in the number of youth that were "heavy users" of marijuana (those smoking either daily or 20 or more days per month). Perceived availability of the drug also declined significantly among youth.

The results of this year's survey demonstrate that anti-drug messages inside and outside of school, participation in religious and other activities, parental disapproval of substance use and positive attitudes about school are linked to lower rates of youth marijuana use. For example, those exposed to anti-drug messages outside of school had rates of current marijuana use that were 25 percent lower than those not reporting such exposure (7.5 percent vs. 10.0 percent). Youth who believe that their parents would "strongly disapprove" of marijuana had use rates fully 80 percent lower than those who reported that their parents would not "strongly disapprove" (5.4 percent vs. 28.7 percent).

Alcohol

The numbers of binge and heavy drinkers did not change between 2002 and 2003. About 54 million Americans ages 12 and older participated in binge drinking at least once in the 30 days prior to being surveyed. These people had five or more drinks on one or more occasion in the past month. There were 16.1 million heavy drinkers, who had five or more drinks on five or more occasions in the past month. The highest prevalence of binge and heavy drinking in 2003 was among young adults ages 18-25, with both binge and heavy drinking at their peak at age 21.

There were 10.9 million drinkers under legal age (ages 12-20) in the month prior to the survey interview in 2003. This is 29 percent of this age group. Of these, nearly 7.2 million (19.2 percent) were binge drinkers and 2.3 million (6.1 percent) were heavy drinkers.

Drunk driving declined from the 2002 survey, but drugged driving remained similar to that reported in the 2002 survey. An estimated 13.6 percent of persons aged 12 or older drove under the

influence of alcohol at least once in the 12 months prior to their interviews (32.3 million people) in 2003, a decrease from 14.2 percent (33.5 million) in 2002. An estimated 10.9 million persons reported driving under the influence of an illicit drug during the past year. This is 4.6 percent of the population ages 12 and older.

Prescription Drug Abuse

Against the backdrop of generally good news, the non-medical lifetime use of prescription pain relievers showed a five percent increase for the population 12 and older, with young adults (18-25) experiencing a 15 percent increase in lifetime, as well as current use. Over all, current use of prescription pain relievers non-medically remained stable from 2002-2003. There was a statistically significant increase in lifetime non-medical use of Vicodin, Lortab, or Lorcet from 13.1 million to 15.7 million. Percocet, Percodan, or Tylox misuse in a lifetime increased from 13.1 million to 15.7 million people. Hydrocodone lifetime non-medical use increased from 4.5 million people to 5.7 million; OxyContin lifetime misuse increased from 1.9 million people to 2.8 million; non-medical methadone use increased from 0.9 million to 1.2 million; and non-medical use of Tramadol increased from 52,000 to 186,000 from 2002 to 2003.

Estimates for persons who currently used psychotherapeutic drugs taken non-medically are similar in 2003 to estimates for 2002. There were 6.3 million persons currently using prescription medications non-medically in 2003, about 2.7 percent of the population ages 12 or older. Of these, an estimated 4.7 million used prescription pain relievers; 1.8 million used tranquilizers; 1.2 million used stimulants, including methamphetamine; and 0.3 million used sedatives.

Other Drugs of Abuse

There were an estimated 2.3 million persons who currently used cocaine in 2003, 604,000 of whom used crack. One million persons used hallucinogens, including LSD, PCP, Ecstasy and other substances, and 119,000 people were estimated to currently use heroin. These projections are all similar to estimates for these drugs in 2002. But, past month inhalant use among youth ages 16 or 17 increased from 0.6 percent in 2002 to 1.0 percent in 2003. Methamphetamine use did not change significantly between 2002 and 2003, with 600,000 past month users each year.

The survey reported 21.6 million Americans in 2003 classified with dependence on drugs, alcohol, or both (9.1 percent of the population ages 12 and older). Over 20 million persons needed but did not receive treatment for an alcohol or drug problem in 2002 and 2003, but the number receiving specialized substance abuse treatment declined from 2.3 million in 2002 to 1.9 million in 2003. Of the 20 million people in need of treatment in 2003 who did not receive it, about 1 million recognized that need. Only 273,000 tried to obtain treatment and were unable to access it. The other 764,000 made no effort to get treatment.

Serious Mental Illness and Substance Abuse

The report found a major correlation between serious mental illness and substance dependence and abuse. In 2003, an estimated 4.2 million adults suffered from serious mental illness and substance dependence or abuse in the past year. Adults who used illicit drugs were more than twice as likely to have serious mental illness, compared to adults who did not use an illicit drug. In 2003, 18.1 percent of

adult past-year users of illicit drugs had serious mental illness that year, while the rate was 7.8 percent among adults who had not used an illicit drug. Among adults with substance dependence or abuse, 21.6 percent had serious mental illness, compared to 8.0 percent among those who did not have dependence or abuse.

Among adults with serious mental illness in 2003, 21.3 percent (4.2 million people) were dependent on or abused alcohol or illicit drugs. The rate among adults without serious mental illness was only 7.9 percent.

Tobacco

Tobacco use rates in the past month remained essentially the same from 2002 to 2003, with 70.8 million people reporting current use of a tobacco product. Of these, 60.4 million smoked cigarettes in the past month, 12.8 million smoked cigars, 7.7 million used smokeless tobacco and 1.6 million smoked tobacco in pipes. There were significant declines in past year and lifetime cigarette use among youths ages 12 to 17 between 2002 and 2003, and a decline in the rate of cigarette smoking among young females.

The 2003 survey is based on interviews with 67,784 respondents ages 12 and older who were interviewed in their homes. This includes persons residing in dormitories or homeless shelters. Not included in the survey are persons on active military duty, in prisons, or other institutionalized populations or people who are homeless but not in shelters.

Recovery Month is observed in September to recognize the accomplishments of people in recovery, the contributions of treatment providers, and advances in substance abuse treatment. This year is the 15th annual observance. The theme, "Join the Voices for Recovery...Now!" emphasizes that addiction to alcohol and drugs is a chronic, but treatable, public health problem that affects everyone in the community.

HHS agencies -- including SAMHSA, the Centers for Disease Control and Prevention (CDC), the National Institute on Drug Abuse (NIDA) and the National Institute on Alcohol Abuse and Alcoholism (NIAAA) -- play a key role in the administration's substance abuse strategy, leading the federal government's programs in drug abuse research and funding programs and campaigns aimed at prevention and treatment, particularly programs designed for youth. An HHS fact sheet with more information is available at http://www.hhs.gov/news/press/. Other background and resources are available at the Web sites for SAMHSA (http://www.samhsa.gov), CDC (http://www.cdc.gov), NIDA (http://www.nida.nih.gov) and NIAAA (www.niaaa.nih.gov).

Findings from the 2003 National Survey on Drug Use and Health are available on the Web at *www.oas.samhsa.gov*

###

Note: All HHS press releases, fact sheets and other press materials are available at *http://www.hhs.gov/news*.

Last Revised: September 10, 2004