

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILE 8672

1442 SCOMM 53: JOINT SPEC. COMMITTEE ON LOCAL OPTION LAWS 1985-86

Urbanization

% Residents outside urban areas in towns of less than 2500 inhabitants	(MHI6C90)	-.05	-.01	.40	.03
% Single-family detached dwellings	(MHI5C19)	-.11	.18	.21	-.50
Population, 1 April 1970	(MHI5C01)	(-.12)	(.21)	(.01)	(-.60)
		.00	.10	-.10	.05
		(.02)	(.14)	(.08)	(.07)

Race-Ethnicity

% Household population Black	(MHI5C12)	.25	.01	-.22	.33
% Population foreign-born or native of mixed parentage	(MHI5C14)	(.25)	(-.03)	(.05)	(.44)
% Population Spanish American	(MHI6C45)	.15	.20	-.18	.28
% Population other non-White	(MHI5C13)	(.13)	(.22)	-.03	(.34)
		.30	.44	-.05	.00
		(.24)	(.42)	(.09)	(-.01)
		.35	-.17	-.04	.65
		(.32)	(-.21)	(.05)	(.67)

Household and Family Structure

% Households of husband-wife families	(MHI5C15)	-.13	.17	.11	-.63
% Divorced or separated males	(MHI6C73)	(-.03)	(.26)	(-.02)	(-.68)
% Divorced or separated females	(MHI6C74)	.08	-.14	.18	.69
Number of children under 5 years per 1000 women aged 15-44 years (fertility ratio)	(MHI6C51)	(.10)	(-.13)	(.16)	(.69)
Ratio of males to females	(MHI6C50)	.12	-.09	-.23	.40
% Households female-headed	(MHI6C76)	(.14)	(-.13)	(.07)	(.57)
Number of persons aged < 18 per 1000 persons 18-64 (youth dependency ratio)	(MHI5C17)	.28	.38	-.01	-.29
Number of persons aged 65+ per 1000 persons aged 18-64 (aged dependency ratio)	(MHI5C18)	(.25)	(.36)	(.01)	(-.31)
Median age of household heads	(MHI5C16)	.11	.01	.49	-.06
		(.30)	(.08)	(.32)	(-.09)
		.20	-.14	-.36	.42
		(-.11)	(-.30)	(-.18)	(.55)
		.23	.46	.00	-.39
		(.23)	(.46)	(.05)	(-.40)
		-.13	-.04	-.03	.19
		(-.32)	(-.16)	(-.24)	(.18)
		-.12	-.01	.10	.25
		(-.24)	(-.08)	(-.19)	(.29)

TABLE 2.—continued

		Public Drunkness Arrest Rates	Misdemeanor Drunken-Driving Arrest Rates	Felony Drunken- Driving Arrest Rates	Cirrhosis Mortality
<i>Condition of Housing</i>					
% Occupied housing units with direct access, complete plumbing and kitchen facilities	(MHI5C22)	-.35 (-.38)	-.04 (-.02)	-.18 (-.03)	-.68 (-.73)
% Persons living in units with 1.01 or more persons per room	(MHI5C21)	.50 (.44)	.55 (.53)	.29 (.29)	.09 (.06)
<i>Familism</i>					
% Small households (1 person)	(MHI6C47)	.07 (-.01)	.21 (-.27)	-.06 (-.06)	.70 (.71)
% Large households (6+ persons)	(MHI6C48)	.32 (.30)	.55 (.55)	.07 (.17)	-.24 (-.25)
<i>Residential Instability</i>					
% Recent moves (1969-70)	(MHI5C23)	.13 (-.06)	-.04 (-.18)	.04 (.04)	-.15 (-.23)
<i>Women's Labor Force</i>					
% Females aged 16+ in labor force	(MHI6C22)	-.13 (-.01)	-.18 (-.12)	.03 (.24)	.19 (.29)
<i>Employment</i>					
% Unemployed aged 16+	(MHI6C16)	.20 (.16)	-.01 (-.08)	.22 (.06)	.03 (.00)

* Zero-order correlations significant at $p < .05$, 49 df, $r = .24$ or greater; and partial correlations (controlling for urbanization and income) significant at $p < .05$, 47 df, $r = .25$ or greater. (Both one-tailed t test.)

Women's Labor Force % Females aged 16+ in labor force	r	(N1116C22)	- .13 (- .01)	- .18 (- .12)	.03 (.24)	.19 (.20)
Employment % Unemployed aged 16+		(N1116C16)	.20 (.16)	-.01 (-.08)	.22 (.06)	.03 (.00)

* Zero-order correlations significant at $p < .05$, 49 df, $r = .24$ or greater; and partial correlations (controlling for urbanization and income) significant at $p < .05$, 47 df, $r = .25$ or greater. (Both one-tailed t test.)

and cirrhosis mortality ($r = -.60$, after controls). The former correlation suggests that felony drunken-driving arrests are relatively more common in more rural areas, perhaps because of increased speeds by drivers and poorer road conditions.

For our third hypothesis, that minority race-ethnicity is positively associated with alcohol-related problems, we found moderate support. Without controls for urbanization and income, public drunkenness arrest rates were significantly correlated with 3 of the 4 variables. When urbanization and income were controlled, the percentage of household population Black and the percentage of population other non-White remained significantly correlated ($r = .25$ and $r = .32$, respectively).¹³

While felony drunken-driving arrest rates had no correlations significantly different from zero with the race-ethnicity variables, misdemeanor drunken-driving arrests did have a correlation of $r = .42$, with the percentage Spanish American, after controlling for urbanization and income, indicating a moderate relationship.

Cirrhosis mortality was significantly related to 3 of 4 race-ethnicity variables, with all of the zero-order correlations increasing after removing the effects of urbanization and income. This indicates the moderate degree to which race and ethnicity are positively related to cirrhosis mortality. Only the percentage of population Spanish American remained unrelated to cirrhosis death rates.

The fourth hypothesis that we considered is related to the degree to which individuals are integrated into relatively more traditional family-oriented settings. The socioculturalists have argued that the greater the degree of attachment to traditional family structures, the more likely will norms of moderation with respect to drinking behavior prevail. Accordingly, a series of household composition and family structure variables, as well as indicators of familism, were tested.

The household composition and family structure variables, for the most part, were minimally related to arrest rates, although there were a few exceptions, after controlling for urbanization and income. Public drunkenness arrest rates correlated positively with the fertility ratio even after controls, negatively with the aged dependency ratio, becoming stronger after controls ($r = -.32$),

¹³ In 1970, the other non-White population was composed of American Indians, Asian and Pacific Islanders and a residual designation of "other." Together, these groups accounted for approximately 3% of the population in California.

and positively with the sex ratio, becoming significant ($r = .30$) after controls. Misdemeanor drunken-driving arrest rates, after controls, were just barely significant with the percentage of households composed of husband-wife families ($r = .26$); however, the correlation is not in the expected direction, if one accepts the argument that the proportion of husband-wife households is an indicator of social stability. Misdemeanor drunken-driving arrests were positively and significantly related to the fertility ratio and the youth dependency ratio even after controls. Only the sex ratio remained correlated with felony drunken-driving arrests after controls ($r = .32$).

The familism indicators were correlated in unexpected ways. If, as is argued, familism, as represented by the percentages of small households (1 person) and large households (6+ persons), represents the degree to which social areas are family versus nonfamily oriented, then to that extent it would be expected that alcohol-related social problems should decline. With the three types of alcohol-related arrests this is not the case. The percentages of small households and large households were correlated significantly different from zero ($p < .05$, two-tailed test) with misdemeanor drunken driving ($r = -.27$ and $r = .55$, respectively) after controlling for urbanization and income. Furthermore, large households were correlated with public drunkenness arrests after controls ($r = .30$), but they were unrelated to felony drunken driving; small households were unrelated to either public drunkenness arrest rates or felony drunken driving.

It is with cirrhosis mortality that support for the hypothesis was found. Only 2 of the 9 correlations of the household variables with cirrhosis mortality were insignificant (sex ratio, aged dependency ratio), while most of the significant correlations were significant at the $p < .01$ level.

Although median age of household heads was correlated with cirrhosis ($r = .29$) after controls, suggesting the connection between age and the relatively long period for the development of the disease, cirrhosis mortality rates were not statistically related to the aged dependency ratio.

The most probable explanation of the significant positive relationship between cirrhosis mortality ($r = .25$) and median age of household heads and the positive but insignificant relationship between cirrhosis mortality and the aged dependency ratio ($r = .19$) is that cirrhosis mortality rates are curvilinear with respect to

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age. That is, the probability of dying of liver cirrhosis increases with age until the early sixties, after which it decreases very gradually. Thus, to the extent that median age of household heads varies across the 51 counties studied, it should be positively associated with cirrhosis mortality, as in fact it is in these data. The smaller but positive association between the aged dependency ratio and cirrhosis mortality reflects in part that the aged dependency ratio is constructed as a ratio of the number of persons aged 65 and over per 1000 persons aged 18-64. Therefore, to the extent that this ratio varies across the 51 counties, it might be expected to be either slightly positively correlated, uncorrelated, or negatively correlated with cirrhosis mortality. In these data the relationship between the aged dependency ratio and cirrhosis mortality is positive and insignificant.¹⁴

The familism indicators provided strong evidence that cirrhosis mortality is related to traditional-nontraditional families. The percentage of large households is significantly inversely related to cirrhosis mortality ($r = -.25$) after controls and is positively related to single-person households ($r = .71$, $p < .001$) after controls.

Other MHDPS indicators provide further evidence that social area characteristics are related to alcohol-related problems in the expected ways, given previous research findings, although in some relationships the correlations are not significantly different from zero. Public drunkenness arrest and misdemeanor drunken-driving arrest rates were significantly related to crowding (percentage of persons living in units with 1.01 or more persons per room) and large households (6 + persons) both before and after controls, and felony drunken-driving arrest rates were related to crowding ($r = .29$) with controls, but not large households. Although positive, women's labor force participation and felony drunken-driving arrest rates were not significantly related. Although expected to be related to the alcohol problems, residential instability was uncorrelated with any of them, as was the percentage unemployed.

Per Capita Sales, Outlet Rates and Alcohol-Related Problems.
Our fifth hypothesis concerned the relationships between alcoholic

¹⁴ Another factor which is probably influencing the correlations in these data is the cirrhosis mortality rate itself. The rate is crude since it is constructed by taking actual cirrhosis deaths and dividing them by the population aged 15+ at the time of the 1970 Census. Thus, the base population is composed of both individuals increasingly at risk (18-64) and those decreasingly at risk (65+). We are grateful to Professor Georges Sabagh for pointing this out.

beverage outlets and taxable retail sales and alcohol-related problems. Table 3 shows the correlations and partial correlations (controlling for urbanization and income) obtained between the outlet rates, per capita sales and the 4 alcohol problems. Per capita sales were more strongly related to several outlet types other than the one (Type 21, off-premise, general) on which they are based, even after controls. Furthermore, sales were related only to felony drunken-driving arrest rates after controls ($r = .28$).

When we initially studied the correlations between outlet types divided only by whether they were on- or off-premise outlets, we failed to detect differential relationships between the types of outlets and both alcohol-related problems and MHDPS variables. When we examined rates for the specific types of outlets, we found that they were indeed differentially related to both problems and social area characteristics. One very important result that emerged is that Type 40 outlets (beer bars) are implicated in both public drunkenness arrests and misdemeanor drunken-driving arrests, while several types of outlets (Types 20, 21, 40, 41, 47) are related to felony drunken-driving arrests, even after controls. However, it was Type 21 (off-premise, general) and Type 48 (on-premise, general) outlets that were most strongly correlated with cirrhosis mortality after controls ($r = .32$ and $r = .42$, respectively).

Per Capita Sales, Outlet Rates and MHDPS Variables. Our last hypothesis concerned the relationship between social area characteristics and sales and outlets. It is hypothesized that there will be differential relationships between the various outlet types, sales and social area characteristics. Outlets such as Type 41 (on-premise, beer and wine, for bona fide eating places) and Type 47 (on-premise, general, for bona fide eating places) would be expected to be positively related to social class, inversely related to minority race-ethnicity, inversely related to household composition, family structure and familism, positively related to urbanization, and inversely related to unemployment. Outlets such as Type 21 (off-premise, general), Type 40 (beer only, on-premise), Type 42 (beer and wine, public premises), and Type 48 (general, public premises) might be expected to be positively related to social class, minority race-ethnicity, nontraditional household composition, low familism and other variables indicating social disorganization. Furthermore, sales might be expected to be positively related to social rank and minority race-ethnicity, and inversely related to household composition, family structure and familism, and unemployment.

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TABLE 3.—Intercorrelations (and Partial Correlations Controlling for Urbanization and Income) among the Alcohol-Problem Indicators (N = 51)*

	Type 20	Type 21	Type 40	Type 41	Type 42	Type 47	Type 48	Per Capita Sales	Public Drunkness	Misdemeanor Drunk Driving	Felony Drunk Driving
Type 21	.81 (.70)										
Type 40	.84 (.75)	.60 (.44)									
Type 41	.79 (.75)	.78 (.68)	.58 (.49)								
Type 42	-.03 (-.39)	-.14 (-.40)	.07 (-.22)	-.19 (-.39)							
Type 47	.83 (.74)	.91 (.84)	.62 (.40)	.91 (.88)	-.16 (-.43)						
Type 48	.36 (-.11)	.55 (.32)	.26 (-.16)	.11 (-.25)	.10 (-.12)	.40 (.09)					
Per capita sales	.35 (.54)	.29 (.38)	.26 (.38)	.58 (.68)	.17 (-.15)	.37 (.48)	-.31 (-.35)				
Public drunkness arrest rates	.10 (.22)	.05 (.19)	.27 (.35)	-.03 (.08)	.03 (-.03)	-.01 (.13)	.07 (.12)	-.04 (-.01)			
Misdemeanor drunken-driving arrest rates	.10 (.16)	-.14 (-.12)	.37 (.45)	-.11 (-.08)	.01 (-.03)	-.16 (-.14)	-.13 (-.17)	.02 (.04)	.13 (.06)		
Felony drunken-driving arrest rates	.72 (.68)	.54 (.42)	.59 (.50)	.59 (.50)	-.19 (-.36)	.58 (.47)	.13 (-.14)	.24 (.28)	.12 (.18)	.28 (.32)	
Cirrhosis mortality rate	.05 (.05)	.25 (.32)	.11 (.11)	.10 (.12)	-.06 (-.09)	.12 (.15)	.36 (.42)	.18 (.19)	.33 (.33)	-.09 (-.10)	-.01 (-.02)

* Zero-order correlations significant at $p < .05$, 49 df, $r = .24$ or greater; and partial correlations (controlling for urbanization and income) significant at $p < .05$, 47 df, $r = .25$ or greater. (One-tailed t -test.)

Table 4 reports the correlations and partial correlations (again, controlling for urbanization and income) between these variables. Although none of the social-rank variables correlated significantly with sales (even after controls) they were, in general, in the expected direction. And, although all are positive with respect to the minority race-ethnicity variables, sales is significantly correlated only with the percentage of population other non-White, after controls ($r = .28$). Three of the nine household composition variables correlate significantly with per capita sales after controls (percentage of husband-wife families, percentage of divorced men and percentage of divorced women). As expected, per capita sales is inversely related to unemployment and positively related to female labor force participation, suggesting that those areas where relatively more women are engaged in the workplace are areas where packaged liquor store sales per capita are relatively greater. Per capita sales is, also as expected, inversely related to familism (percentages of large and small households).

It is with the outlet rates that we find several important relationships. As hypothesized, restaurants with on-premise licenses (Types 41 and 47) are positively related to social rank and either inversely or insignificantly related to minority race-ethnicity. Only the percentage of population other non-White shows a significant positive relationship with both Type 41 and Type 47 outlets after controls ($r = .27$ and $r = .25$, respectively). As predicted by the hypothesis, both types of outlets are inversely related to unemployment, but positively and strongly related to women's labor force participation (Type 41, $r = .66$; Type 47, $r = .56$, after controls). Furthermore, the correlations of the household composition and family structure variables, as well as the familism variables, support the idea that social areas with traditional family structures have relatively fewer Type 41 and Type 47 outlets.

One point should be noted with virtually all of the outlet rates. Contrary to previous findings (7, 10) we found strong inverse relationships with urbanization as measured by our percent-rural variable, and weak inverse relationships with urbanization as measured by the total population in each county on 1 April 1970. This suggests that caution should be exercised when conducting studies at the aggregate level; outlet rates will not always vary directly with urbanization.

The two public premises outlets (Types 42 and 48) are unrelated to the social rank variables after controls. Although correlated with

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TABLE 4—Correlations (and Partial Correlations Controlling for Urbanization and Income) between Types of Alcoholic Beverage Outlets, per Capita Sales and Mental Health Demographic Profile System Variables

		Type 20	Type 21	Type 40	Type 41	Type 42	Type 47	Type 48	Per Capita Sales	
Social Rank	Median income of families and unrelated individuals	(MHH5C07)	-.19	.01	-.32	.07	-.29	.05	-.19	.11
	% Families living below poverty line	(MHH5C08)	.33 (.35)	-.02 (-.09)	.55 (.56)	-.04 (-.01)	.19 (-.07)	-.05 (-.07)	.05 (-.23)	.01 (.15)
	% Employed males aged 16 + : operative, service workers and laborers, including farmworkers	(MHH5C09)	.32 (-.07)	.08 (-.24)	.37 (-.02)	.09 (-.39)	.21 (-.07)	-.02 (-.39)	.29 (-.03)	-.17 (-.15)
	% Employed males aged 16 + : professional, technical and kindred workers and managers	(MHH5C10)	-.19 (.18)	.02 (.20)	-.31 (.02)	.21 (.46)	-.32 (-.12)	.14 (.47)	-.23 (.03)	.22 (.20)
	Median years school completed by persons aged 25 +	(MHH5C11)	-.23 (-.09)	.09 (.24)	-.42 (-.31)	.17 (.28)	-.03 (.15)	.12 (.26)	-.10 (.08)	.10 (.05)
	Urbanization									
% Residents outside urban areas in towns of less than 2500 inhabitants	(MHH6C90)	.71	.60	.61	.48	.32	.60	.59	-.04	
	% Single-family detached dwellings	(MHH5C19)	.24 (-.21)	-.04 (-.51)	.30 (-.03)	-.12 (-.49)	.30 (.16)	-.01 (-.47)	.17 (-.19)	-.35 (-.39)
	Total population, 1 April 1970	(MHH5C01)	-.27 (.03)	-.16 (.10)	-.26 (.02)	-.14 (.05)	-.13 (.03)	-.15 (.11)	-.25 (.00)	.17 (.16)

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		Type 20	Type 21	Type 40	Type 41	Type 42	Type 47	Type 48	Per Capita Sales
<i>Social Rank</i>									
Median income of families and unrelated individuals									
	(MHI5C07)	-.19	.01	-.32	.07	-.29	.05	-.19	.11
% Families living below poverty line									
	(MHI5C08)	.33 (.35)	-.02 (-.09)	.55 (.56)	-.04 (-.01)	.19 (-.07)	-.05 (-.07)	.05 (-.23)	.01 (.15)
% Employed males aged 16 + : operative, service workers and laborers, including farmworkers									
	(MHI5C09)	.32 (-.07)	.08 (-.24)	.37 (-.02)	.09 (-.39)	.21 (-.07)	-.02 (-.39)	.29 (-.03)	-.17 (-.15)
% Employed males aged 16 + : professional, technical and kindred workers and managers									
	(MHI5C10)	-.19 (.18)	.02 (.29)	-.31 (.02)	.21 (.46)	-.32 (-.12)	.14 (.47)	-.23 (.03)	.22 (.20)
Median years school completed by persons aged 25 +									
	(MHI5C11)	-.23 (-.09)	.09 (.24)	-.42 (-.31)	.17 (.28)	-.03 (.15)	.12 (.26)	-.10 (.08)	.10 (.05)
<i>Urbanization</i>									
% Residents outside urban areas in towns of less than 2500 inhabitants									
	(MHI6C00)	.71	.60	.61	.48	.32	.60	.59	-.04
% Single-family detached dwellings									
	(MHI5C19)	.24 (-.21)	-.04 (-.51)	.30 (-.03)	-.12 (-.49)	.30 (.16)	-.01 (-.47)	.17 (-.19)	-.35 (-.39)
Total population, 1 April 1970									
	(MHI5C01)	-.27 (.03)	-.16 (.10)	-.26 (.02)	-.14 (.05)	-.13 (.03)	-.15 (.11)	-.25 (.00)	.17 (.16)
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TABLE 4.—continued

		Type 20	Type 21	Type 40	Type 41	Type 42	Type 47	Type 48	Per Capita Sales
<i>Race-Ethnicity</i>									
% Household population		-.40	-.22	-.30	-.29	-.24	-.29	-.17	.08
Black	(MHI5C12)	(.09)	(.29)	(.12)	(.07)	(.09)	(.20)	(.31)	(.09)
% Population									
foreign-born or native		-.34	-.27	-.18	-.16	-.38	-.23	-.16	.19
of mixed parentage	(MHI5C14)	(-.03)	(.06)	(.17)	(.12)	(-.28)	(.13)	(.19)	(.20)
% Population		-.19	-.37	.12	-.30	-.24	-.32	-.24	.06
Spanish American	(MHI6C45)	(.04)	(-.20)	(.37)	(-.14)	(-.23)	(-.12)	(-.09)	(.08)
% Population		-.01	.15	-.09	.09	-.22	.03	.11	.26
other non-White	(MHI5C13)	(.19)	(.39)	(.01)	(.27)	(-.21)	(.25)	(.29)	(.28)
<i>Household and Family Structure</i>									
% Households of		.16	-.07	.21	-.11	.18	-.05	-.06	-.28
husband-wife families	(MHI5C15)	(-.09)	(-.42)	(.09)	(-.41)	(.16)	(-.41)	(-.31)	(-.32)
% Divorced or		.21	.38	.10	.37	-.13	.31	.19	.27
separated males	(MHI6C73)	(.21)	(.41)	(.06)	(.39)	(-.16)	(.32)	(.18)	(.28)
% Divorced or		-.40	-.27	-.42	-.09	-.21	-.24	-.39	.28
separated females	(MHI6C74)	(.16)	(.23)	(.00)	(.38)	(.02)	(.30)	(.03)	(.34)
Number of children									
under 5 years per 1000									
women aged 15-44		-.04	-.28	.18	-.32	-.02	-.27	-.14	-.12
(fertility ratio)	(MHI6C51)	(-.04)	(-.32)	(.21)	(-.34)	(-.05)	(-.29)	(-.17)	(-.11)
Ratio of males to		.65	.66	.56	.48	.01	.55	.34	-.03
females	(MHI6C50)	(.35)	(.42)	(.33)	(.20)	(-.24)	(.21)	(-.06)	(-.03)
% Households		-.51	-.37	-.47	-.26	-.11	-.33	-.17	.15
female-headed	(MHI6C76)	(-.21)	(.01)	(-.31)	(.14)	(.00)	(.15)	(.25)	(.20)
Number of persons aged under									
18 per 1000 persons 18-64		-.09	-.36	.17	-.36	.02	-.36	-.31	-.19
(youth dependency ratio)	(MHI5C17)	(-.02)	(-.37)	(.28)	(-.35)	(.04)	(-.38)	(-.32)	(-.19)
Number of persons aged									
65+ per 1000 persons									
aged 18-64 (aged		.17	.10	.15	.01	.43	.09	.40	.02
dependency ratio)	(MHI5C18)	(-.21)	(-.12)	(-.27)	(-.15)	(.28)	(-.10)	(.22)	(.10)

Females	(MHI6C50)	(.35)	(.42)	(.33)	(.20)	(-.24)	(.21)	(-.06)	(-.03)
% Households		-.51	-.37	-.47	-.26	-.11	-.33	-.17	.13
female-headed	(MHI6C76)	(-.21)	(.01)	(-.31)	(.14)	(.00)	(.15)	(.25)	(.20)
Number of persons aged under 18 per 1000 persons 18-64 (youth dependency ratio)	(MHI5C17)	-.09	-.36	.17	-.36	.02	-.36	-.31	-.19
		(-.02)	(-.37)	(.28)	(-.35)	(.04)	(-.38)	(-.32)	(-.19)
Number of persons aged 65 + per 1000 persons aged 18-64 (aged dependency ratio)	(MHI5C18)	.17	.10	.15	.01	.43	.09	.40	.02
		(-.21)	(-.12)	(-.27)	(-.15)	(.28)	(-.10)	(.22)	(.10)

Median age of household heads	(MHI5C16)	.29	.23	.25	.06	.42	.19	.54	-.06
		(-.26)	(-.15)	(-.27)	(-.08)	(.25)	(-.22)	(.29)	(-.01)

Condition of Housing

% Occupied housing units with direct access, complete plumbing and kitchen facilities	(MHI5C22)	-.38	-.50	-.45	-.33	-.04	-.38	-.38	-.21
		(-.15)	(-.40)	(-.26)	(-.22)	(.13)	(-.24)	(-.38)	(-.21)

% Persons living in units with 1.01 or more persons per room	(MHI5C21)	.30	.01	.55	.01	-.03	-.02	-.06	.13
		(.29)	(-.02)	(.55)	(.02)	(-.21)	(-.04)	(-.23)	(.20)

Familism

% Small households (1 person)	(MHI6C47)	.03	.29	-.06	.21	-.02	.22	.34	.24
		(.03)	(.41)	(-.14)	(.29)	(-.08)	(.34)	(.41)	(.27)

% Large households (6 + persons)	(MHI6C48)	-.07	-.31	.23	-.28	-.14	-.31	-.34	-.05
		(.11)	(-.22)	(.45)	(-.19)	(-.11)	(-.22)	(-.29)	(-.04)

Residential Instability

% Recent moves (1969-70)	(MHI5C23)	.18	.04	.19	.18	.06	.11	-.13	.03
		(.23)	(.14)	(.11)	(.36)	(-.09)	(.30)	(-.27)	(.10)

Women's Labor Force

% Females aged 16 + in labor force	(MHI6C22)	.03	.14	-.21	.35	-.56	.20	-.29	.43
		(.45)	(.47)	(.16)	(.66)	(-.46)	(.56)	(-.07)	(.46)

Employment

% Unemployed aged 16 +	(MHI6C16)	.26	.24	.22	-.06	.27	.09	.48	-.43
		(-.12)	(.01)	(-.18)	(-.33)	(.08)	(-.20)	(.29)	(-.46)

the social rank variables in the expected directions without controls, beer bars (Type 40), after controls, have a significant positive relationship to the percentage of families in poverty ($r = .56$).

Type 48 outlets (all beverages) are related to the percentage of population Black and other non-White after controls, while beer bars (Type 40) are related only to the percentage Spanish American, after controls ($r = .37$). The household composition variables show no consistent patterns with Types 42 and 48 outlets after controls, although the percentage of female-headed households is correlated positively with Type 48 outlets ($r = .25$). Beer bars are positively related to the sex ratio and the youth dependency ratio but they are inversely related to the percentage of female-headed households and the aged dependency ratio. This suggests that beer bars are primarily frequented by men and the relatively young, the correlation with the median age of household heads being $r = -.27$ after controls.

As expected, the familism variables are inversely related to Type 48 outlets, while their relationships with Type 42 outlets are not significant. And, of the other variables, only the percentage of females aged 16 + in the labor force is inversely related to Type 42 outlets, while the percentage unemployed is positively related to Type 48 outlets.

Beer bars (Type 40) are unrelated to social areas where there are larger numbers of single persons, but are moderately related to areas where there are relatively large households ($r = .45$). Beer bars are unrelated to residential instability, women's labor force participation, and unemployment both with and without controls for urbanization and income. However, just as beer bars are correlated strongly with the percentage of families in poverty ($r = .56$), they also correlate strongly with crowding ($r = .55$). All in all, these results demonstrate that on-premise outlet rates are not uniformly distributed across the 51 counties and are differentially related to the MHDPS social area characteristics.

The correlations of off-premise outlet rates present a somewhat different picture. The only significant correlations with the social rank variables occur between the percentage of families in poverty and Type 20 (off-premise, beer and wine only), and the percentage of high-occupational-status men and Type 21 (off-premise, general). The race-ethnicity variables are uncorrelated with Type 20 outlets, while only the percentage of household population Black and the percentage of population other non-White are significantly correlated with Type 21 outlets ($r = .29$ and $r = .39$, respectively).

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With respect to the household composition variables, Type 20 outlets are positively related to the sex ratio ($r = .35$) and inversely correlated with median age of household head ($r = -.26$) after controls. Type 21 (off-premise, general) outlets are inversely related to the percentage of husband-wife families ($r = -.42$) and positively related to the percentage of divorced or separated men ($r = .41$) and the sex ratio ($r = .42$) after controls.

The familism variables correlated inversely, as expected, with Types 20 and 21 outlets, although only the correlation between Type 21 outlets and single-person households remained significant after controls ($r = .41$), while among the rest of the MHDPS variables, only the percentage of women 16+ in the labor force correlated positively with both types after controls ($r = .45$ and $r = .47$, respectively).

Multiple Regression Models. We employed simultaneous multiple regression in a series of models to examine the net effects of both the sociodemographic and availability variables on the dependent variables of interest. Table 5 reports the results of several of these regressions.¹⁵

Public drunkenness arrest rates were first regressed on the percentage of families in poverty and the percentage of population Black (column 1). Both beta coefficients were significant at the .05 level; however, the percentage of families in poverty showed the strongest effect (beta = .526, $p < .001$). The adjusted R^2 in this model accounted for 31.2% of the variance in the dependent variable and overall the equation was significant ($F = 12.332$, $p < .001$).

The addition of Type 40 (beer bars) outlets into the model lowered the beta coefficient for the percentage in poverty (beta = .474, column 2). Both the percentage Black and Type 40 outlets are not significant in this model, while the percentage in poverty remained significant at the .01 level. The overall equation remains significant ($F = 8.259$, $p < .001$) and the adjusted R^2 accounts for slightly less of the variance explained in public drunkenness arrests (30.3%).¹⁶

The third regression reported shows the relationship between public drunkenness arrest rates and the two sociodemographic

¹⁵ Since we were constrained by the small number of cases, no regression possesses more than four predictor variables.

¹⁶ Type 40 outlets correlated with the percentage of families in poverty, $r = .55$.

TABLE 5.—Standardized Regression Coefficients (and Unstandardized Regression Coefficients) for Several Predictor Variables of Public Drunkenness, Misdemeanor Drunken-Driving, and Felony Drunken-Driving Arrest Rates, and Cirrhosis Mortality Rates) (N = 51)

Sociodemographic Characteristics	Public Drunkenness Arrest Rates			Misdemeanor Drunken-Driving Arrest Rates		Felony Drunken-Driving Arrest Rates			Cirrhosis Mortality Rates	
	(1)	(2)	(3)	(1)	(2)	(1)	(2)	(3)	(1)	(2)
% Families living below poverty line (MHI5C08)	.526† (2.079)	.474† (1.871)	.529† (2.089)	.315* (.617)	.182 (.387)	.308* (.017)	.171* (.009)		.232* (.083)	
% Household population Black (MHI5D12)	.253* (.827)	.281 (.919)	.279* (.913)			-.185 (-.008)	.010 (.0005)			
% Household population Spanish American (MHI6D45)				.313* (.208)	.338* (.225)	-.122 (-.002)	-.014 (-.0002)			
% Small Households (1 person) (MHI6C47)									.843† (.236)	.874† (.245)
Aged dependency ratio (MHI5C18)									-.270* (-.047)	-.245* (-.042)
% Population outside urban areas in towns of less than 2500 inhabitants (MHI6C90)							.358* (.002)	-.054 (-.0003)		
Outlet Availability										
Type 21 (off-premise, general)			.121 (1.564)					.313* (.056)		-.146 (-.172)
Type 40 (on-premise, beer only)		.097 (3.106)			.227 (3.931)			.438† (.196)		.285* (.832)
Constant	-9.004	-9.137	-11.097	5.911	6.085	.161	.109	.106	-1.442	-1.172
R ²	.3394	.3452	.3534	.2740	.3097	.1263	.1872	.4082	.5652	.5636
Adjusted R ²	.3119	.3034	.3122	.2438	.2656	.0706	.1165	.3704	.5374	.5256
F	12.332†	8.259†	8.564†	9.058†	7.028†	2.266	2.648*	10.804†	20.364†	14.850†

*P < .05 †P < .01 ‡P < .001.

The third set of regressions is reported for felony drunken-driving arrests. The first regression shows the coefficients for the percentage of families living in poverty, the percentage Black and the

percentage Spanish American. Only the percentage in poverty is significant ($\beta = .308$, $p < .05$), and the model explains only 7.1% of the variance in felony drunken-driving arrest rates. Since these rates were moderately correlated with our measure of urbanization ($r = .40$), we regressed felony arrest rates on the same three variables and the percentage of population outside metropolitan areas (column 2). Both "ruralization" and the percentage of families living in poverty are significant ($\beta = .358$ and $.171$, respectively).

When we removed the percentages Black and Spanish American from the model (both having virtually no effect on felony arrests) and added the availability variables (Types 21 and 40),¹⁷ the percentage of families living in poverty was unrelated to felony arrests.

In the final regression (column 3) we retained the percentage of population outside metropolitan areas with the two availability indicators. Both availability variables remained significant at the .05 level net of urbanization, while the urbanization coefficient became insignificant. The overall model for the last regression is significant ($F = 10.804$, $p < .001$) and the adjusted R^2 shows substantial improvement over the first two regressions (adjusted $R^2 = .37$).

With the last dependent variable, cirrhosis mortality rates, we considered as predictors in the first regression (column 1) the percentage of families in poverty, the percentage of one-person households and the aged dependency ratio. It is clear that the percentage of one-person households is the single best predictor of cirrhosis mortality ($\beta = .843$, $p < .001$) while the percentage of families living in poverty is significant at the .05 level ($\beta = .232$). The aged dependency ratio, although correlated with the percentage of one-person households ($r = .46$), was entered into the model to adjust for differences in distribution of the elderly across counties. Given the zero-order correlation of .18 between the aged dependency ratio and cirrhosis mortality, the negative regression coefficient was unexpected ($\beta = -.270$, $p < .05$).

When the two availability indicators were entered into the model the coefficient for the percentage of families living in poverty was not significant (regression not reported). In the final regression

¹⁷ We do not report these regressions.

(column 2), the percentage of one-person households remains an important predictor ($\beta = .874$, $p < .001$) of cirrhosis mortality, both the dependency ratio and Type 40 outlets are significant at the .05 level, and the adjusted R^2 is slightly less (.525) than that in the model in column 1. Again, given the correlation of $r = .25$ between cirrhosis mortality and Type 21 outlets, the negative coefficient ($\beta = -.146$) was unexpected. Most of the unexpected negative coefficients result from a moderate degree of multicollinearity between the independent variables and represent a good example of net suppression under the condition that all zero-order correlations are positive (27).

SUMMARY AND CONCLUSIONS

Following Donnelly (17), we employed the MHDPS in the analysis of alcohol availability, packaged liquor store sales and alcohol-related problems in California. In general, our results substantially support the findings of Donnelly and confirm the usefulness of a census-based system of sociodemographic information in analyses of alcohol-related problems. However, there are several differences in the findings for California and Pennsylvania. A brief review of the results in the two studies is informative.

Whereas Donnelly found that increases in per capita sales are positively correlated with alcohol-related problems, such as total alcohol-related arrests and cirrhosis mortality, our findings indicate that per capita sales of packaged liquor stores (an admittedly weak measure) is not related to public drunkenness arrest, misdemeanor drunken-driving arrest and cirrhosis mortality rates, but is correlated with felony drunken-driving arrest rates, after controlling for urbanization and income.

Although Donnelly found contradicting evidence of a positive relationship between alcohol-related arrest rates and social rank variables, we find confirmatory evidence for the hypothesized inverse relationships (4-6). Most of our social rank variables correlate with the arrest rates in the expected directions, although only the percentage of families living in poverty and median education are consistently and significantly related to arrest rates after controlling for urbanization and income. And, although hypothesized to be negatively associated with cirrhosis mortality, none of the correlations with the social rank variables was significantly different from zero. This is in accord with Donnelly's findings, even after controlling for urbanization and income.

Whereas Donnelly found strong relationships between minority race-ethnicity and his problem measures, we found only a few moderate correlations with specific types of arrests. Three of our 4 minority race-ethnicity variables are correlated significantly with cirrhosis mortality, while only 2 of Donnelly's correlations are significant. Interestingly, in both sets of correlations, the percentage Spanish American is unrelated to cirrhosis mortality.

In both Donnelly's data and our own, there is support for the hypothesized inverse relationship between relatively more traditional family structures and alcohol-related arrests, although in our correlations the relationships are modest. We found, as did Donnelly, relatively strong zero-order correlations between cirrhosis mortality and several household composition and family structure variables, although there are differences, e.g., Donnelly's low correlations between cirrhosis and male and female divorce and our moderately strong correlations. And, though Donnelly did not include familism variables, we found a strong relationship between the percentage of households with one person and cirrhosis mortality ($r = .70$), confirming findings made by Gove and Hughes (28) for 389 American cities.¹⁸

Donnelly did not investigate on- and off-premise outlet rates and therefore we have no information with which to make direct comparisons on the MHDPS variables at the county level in Pennsylvania. However, as mentioned above, several researchers (7-10) have studied the effects of availability on consumption and cirrhosis mortality at the state aggregate level, employing different measures of availability, and statistical controls for income, urbanism and restrictions on outlets by population. These studies have provided conflicting results. For example, Smart (7), using a composite measure of availability, found that income and urbanism were more closely associated with consumption and alcoholism than was availability. Parker et al. (9) re-examined Smart's data, but used on- and off-premise outlet rates as their indicator of availability and found strong effects of outlet rates on consumption and cirrhosis mortality rates in states without controls on the number of outlets per unit of population. Harford et al. (10), restricting the analysis to on-premise outlets per 100,000 persons, found that on-premise rates were significantly related to alcoholism rates in 39 jurisdic-

¹⁸ Gove and Hughes (28), employing ecological data, found that living alone was strongly correlated ($r = .64$) with and was, by far, the best predictor of cirrhosis mortality.

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tions. The authors concluded that, although rates of on-premise outlets and urbanization contribute to cirrhosis mortality rates when per capita consumption and income are controlled, the limitations of the overall small sample size and the considerable heterogeneity of state jurisdictions made firm conclusions about the relationships between the variables premature. They called for further study of the variables at the Standard Metropolitan Statistical Area or county level and suggested that a comprehensive model of alcohol availability needed to be developed.¹⁹

In this study we employed five types of on-premise and two types of off-premise outlets as indicators of physical availability, accounting for 90% of all alcoholic beverage outlets in the 51 counties studied. By studying the relationships between social area characteristics, outlet types and alcohol problems, we found several moderate relationships that were masked when the data were analyzed using only on- and off-premise outlet rates. Type 40 outlets (beer bars) are moderately positively correlated with the three types of arrests, even after controlling for urbanization and income, but are minimally correlated with cirrhosis mortality, while Type 21 (off-premise, general) and Type 48 (on-premise, general) outlets were related moderately to cirrhosis mortality.

Furthermore, our analysis revealed important relationships between social area characteristics and specific outlet types. For example, beer bars (Type 40) showed moderate relationships with poverty, crowding and the Spanish American population while off-premise general outlets (Type 21) showed significant positive correlations with the percentage Black, the percentage other non-White and several indicators of social disorganization and disruption of traditional families.

These results suggest that outlet rates (at least in the state of California) are related in important ways to alcohol problems. They lend support to the findings of Parker et al. (9) and Harford et al. (10) regarding the effects of on- and off-premise outlets on liver cirrhosis mortality and, furthermore, they show that specific outlet types are implicated differentially in alcohol-related problems.²⁰

Our multiple regression results showed that physical availability of specific types contributed significantly and positively to the

¹⁹ Smart's study (8) used the formulation of a wider conception of availability developed by Medicine in the Public Interest (21).

²⁰ Neither Smart (7), Parker et al. (9) nor Harford et al. (10) examined the impact of outlets on arrest rates.

explained variance in felony drunken-driving arrest rates and cirrhosis mortality. In the other two dependent variables—public drunkenness arrests and misdemeanor drunken-driving arrests—the two availability variables, although not contributing significant coefficients, did reveal important B values net of the selected sociodemographic variables.²¹ Since we were primarily concerned with an overall description of the data, we did not deal with a number of problems related to technical issues in multiple regression (29). For example, it should be kept in mind that there are statistical outliers in these data.²²

All in all, we found the MHDPS to be quite valuable in ecological research on alcohol-related problems. We found support for a number of hypotheses recently offered in the literature on social factors influencing alcohol problems. However, some considerations and adjustments need to be made when analyzing data of this type. First, aggregate data analysis assumes that the units of analysis are of a "comparable" nature (30). One would probably not want to use, as units of analysis, all states in the United States and all counties in California in the same analysis. Second, inspection for "outliers" must be made; we found that several of our alcohol indicators had outliers for one or another of the counties. We surmise that the very small counties are outliers because of small populations. And, third, although we did not present any regression analyses of the outlet rates on the MHDPS variables, previous analyses of these and other data suggest that tourism is a factor influencing consumption and on-premise availability (13).

Furthermore, as Donnelly pointed out, differential enforcement patterns, and that arrests represent number of arrests and not the number of people arrested, also can bias the data in certain ways. Also, there is evidence that cirrhosis mortality rates for small areas, say with populations under 300,000, may be biased (31). Yet we must conclude that a social area-epidemiological system of information, such as the MHDPS first employed by Donnelly, is invaluable in determining the relative influences of social area profile characteristics and outlet availability on alcohol problems. Further

²¹ There were problems of both multicollinearity and some heteroscedasticity in virtually all of the models, to which we did not fully attend.

²² Neither Smart (7) nor Parker et al. (9) considered outliers in their data and Harford et al. (10) only considered the District of Columbia. Donnelly's published data revealed outliers (17, Table 1), but he did not mention them. Anscombe (29) made several suggestions for the analysis of outliers.

studies of this type are needed in a variety of jurisdictions so that a general social area profile may be developed which can provide the various jurisdictions with policy recommendations.

With respect to the competing theories of alcohol problems and alcoholism we conclude, on the basis of this analysis, that neither the sociocultural model, which emphasizes the normative structure of ethnic, racial, and class subgroups, nor the distribution of consumption model, which emphasizes the level of consumption and restrictions on consumption by manipulation of economic and physical availability, is sufficient to understand alcoholism and alcohol-related problems. Both approaches have something to offer in improving our understanding of drinking behavior and its pernicious consequences (32-34). The two sociological perspectives, perceived as competing, with an empirical test turn out to be complementary. Why an ecological and normative perspective has been treated in isolation is well beyond the scope of this paper. Our complementary perspective, however, suggests that among particular subgroups certain types of outlets (and drinking) are used more frequently. Availability has an effect on alcohol problems independent of social area characteristics. Our work also suggests the need for time series research which could pinpoint the causal direction in this sociocultural and ecological debate.

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Prediction of Alcoholism from Alcohol Availability, Alcohol Consumption and Demographic Data

Israel Colón, Ph.D.,¹ Henry S. G. Cutter, Ph.D.²
and Wyatt C. Jones, Ph.D.³

SUMMARY. *Cirrhosis mortality in the fifty states and the District of Columbia was predicted by alcohol consumption, alcohol availability, and several social, cultural, economic and demographic variables.*

ALCOHOL AVAILABILITY, alcohol consumption, and demographic variables have all been posited to influence the incidence of alcoholism. The relationship of these variables to liver cirrhosis mortality as an index of alcoholism is the subject of the present study.

In the United States, laws enacted at the state level seek to control alcohol consumption, establish the minimum legal age for purchasing or drinking alcohol, limit the kind and number of retail outlets and their hours of sale, and specify the type and amount of taxation and advertising. Despite these laws having their origins in the compromises of the political process and the economics of alcohol revenues, the manipulations of these statutes reflect social policy and are central to many public-health alcoholism-prevention models.

¹ Assistant Professor, School of Social Administration, Temple University, Philadelphia, Pennsylvania 19122.

² Research Psychologist, Veterans Administration Medical Center, Brockton, Massachusetts 02401, and Adjunct Associate Professor, Florence Heller School of Social Welfare, Brandeis University.

³ Professor, Florence Heller School of Social Welfare, Brandeis University, and Research Sociologist, Veterans Administration Medical Center, Brockton, Massachusetts.

Reprint requests to Dr. Cutter.

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Representatives of the beverage alcohol industry and others argue that restrictive control laws are unnecessary impositions on the social drinker and are likely to exert no influence on the problem drinker (1, 2). Such legislation may create an aura of intrigue about alcohol that encourages its use by the young (3). Some analysts argue that strong and consistent social-drinking norms limit intoxication and the consequent problems due to excessive drinking. Others, employing an economic model, contend that price or taxation is the key to the control of alcohol availability and, in turn, of alcoholism. Such legally enforced economic sanctions are presumed to eliminate harmful levels of consumption (4-10). Alcohol is conceptualized as the disease agent, and the distribution and availability laws as the primary means of prevention (11).

The single-distribution (lognormal) model, which has generated some of the strongest arguments for alcohol control legislation short of prohibition, is based on the positive association between alcohol consumption and cirrhosis mortality. The distribution of consumption in a population is said to approximate a lognormal curve, and the daily consumption of 15 cl or more of absolute alcohol is considered the operational definition of alcoholism. For example, Whalley (12) found that this level of consumption distinguished 94% of the hospitalized alcoholics in his sample from a matched set of controls. People consuming this amount tend to be physically dependent on alcohol.

Assuming that consumption is causally linked to cirrhosis mortality, and that there is little variation from society to society in the dispersion of the consumption curve, Bruun et al. (8) concluded that the proportion of heavy drinkers found in the upper limits of the distribution is determined primarily by the average level of consumption, which in turn reflects demographic differences. To the extent that beverage alcohol behaves like most other economic commodities, this model suggests that alcohol can be controlled by such regulatory measures as raising the minimum legal purchasing age, restricting the number of retail outlets, and controlling the price by taxation.

Empirical assessment of the model has focused on the shape of the distribution (8, 9, 13-17). The lognormal curve fits the data better than either the normal or the bimodal distributions, although it does not account for the proportion of abstainers in a population because it erroneously sets their number at zero (18). In fact, the proportion of abstainers might be negatively related to

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alcohol consumption by drinkers. The lognormal model is suggestive but it requires further empirical evaluation.

Cartwright et al. (19), in a longitudinal study testing several propositions derived from the single-distribution model, found that an increase in consumption in a London suburb between 1965 and 1974 was due to drinkers shifting to higher consumption levels rather than to abstainers becoming drinkers. Increased amounts of consumption per occasion and not more frequent occasions accounted for the increase in alcohol-problem scores. Alcohol problems were associated with younger age and lower occupational status. The factor of alcohol availability could not be assessed unambiguously because the number of outlets selling alcohol for off-premise consumption increased and the number of outlets selling alcohol for on-premise consumption decreased during the study period.

In a cross-sectional study of the states, Smart (20) found no relationship between alcohol availability and consumption or cirrhosis mortality rates when urbanization and income were controlled for. Suggesting its role as an antecedent variable, income is more strongly related to consumption and cirrhosis mortality than it is to availability. Ede and Templer (21) similarly found that the diminished availability occasioned by a 61-day strike by Canadian liquor-store employees had no measurable influence on hospital admissions for acute episodes of alcoholism. In contrast to these two studies, Magruder (22) found alcohol availability to be significantly associated with cirrhosis mortality in the 100 counties of North Carolina.

There are at least two problems in these and other studies that bias their measurement of consumption as based on records of alcohol sales and shipments. Consumption in some jurisdictions is underestimated by the failure to take account of illegally made and distributed "moonshine" and "bootleg" liquor and is distorted (e.g., in Nevada, Florida, and the District of Columbia) by the failure to consider the impact of tourism (5, 23, 24).

In a regression analysis of 67 counties in Pennsylvania, Donnelly (25) found that per-capita liquor sales were best predicted by median income, the percentage of men in high-status occupations, the percentage of the population with foreign parentage, and (negatively) by the percentage of families with children under 18. Police arrests for alcohol-related incidents were best predicted by median income, the percentage of the population Black, the

percentage of other non-Whites, and per-capita liquor sales. Cirrhosis deaths were best predicted by the percentage of the population with foreign parentage, and negatively by both the percentage of husband-wife families and the percentage of families with children under 18. Consumption (as measured by sales) was not among the highest-ranked variables accounting for cirrhosis mortality.

These findings suggest that efforts to link cirrhosis mortality rates to average consumption would be enhanced by the inclusion of sociocultural and demographic factors and by taking account statistically of illegal availability and tourism.

These studies provide evidence for the approximate fit of the lognormal curve of the distribution of consumption and establish the consumption level critical to alcoholism, but the relationship of legislated alcohol availability to consumption and cirrhosis mortality is equivocal. Appropriate controls for illegal availability and tourism are indicated. Economic variables, such as income, and sociocultural and demographic variables account for some part of consumption and cirrhosis mortality. The analyses reported below evaluate the relationship of these variables to consumption and cirrhosis mortality, and assess in turn the role of consumption in accounting for cirrhosis mortality.

METHOD

The units of analysis were the 50 states and the District of Columbia for the Census year 1970. The independent variables included six indicators of alcohol availability (or restrictiveness), numerous demographic and sociocultural characteristics, one indicator of moonshining (illicit production) or bootlegging (illicit sale), and two indicators of tourism. Since some of the variables proved to be quite skewed, appropriate transformations were used to reduce the effect of extreme scores on the product-moment correlations. Nonlinear transformations, the logarithmic transformation in particular, not only alleviate distributional nonnormality (positive skew), but also reduce unequal variability (heteroscedasticity), still maintaining the relative positions of the data points (26).

To test for the possibility that the transformations distorted the relationships obtained among the independent, control, and dependent variables, oblique and orthogonal factor analyses were conducted on both transformed and untransformed variables. Since the observed differences were minimal, only the results of analyses with transformed variables are reported.

An oblique factor analysis was performed to delineate dimensions among the independent variables and to reduce their number. Consump-

liquor sales, percentage of the population by both the age of families (by sales) was used for cirrhosis mortality rates. The inclusion of consumption taking account of the rate of fit of the model and establish the relationship of cirrhosis mortality and availability and income, and some part of the reported below consumption and consumption in

Dependent Variables. Cirrhosis deaths per 1000 people aged 14 years and older were used as the main dependent variable (27). Treatments of the data employing a different dependent variable can be found in Colón (28) and Colón et al. (29).

Employed both as a dependent and an independent variable, the per-capita consumption of absolute alcohol (30) attributed to the population aged 15 years or older was estimated from quantities of distilled spirits, wine and beer shipped, multiplied by their alcohol content (45, 16 and 4.5%, respectively).

Control Variables. Seizures of grain mash (gallons per 1000 population) were used to account for the distorting influences of illicit supplies (30). A 3-year average centered on 1970 was used to smooth year-to-year fluctuations.

Tourism was represented by the proportion of the labor force providing recreation, entertainment and lodging services (31).

Independent Variables. Measures of income, price and state restrictions on alcohol availability were selected to represent the policy elements of the single-distribution model. The measure of income was per-capita disposable personal income.⁴

The price of a popular brand of whisky was used as an index of the price of absolute alcohol (32). It was assumed that the prices of other alcoholic beverages were comparable. The composite Consumer Price Index for alcoholic beverages could not be used because it is a measure of price changes rather than of price levels.

Degree of availability was measured by six policy variables: county-level prohibition, state taxes, method of distribution (state-monopoly vs license state), minimum legal purchasing age, retail outlets, and on-premise licenses. County-level prohibition was measured by the proportion of a state's population residing in dry counties (33).

State control of distribution was represented by a dummy-coded variable (1 = control state; 0 = license state). State alcoholic-beverage taxes (34) were converted to a per-gallon basis by dividing total tax receipts by consumption of absolute alcohol in gallons. The minimum legal purchasing age was measured by the proportional increment in the legal drinking population attributable to the decrease in the drinking age. When a state varied its purchasing age by beverage type (always lower for wine and beer than for distilled spirits), the lowest age was used, as it

⁴ U.S. DEPARTMENT OF COMMERCE. BUREAU OF ECONOMIC ANALYSIS. Disposable personal income by state for 1970. (Data available from source upon request.)

probably best reflects the impact of the policy. The variable of retail outlets was formed by summing U.S. Treasury Department licenses issued for the distribution of distilled spirits, wine and beer (30). The total number of off-premise retail outlets was measured per 10,000 population. On-premise licenses per 1000 were counted for distilled-spirits licenses only (32). Private clubs and dual licenses (on- and off-premise) were included in the on-premise count.

Various sociocultural and demographic concepts were represented in the remaining independent variables. Social control was represented by per-capita churches and police. Churches per 10,000 population is a count of parishes and congregations (35). Inexplicably, the Mormon Church of Utah reported zero churches in that state. An estimate of Mormon churches from national data was made in proportion to each state's Mormon population in the national total. Per-capita police includes both state and local police (36). The proportion of unassimilated groups (Blacks, American Indians, Hispanics, and foreign-born) in the population (37) was included as a variable because these groups exhibit different drinking patterns from those of the general population (5, 38).

Several measures were employed to reflect the concept of isolation: the proportions of men and women over 14 years of age who were single, divorced, widowed (37) or living in single-person households (39).

RESULTS

Factor Analysis. Five factors were extracted in a principal-components analysis with communalities in the diagonals and oblique rotations (direct oblimin, $\Delta = .5$). The Statistical Package for the Social Sciences (40) was used to perform the analyses. The pattern matrix, which best approximates simple structure and consequently is most useful in the overall interpretation of the factors, and the structure matrix, which reveals variables loading on more than one factor, are presented in Table 1 along with simple correlations of the separate variables with consumption and cirrhosis mortality. Correlations (r) among the five sets of factor scores that reflect the interrelationship of nonorthogonal factors are given in Table 2.

Factor 1, entitled Urban Conditions, loaded, in descending order of magnitude, on per-capita police, unintegrated groups, percentage of urbanized population, few churches per capita, high disposable personal income, and state-monopoly distribution. Factor 2, Large Aged Population, was characterized by a low ratio of men to women, a high proportion of divorced or widowed women, high median age, and numerous single-person households. Factor 3, Restricted Availability, was characterized by county prohibition, mash seizures, high per-gallon state taxes, and an absence of on-

TABLE 1.—Transformations, Pattern and Structure Factor Loadings, and Correlations

	Pattern Matrix, Factor Loadings and Communalities										Structure Matrix Factor Loadings				Correlations	
	Large					Low					Urban				Consumption per Capita ^a	Circles Mortality Rate ^a
	Urban Conditions	Aged Pop.	Restricted Pop.	Liberal Pop.	Adult Pop.	Urban Conditions	Aged Pop.	Restricted Pop.	Liberal Pop.	Adult Pop.	Urban Conditions	Aged Pop.	Restricted Pop.	Liberal Pop.		
State & local police per capita ^a	.907	.034	-.109	-.092	.245	.911	.901	.096	-.388	-.014	.188	.705	.699			
% Foreigners, Native Americans, ^a																
Blacks, Latin surnames	.809	.018	.203	.035	-.058	.735	.828	-.025	.004	.114	-.184	.490	.516			
Urbanization	.783	.257	-.133	-.342	.032	.845	.778	.315	-.348	-.313	.011	.425	.588			
Churches per capita	-.697	-.087	.300	.271	-.145	.739	-.729	-.169	.509	.223	-.160	-.671	-.819			
Disposable personal income per capita	.599	.094	-.483	-.243	-.026	.784	.695	.145	.631	-.208	.042	.677	.871			
Control or license state	-.441	.040	-.196	.013	-.026	.189	-.381	.050	-.085	-.038	.070	-.162	-.188			
Sex ratio ^a	-.079	-.844	-.209	-.147	.353	.902	-.062	-.829	.218	-.001	.195	.069	.250			
% Divorced & widowed women ^b	.067	.894	.500	.258	.161	.901	-.119	.771	.421	.134	.232	-.153	.062			
Median age	-.002	.748	-.141	-.050	.035	.621	.013	.772	-.189	-.173	.234	.086	.342			
Single-person households ^a	.184	.696	-.308	.265	.177	.782	.255	.706	.427	.167	.385	.408	.541			
Dry-county population ^c	-.037	.039	.857	-.019	.148	.718	-.903	.029	.831	-.020	-.029	-.513	-.401			
Callous of man seizures per capita	.116	.071	.676	-.155	.134	.432	-.078	.087	.613	-.148	-.012	-.317	-.311			
State tax per gallon of alcohol	.116	-.245	.636	.276	.015	.561	.012	-.323	.620	.333	-.190	-.233	-.345			
On-premise licenses per capita	.143	-.188	-.538	.099	.140	.427	.273	.145	.593	.138	.203	.563	.300			
Retail outlets	-.201	-.068	-.388	.582	.304	.639	-.082	.070	.397	.572	.398	.357	.050			
Minimum legal purchasing age ^a	-.067	.090	.059	.519	.130	.278	-.022	.028	.104	.408	-.113	-.122	-.126			
Price	.083	-.108	.038	-.201	-.092	.105	.058	.085	.041	.266	.135	-.163	-.000			
% Single women ^a	.381	.145	-.322	.319	.737	.682	.559	-.061	.257	.322	.668	.302	.356			
% Divorced & widowed men ^a	.193	.347	-.057	.032	.700	.755	.136	.499	-.277	-.003	.772	.377	.427			
Recreation, entertainment & lodging employees	-.270	-.089	.086	.177	.641	.452	.204	.018	-.115	.221	.577	.308	.266			
Single men	.331	-.321	-.203	.423	-.478	.812	.471	-.491	.156	.500	.535	.347	.132			
Eigenvalues	5.001	3.324	2.276	1.544	1.335											
% Total variance	25.0	16.9	12.5	9.0	8.4											

^aLog 10 X transformation.^bX² transformation.^c1/X transformation.

TABLE 2.—*Intercorrelations of the Five Sets of Oblique Factor Scores*

	(2)	(3)	(4)	(5)
(1) Urban conditions	-.015	-.244	.091	-.098
(2) Large aged population		-.055	-.162	.224
(3) Restricted availability			.010	-.221
(4) Liberal availability				.006
(5) Low young-adult population				

premise availability. Factor 4, Liberal Availability, had positive loadings on per-capita retail outlets and minimal legal purchasing age, and a negative loading on price. Factor 5, Low Young-Adult Population, had negative loadings on the proportions of single men and women, and a moderately positive loading on the proportion of divorced and widowed men and the proportion of recreational employees (indicating tourism).

Inspection of the structure matrix indicates that the number of churches, which was negatively loaded on Factor 1, was positively loaded on Factor 3. Income, which loaded positively on Factor 1, loaded negatively on Factor 3. Divorced and widowed men, which loaded primarily on Factor 5, also loaded positively on Factor 2. Single women, which loaded negatively on Factor 5, loaded positively on Factor 1. Single men loaded principally on Factor 5 but also loaded negatively on Factor 2 and positively on Factor 4.

None of the intercorrelations among the factor scores given in Table 2 was statistically significant. Urban Conditions was, however, weakly and negatively related to Restricted Availability; Large Aged Population was positively related to Low Young-Adult Population, which in turn was negatively related to Restricted Availability.

Multiple-Regression Analyses. First, consumption was regressed on the five sets of factor scores. The independent variables were entered stepwise into the equation and are reported in order of variance accounted for. With the exception of variance added at a step (v_A), the statistics given—raw (B) and standardized ($Beta$) regression coefficients, F , p and variance added at the last step, or unique variance (uv)—were obtained when all variables had entered the equation. Simple correlations (r) are also given.

Inspection of Table 3 indicates that the independent variables overall accounted for a large and highly significant proportion of variance (69%). Urban Conditions accounted for the most variance, followed by Restricted Availability (negative relationship), and Liberal Availability. Low Young-Adult Population and Large

Factor Scores

(4)	(5)
.091	-.098
-.162	.224
.010	-.221
	.006

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TABLE 3.—Regression of Consumption on Factor Scores: Unstandardized (B) and Standardized (Beta) Coefficients, Simple Correlation (r), Significance Tests (F) and Unique Variances (UV), All at Final Step, with Variables Ordered by Variance Added (VA) at Step of Entry

	B	Beta	r	F	UV	VA
Urban conditions ‡	.168	.514	.639	33.490	.234	.408
Restricted availability ‡	-.143	-.426	-.608	22.211	.155	.197
Liberal availability †	.081	.232	.260	7.449	.052	.051
Low young-adult population	.058	.174	.217	3.813*	.027	.030
Large aged population	.006	.019	.030	.048	.000	.000
Constant = .923						

$$R^2 = .686, F = 19.628, 5/45 \text{ df}, p < .001$$

† $P < .01$. ‡ $P < .001$.

TABLE 4.—Regression of Cirrhosis Mortality on Factor Scores: Unstandardized (B) and Standardized (Beta) Coefficients, Simple Correlation (r), Significance Tests (F) and Unique Variances (UV), All at Final Step, with Variables Ordered into the Equation by Variance Added (VA) at Step of Entry

	B	Beta	r	F	UV	VA
Urban conditions ‡	.192	.538	.621	30.005	.256	.386
Large aged population ‡	.122	.343	.352	12.716	.109	.129
Restricted availability †	-.115	-.315	-.487	9.906	.085	.098
Low young-adult population	.018	.048	.146	.240	.002	.002
Liberal availability	.009	.025	.013	.069	.001	.001
Constant = 2.893						

$$R^2 = .616, F = 14.409, 5/45 \text{ df}, p < .001$$

† $P < .01$. ‡ $P < .001$.

Aged Population did not account for significant proportions of variance when all other variables were in the equation.

The regression of cirrhosis mortality on the five sets of factor scores was similarly conducted and is presented in Table 4. The overall R^2 (62%) is highly significant. Urban Conditions, Large Aged Population, and Restricted Availability (negative relationship) accounted for significant proportions of variance with all variables in the equation.

The regression of cirrhosis mortality on consumption and the five sets of factor scores is reported in Table 5. The overall R^2 (76%) is highly significant, as were the individual variables of Consumption and Large Aged Population. With Consumption in the equation, Urban Conditions and Restricted Availability no longer accounted for significant proportions of variance in predicting cirrhosis mortality.

When the equation contained only Consumption, R^2 is .595; only the other five factor-score variables, R^2 is .616; and all six

TABLE 5.—Regression of Cirrhosis Mortality on
Scores: Unstandardized (B) and Standardized (Beta)
Correlation (r), Significance Tests (F) and Unique
Step, with Variables Ordered into the Equation by
Step of Entry

	B	Beta	r
Consumption ‡	.727	.667	.727
Large aged population ‡	.118	.330	.330
Urban conditions	.070	.196	.62
Liberal availability	-.050	-.130	.013
Low young-adult population	-.025	-.068	.146
Restricted availability	-.011	-.031	.487
Constant = 2.893			

$R^2 = .755$, $F = 27.683$, 6/

‡ $P < .001$.

independent variables, R^2 is .755. Commonality analysis shows that the common variance of consumption (.595) plus the variance of factor scores (.616) minus all independent variables (.727) is .456 ($F = 36.88$, 1/44 df, $p < .001$). Consumption added unique variance over the other variables; $uv = .755 - .616 = .140$ ($F = 25.14$, 1/44 df, $p < .001$). The other variables added unique variance over consumption; $uv = .755 - .595 = .160$ ($F = 5.80$, 5/44 df, $p < .001$).

Inspection of significant effects in the three analyses suggests more specifically, that Urban Conditions was positively related to Cirrhosis Mortality. Restricted Availability was negatively related both to Consumption and to Cirrhosis Mortality. Liberal Availability had a small positive relationship to Consumption only, and Large Aged Population was related to Cirrhosis Mortality only. When Consumption was entered as an intervening variable with the factor-score sets, Urban Conditions and Restricted Availability dropped out, their variance having been accounted for by Consumption, to which they are also strongly related. The relationship of Large Aged Population to Cirrhosis Mortality is due in part to the low rate of alcohol intake to develop cirrhosis and to the

The two

TABLE 6.—*continued*

	Urban Conditions	Large Aged Population	Restricted Availability	Liberal Availability	Low Young- Adult Population
Rhode Island	1.103	0.100	- 0.472	- 0.221*	- 0.454
South Carolina	- 0.578	- 1.021	1.199	1.315	- 1.166
South Dakota	- 0.979	- 0.663	- 0.144	1.831	- 0.611
Tennessee	- 0.724	0.573	1.609	- 0.536	0.066
Texas	0.206	0.217	0.889	0.120	0.517
Utah	- 0.064	- 0.999	0.147	- 0.862	- 1.434
Vermont	- 0.466	- 0.497	- 0.245	2.359	- 0.176
Virginia	- 0.026	- 0.765	0.736	- 0.273	- 0.718
Washington	- 0.205	0.549	- 0.731	- 0.677	0.851
West Virginia	- 2.320	0.719	0.412	0.447	- 0.206
Wisconsin	0.259	- 0.299	- 1.233	1.631	0.090
Wyoming	- 0.707	- 0.189	- 0.913	- 0.438	1.325
District of Columbia	3.404	2.198	- 0.705	2.613	- 0.434

The restricted-availability dimension characterizes areas with fundamentalist and proscriptive attitudes, e.g., the Southeast. It would seem difficult to argue that availability measures induce such attitudes; more plausibly, availability is an index or result of such attitudes. It is interesting that only this form of availability is significantly related to cirrhosis mortality. The other availability factor, liberal availability, characterizes states that cater to transient populations such as tourists and out-of-state purchasers, e.g., Nevada and Vermont. Although such states may be high on apparent consumption, no relationship was obtained between this factor and cirrhosis mortality.

The factor analysis also revealed that the availability factors were mostly unrelated to urban conditions, which also has a primary loading on disposable personal income. It would appear, then, that a prevention model based solely on economic variables is untenable because these variables are intertwined with sociodemographic variables that are themselves individually predictive of alcoholism. An economic conception of alcoholism prevention is even more problematic when one considers that the only availability factor related to cirrhosis mortality appears to be a reflection of the normative structure of a region.

Consumption appears to be the most immediate cause of liver cirrhosis but examination of the relationship of all the factors to cirrhosis mortality suggests a rather broad approach to prevention.

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F	UV	VA
103	.140	.595
094	.101	.108
186	.019	.033
521	.014	.015
669	.004	.004
097	.000	.001

df, $p < .001$

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high on one set of measures and low on the other (Table 6). The complex interplay of social, political, economic and religious forces that have contributed to the evolution of control laws and the piecemeal manner in which these have been repealed and amended would preclude the emergence of any single unifying policy structure or philosophy.

TABLE 6.—Oblique Factor Scores for the 50 States and the District of Columbia

	Urban Conditions	Large Aged Population	Restricted Availability	Liberal Availability	Low Young- Adult Population
Alabama	- 0.545	0.152	2.013	- 0.773	- 0.452
Alaska	0.617	- 3.796	- 0.966	0.039	0.765
Arizona	0.949	- 0.574	- 0.534	- 0.210	0.242
Arkansas	- 1.180	0.661	1.737	- 0.779	0.807
California	1.447	- 0.297	- 1.504	- 0.896	0.266
Colorado	0.150	- 0.135	- 0.522	0.101	0.097
Connecticut	0.689	0.375	- 0.600	- 0.806	- 1.095
Delaware	0.278	0.057	- 0.308	- 1.156	- 0.630
Florida	0.671	1.262	1.112	- 0.281	1.934
Georgia	- 0.065	0.069	2.487	- 0.357	- 0.544
Hawaii	1.860	- 2.879	- 0.262	0.198	- 0.968
Idaho	- 0.970	- 0.416	- 0.817	0.252	1.046
Illinois	0.841	0.876	- 0.352	- 0.795	0.066
Indiana	- 1.118	0.671	0.021	- 1.279	- 0.107
Iowa	- 1.276	0.586	- 0.885	- 0.915	- 0.109
Kansas	- 0.518	0.521	0.114	- 0.051	0.325
Kentucky	- 1.491	0.177	1.229	- 0.616	- 0.222
Louisiana	0.663	- 0.534	1.006	1.126	- 0.164
Maine	- 0.946	0.441	- 0.271	0.514	0.323
Maryland	0.599	- 0.238	- 0.280	- 1.180	- 0.611
Massachusetts	1.351	0.722	- 0.192	- 0.295	- 1.151
Michigan	0.386	- 0.182	- 0.208	- 0.890	- 0.249
Minnesota	- 0.266	- 0.093	- 0.393	0.374	- 1.138
Mississippi	- 0.321	- 0.537	2.115	1.456	- 0.297
Missouri	0.050	1.113	- 0.452	0.102	0.910
Montana	- 0.336	- 0.395	- 0.695	0.867	1.187
Nebraska	- 0.754	0.473	- 0.578	0.079	- 0.369
Nevada	0.623	0.352	- 1.186	0.041	3.788
New Hampshire	- 0.645	0.081	- 0.857	0.280	- 0.033
New Jersey	1.001	0.506	- 0.454	- 1.406	- 0.795
New Mexico	0.476	- 0.997	0.768	- 0.010	- 0.319
New York	1.625	0.814	- 0.816	0.550	- 0.371
North Carolina	- 0.432	- 0.838	1.661	0.285	- 1.013
North Dakota	- 0.768	- 1.561	- 0.015	1.039	- 1.319
Ohio	- 0.289	0.730	- 0.375	- 0.626	- 0.049
Oklahoma	- 0.692	1.003	0.148	0.290	1.953
Oregon	- 0.541	0.867	- 0.870	- 0.668	1.165
Pennsylvania	- 0.027	1.042	- 0.568	- 0.915	- 0.521

continued—

ty	Low Young- Adult Population
	- 0.454
	- 1.166
	- 0.611
	0.066
	0.517
	- 1.434
	- 0.176
	- 0.718
	0.851
	- 0.206
	0.090
	1.325
	- 0.434

It appears futile to develop a prevention strategy that touches only on alcohol consumption without addressing attitudes, social conditions, and urbanization factors. Community programs that influence the immediate quality of life are indicated rather than centralized approaches that rely on laws and their enforcement. Church, social and recreational programs may be more efficacious than the manipulation of alcoholic beverage control laws. Alcoholics Anonymous and other socially integrative mutual-help groups with and without religious overtones have demonstrated some efficacy in the arrest of alcoholism. The encouragement of groups that increase social integration and work to prevent excess consumption and the consequent alcoholism would seem to be desirable. This is not to say that alcohol-control policies do not serve other fiscal, social, or psychological ends; just that, given the limited resources available to address the problem of alcoholism, care should be exercised in clearly identifying the ends served by a policy.

The results support the idea that the consumption of alcohol is a necessary but not sufficient prerequisite of alcoholism. Consumption is associated with several of the sociocultural, economic and availability factors but is fully explained by none of them. Thus no single, simple or sovereign solution to the problem of alcoholism is available or feasible. Economic and legislative approaches to the problem are readily short-circuited by illegal availability, especially, as noted above, in the areas where the most restrictive legislation is still in force. If the experience with Prohibition is any guide, the overall average reduction in intake accounted for by law-abiding citizens may not serve to reduce heavy drinking among those less scrupulous. Clearly there is still a strong need for a national policy and a personal consensus that recognize the damage caused by excessive alcohol consumption and seek to establish a lifestyle that is free of this disabling practice.

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FIFTH SPECIAL REPORT TO THE U.S. CONGRESS ON
ALCOHOL AND HEALTH
FROM THE SECRETARY OF HEALTH AND HUMAN SERVICES

DECEMBER 1983

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Foreword

As this report so amply documents, the price of alcohol abuse to the American people is appallingly high. And that price is paid by all of us. The cost to our economy has been estimated at over \$49 billion each year. But the dollar cost is only the beginning. The cost in human pain and misery, disease, and death is still more staggering. Accidents on our streets and highways claim about 50,000 Americans' lives each year—leaving another 150,000 permanently disabled. Half of those tragedies are alcohol related. Alcohol's role in disrupting family life is less easily documented, but few doubt that it is significant. One in three Americans surveyed last year felt that alcohol caused problems in his or her family.

Fortunately, this long-neglected problem has now become of increasing concern to many Americans. As a result of citizen action, drunk driving, once largely ignored, is now being taken seriously. More and more States are enacting tougher laws to discourage driving after drinking. Treating alcoholics once was of

interest to a few dedicated men and women—themselves often recovering alcoholics. Treatment now involves many thousands in the helping professions as well. In industry, many, perhaps most, companies are coming to recognize that losing a valued employee to alcoholism is costly—and that making provision for treatment just makes good business sense. Many health insurance plans are providing benefits to treat alcoholism itself as they discover it costs much less in the long run than treating its chronic health consequences.

Perhaps the most encouraging sign is the increasing awareness Americans are developing that we ourselves have a primary responsibility for preserving our well-being by practicing better health habits—including moderation in alcohol consumption.

This report deserves to be widely read—and its implications thoughtfully considered. Through our combined efforts, we can sharply reduce alcohol abuse and its devastating consequences.

Margaret M. Heckler
Secretary of Health and Human Services
December 1983

Preface

This has been a century of impressive achievement in public health. The advent of vaccines against such diseases as smallpox, diphtheria, and polio and their widespread application have virtually eliminated those once dreaded illnesses. Tuberculosis, the cause of one in eight deaths in 1900, is now uncommon and still more rarely fatal. Antibiotics have made most infectious diseases easily curable. But the devastation of one disease has not yet been significantly eroded. It plays a role in 10 percent of all deaths in the United States. In some segments of the population, it produces still higher mortality. It is the principal cause of deaths through accidents among those aged 15 to 24. That malady is, of course, alcohol abuse.

Alcohol abuse during pregnancy has been found to cause fetal alcohol syndrome and other alcohol-related birth defects. Fetal alcohol syndrome appears to be one of the leading known teratogenic causes of mental retardation. There is reason to believe that alcohol may be injurious to the developing fetus at dose levels no higher than those often consumed by those who drink moderately.

In adults, alcohol abuse is the leading cause of liver cirrhosis (the eighth leading cause in the United States), the leading contributing factor for chronic pancreatitis, and has been

implicated in a wide range of other illnesses as well.

As this and previous Alcohol and Health reports indicate, the increased Federal role in this area has markedly altered an earlier pessimistic outlook with respect to treating those dependent on alcohol. We no longer believe that the alcoholic must reach the late stages of the illness before he or she can benefit from help. On the contrary, as in other illnesses, there is good evidence that the earlier treatment begins, the greater is the likelihood of successful recovery.

Alcohol research has provided us with greater insight into the underlying mechanisms of alcohol dependence. It is by no means visionary to say that our enhanced understanding holds the promise not only of improved treatment, but of preventing alcohol dependence before it develops. We may not be far from the day when simple laboratory tests can determine those who are at greatest risk of becoming alcoholic—before they take that first drink.

The Fifth Special Report, together with its predecessors, provides valuable insight into the impressive progress that has been made—and the distance yet to be traveled before we resolve this major public health problem.

Edward N. Brandt, Jr., M.D.
Assistant Secretary for Health

Acknowledgments

This Fifth Special Report on Alcohol and Health is the product of many people's efforts in reviewing and summarizing hundreds of scientific papers, begun shortly after the Fourth Special Report was forwarded to the U.S. Congress in 1981. The chief contributors, many of whom also contributed to previous reports, include some of the most distinguished scientists and knowledgeable alcoholism researchers and medical authorities in the world today.

Equally important roles were played by individuals who provided professional review of the preliminary report. The combined efforts are reflected in every chapter of the report.

Contributors

Harold L. Altshuler, Ph.D.
Texas Research Institute of Mental Sciences
Texas Medical Center
Houston, Texas

Thomas F. Babor, Ph.D., M.P.H.
Department of Psychiatry
University of Connecticut
School of Medicine
Farmington, Connecticut

Herbert Barry III, Ph.D.
Department of Pharmacology and Toxicology
University of Pittsburgh
Pittsburgh, Pennsylvania

Ralph Hingson, Sc.D.
School of Medicine
Boston University
Boston, Massachusetts

Paula L. Hoffman, Ph.D.
Department of Physiology and Biophysics
University of Illinois at the Medical Center
Chicago, Illinois

Ronald Kadden, Ph.D.
Department of Psychiatry
University of Connecticut
School of Medicine
Farmington, Connecticut

Charles Kaelber, M.D.
Division of Biometry and Epidemiology
National Institute on Alcohol Abuse
and Alcoholism
Rockville, Maryland

Ting-Kai Li, M.D.
Indiana University
School of Medicine
Indianapolis, Indiana

Henry Malin
Acting Chief
Surveillance Branch
Division of Biometry and Epidemiology
National Institute on Alcohol Abuse
and Alcoholism
Rockville, Maryland

Peter R. Martin, M.D.
Acting Chief
Section of Clinical Science
Laboratory of Clinical Studies
National Institute on Alcohol Abuse
and Alcoholism
Rockville, Maryland

Barbara S. McCrady, Ph.D.
Center of Alcohol Studies
Rutgers University
Piscataway, New Jersey

Roger E. Meyer, M.D.
Department of Psychiatry
University of Connecticut
School of Medicine
Farmington, Connecticut

Peter E. Nathan, Ph.D.
Alcohol Behavior Research Laboratory
Rutgers University
New Brunswick, New Jersey

Robert J. Sokol, M.D.
Wayne State University
Department of Obstetrics and Gynecology
Detroit, Michigan

Boris Tabakoff, Ph.D.
Department of Physiology and Biophysics
University of Illinois at the Medical
Center
Chicago, Illinois

David H. Van Thiel, M.D.
University of Pittsburgh
School of Medicine
Pittsburgh, Pennsylvania

Diana Walsh, Ph.D.
School of Medicine
Boston University
Boston, Massachusetts

Reviewers

James Beard, Ph.D.
University of Tennessee
College of Medicine
Memphis, Tennessee

Linda J. Beckman, Ph.D.
University of California at Los Angeles
Department of Psychiatry
Los Angeles, California

Henri Begleiter, Ph.D.
Department of Psychiatry
SUNY Downstate Medical Center
Brooklyn, New York

Nancy L. Day, Ph.D.
Department of Psychiatry and Epidemiology
Western Psychiatric Institute and Clinic
University of Pittsburgh
Pittsburgh, Pennsylvania

Richard A. Deitrich, Ph.D.
University of Colorado
Health Sciences Center
Denver, Colorado

Ivan Diamond, M.D., Ph.D.
University of California
School of Medicine
San Francisco, California

Herman Diefenhaus, Ph.D.
Colorado State Department of Health
Denver, Colorado

Terryl T. Foch, Ph.D.
Pennsylvania State University
College of Human Development
University Park, Pennsylvania

Donald W. Goodwin, M.D.
University of Kansas
School of Medicine
Kansas City, Kansas

Richard Jessor, Ph.D.
University of Colorado
Institute of Behavioral Sciences
Boulder, Colorado

Benjamin Kissin, M.D.
State University of New York
College of Medicine
Department of Psychiatry
Brooklyn, New York

Gerald E. McClearn, Ph.D.
Pennsylvania State University
College of Human Development
University Park, Pennsylvania

William C. McCready, Ph.D.
National Opinion Research Center
University of Chicago
Chicago, Illinois

Mariene Oscar-Berman, Ph.D.
School of Medicine
Boston University
Boston, Massachusetts

Carrie Randall, Ph.D.
Medical University of South Carolina
Charleston, South Carolina

Theodore Reich, M.D.
Psychiatrist-in-Chief
Jewish Hospital
St. Louis, Missouri

Robin Room, Ph.D.
Pacific Medical Center
San Francisco, California

Steven Schenker, M.D.
University of Texas
Health Science Center
San Antonio, Texas

Brian Suarez, Ph.D.
Washington University
Jewish Hospital
St. Louis, Missouri

Don Walker, Ph.D.
University of Florida
College of Medicine
Gainesville, Florida

James R. West, Ph.D.
University of Iowa
Iowa City, Iowa

Sharon Wilsnack, Ph.D.
University of North Dakota
School of Medicine
Grand Forks, North Dakota

A significant number of NIAAA staff members made major contributions to this report as technical reviewers and consultants. These individuals included Loran Archer, Deputy Director, NIAAA; Lois Chatham, Ph.D., Kenneth Warren, Ph.D., Helen Chao, Ph.D., Tina Vanderveen, Ph.D., Mark Green, Ph.D., Albert Pawlowski, Ph.D., Daniel Lettieri, Ph.D., Nathan Rosenberg, Ph.D., Norman Chang, Ph.D., and Elsie Taylor, Division of Extramural Research; Henry Malin, Division of Biometry and Epidemiology; William Gregory, Rita Alberty, and Judi Funkhouser, Division of Prevention and Research Dissemination; Susan Farrell and Joan White, Office of Policy Analysis; and Brenda Hewitt, Special Assistant to the Director, NIAAA.

Other individuals who made significant contributions were Robert Petersen, Ph.D., who served as a writer and provided technical assistance, particularly in the overview and other front matter, and Samuel Rosenfeld, a science writer who participated during the early draft stages of the report.

Introduction

To know where you are, it is often useful to look back at where you've been. Less than 15 years ago, a major U.S. Government publication described the problem of alcohol abuse in America as follows:

No other national health problem has been so seriously neglected as alcoholism. Many doctors decline to accept alcoholics as patients. Most hospitals refuse to admit alcoholics. Available methods of treatment have not been widely applied. Research on alcoholism and excessive drinking has received virtually no significant support.¹

It went on to laud the transition from an "atmosphere of moral disapproval" in which alcoholics were treated as "sinners or criminals" to the recognition that alcoholism is an illness. Only 3 years before, a U.S. Court of Appeals, in a precedent-setting decision, held that a homeless alcoholic's public drunkenness was involuntary. Up until then, nearly half of all arrests (excluding traffic offenses) were related to drunkenness. By 1968, Congress enacted the Alcoholic Rehabilitation Act (P.L. 90-574), declaring that "alcoholism is a major health and social problem" and that "the handling of chronic alcoholics within the system of criminal justice perpetuates and aggravates the broad problem of alcoholism whereas treating it as a health problem permits early detection and prevention . . . and effective treatment and rehabilitation. . . ."

This Act and subsequent legislation (P.L. 91-616) establishing the National Institute on Alcohol Abuse and Alcoholism (NIAAA) translated the long-held position of knowledgeable professionals that alcoholism was a treatable disease into national public policy. It officially declared, "Our task is not to punish, but to heal."

It is ironic that it took so long for public policy to reflect an informed consensus. Nearly 200 years ago, one of our country's most distinguished physicians, Dr. Benjamin Rush, labeled alcohol abuse an "addiction and a disease."² He also provided the first epidemiological estimate of the number of deaths each year from alcohol abuse. His estimate of 4,000 deaths annually in a population of 6 million (66.7 per 100,000) is surprisingly close to present estimates (as high as 93.2 per 100,000).

While the problems associated with alcohol are still very much with us, we at the Institute take satisfaction in what has been achieved in the 12 years since NIAAA was established. The first edition of the Alcohol and Health reports (1971) referred to alcoholism as an "iceberg problem," because social pressures caused so many with the disease to deny it. In the years since, the hidden portion of that iceberg has become more and more exposed. There have been important shifts in our attitudes toward drinking. Removing the moral onus from alcoholism made it easier for alcoholics to admit to having a disease rather than a defect of will. Organizations that previously stressed anonymity in their rehabilitation efforts have become more sympathetic to individual self-disclosure. Many of our leading citizens are now willing to "come out"—to acknowledge their own hard-fought battles with alcohol addiction. Their courage has made it easier for others to recognize that they too have alcohol problems—and to do so at an earlier stage.

There have been other benefits of more honestly recognizing that problems from alcohol abuse can occur at all levels of drinking and of the society. The still prevalent myth that drinking is "sophisticated," a necessary part of the "successful" life, is slowly being eroded. It now requires less social courage to refuse a drink or to request a nonalcohol substitute. The belief that drinking is essential to masculinity has been very much a part of

¹ U.S. Department of Health, Education, and Welfare. Alcohol and Alcoholism. National Clearinghouse for Mental Health Information Pub. No. 5011. Washington, D.C.: U.S. Government Printing Office, 1969.

² Rush, B. An Inquiry into the Effects of Ardent Spirits upon the Human Body and Mind; With an Account of the Remedies for Curing Them. (1785) Brookfield, Merriam, 8th ed. 1814.

American folklore. It is being supplanted by an increasing recognition of the health hazards of alcohol abuse and a new commitment to affirmation of good health practices. A public health revolution is underway with official recognition that the individual can do more for his or her own health than any doctor, hospital, drug, or other medical innovation. The past decade has clearly shown that habits as basic to personal health as smoking, diet, and exercise can be changed--and in a remarkably short time. Our success in changing behaviors that were once thought immutable provides good reason for optimism about alcohol abuse. As has become true of smoking, not drinking or drinking more moderately may become the "in" thing.

The carnage on our highways documented here and in earlier reports has also led to a new public appreciation of the gravity of mixing drinking with driving. Citizen groups have been impressively effective in changing public attitudes toward drinking and driving, making individuals more aware of just how much alcohol impairs driving skill.

Primary prevention--before drinking has even begun--may be one key to sharply reducing the high casualty rate from alcohol described in this report. Early intervention, between the sixth and ninth grades, is one means of educationally "inoculating" children against alcohol (and tobacco) abuse. Such efforts to teach good health habits early need to be carefully evaluated. As indicated here, most alcohol education efforts at older ages have been more successful in increasing knowledge about the drug, possibly altering expressed attitudes, but not in changing actual drinking.

Drinking during pregnancy is now known to pose risks for the health of the newborn. Programs directed toward women who have alcohol problems could sharply reduce the number of newborn who suffer such serious consequences of maternal drinking as the fetal alcohol syndrome and other alcohol-linked birth anomalies.

Treatment of alcoholism has come of age. Once largely confined to dedicated members of groups like Alcoholics Anonymous and a few committed professionals, treatment efforts in recent years have grown almost exponentially. Treating alcoholics is now "respectable"--and training for physicians and others to treat the alcohol-dependent person reflects this new found status.

There is an increased willingness to subject therapeutic efforts to research scrutiny--to

determine what works best with whom and under what circumstances. Innovative employee assistance programs are now challenging the traditional belief that treatment must be completely voluntary to be successful. There is evidence that job-based referrals to treatment, provided early and in lieu of disciplinary action on the job, can be as effective as treatment sought on one's own. Treating alcohol dependence early is far more likely to succeed and is less costly to treat than intervention when this insidious disease is far advanced.

The fact that treating alcoholism within the framework of health insurance plans is cost-effective has now been proven repeatedly. There is no question that this leads to lower long-term health costs to the individual and the plan. Encouraging expansion of health insurance coverage to include adequate treatment of alcohol dependence is an important and continuing priority of the Institute.

The high costs of medical care are coming under more careful scrutiny. While a hospital was once thought to be the only suitable setting for detoxifying alcoholics, other settings may be equally effective--and much more cost-effective. Alternative treatment models employing certified alcoholism counselors have had demonstrated success. As the capabilities of these less expensive alternatives become apparent, health insurance programs should include them within their benefit structure.

A lack of agreement as to just what is meant by such terms as "alcohol abuse" and "alcoholism" has plagued us for many years. Because of it, comparing research and treatment outcomes has sometimes been difficult. We now recognize that alcohol abuse and alcoholism are both multidimensional with multiple causes. The newer modes of classification described in this report attempt to take this complexity into consideration.

One of the most satisfying developments in recent years has been research innovation. Federal support for alcohol research, once almost nonexistent, has had significant impact. By its very nature, basic research is a long-range enterprise, and its practical implications are often not immediately apparent. But studies of the ways in which alcohol alters the cellular anatomy and neurophysiology of the brain are already enlarging our understanding in ways that have practical "payoffs." A sensitive measure of the brain's electrical responses to sound and light stimulation may prove useful in determining those at greater

risk of becoming alcohol dependent. Other indications of the effects of alcohol on chemicals that govern nerve transmission are providing better explanations of just why certain symptoms of alcohol abuse occur. New neurophysiological explanations of how alcohol and other dependency-producing drugs operate offer the tantalizing possibility of some form of chemotherapy to reduce or even eliminate the likelihood of becoming alcohol dependent. While this is not a promise for the immediate future, it is an example of the kind of payoff that is unpredictable in the initial stages of basic research.

Biological markers described here--tests that distinguish heavy drinkers from others by measuring effects on the blood or other biological variables--are becoming valuable in the early diagnosis of those with drinking problems. Used in many kinds of settings, such tests can serve to alert the individual to the reality that he or she has an alcohol problem. There is now evidence that making patients aware of the results of such tests, together with limited followup treatment, can be effective.

Advanced computer technology applied to brain scanning has also shown evidence of alcohol-induced brain damage--even in the absence of obvious clinical signs.

In earlier reports, the significance of heredity--a biological predisposition toward alcoholism--was in doubt. A substantial body of animal and human research now leaves little question that heredity plays a role in susceptibility to some of alcohol's effects and in some individuals increases their likelihood of becoming dependent on it. The distinct possibility of identifying such potential alcoholics early may enable us to focus prevention efforts on those at high risk.

Our advances in knowledge have led to a measure of optimism in dealing with alcohol abuse. The 1990 Objectives for the Nation cited in this report reflect this. We are hopeful, for example, that, by 1990, 80 percent of high school seniors will feel, as only a third now do, that there is "great risk" in becoming intoxicated. It may be possible to reduce the

percentage of problem drinkers of all ages by 20 percent. The increased health awareness in our country should facilitate achieving that goal. At the same time, we hope to attain reductions in alcohol-related accidents of over 20 percent and decrease cirrhosis mortality by 10 percent.

The risk of women's drinking while pregnant is now recognized by only three-quarters of women of childbearing age. Raising the consciousness of women to the point where at least 9 out of 10 are aware of the potential risk by the end of the decade is a realistic goal for our public information efforts.

While over half of Fortune 500 firms now have alcohol prevention and referral programs, we believe that a heightened awareness of the value of employee assistance programs will increase their numbers of 70 percent by 1990.

Building on the significantly improved epidemiological effort of the past decade, it should be possible by 1990 to collect far more comprehensive data on the impact of alcohol abuse on American society that will enable us to better monitor what is happening--and to modify our programs as we become more aware of changing national needs.

If this edition of Alcohol and Health provides some grounds for optimism, there is little basis for complacency. Alcohol continues to exact a fearsome toll. We sometimes forget that the cost of alcohol abuse to American society is higher than that for cancer, and at least equal to that for heart and vascular disease (Alcoholism and Related Problems: Opportunities for Research. Report of the Institute of Medicine of the National Academy of Sciences, Washington, D.C., 1980). The amount of our national resources devoted to reducing these costs is still modest compared with that earmarked for more "acceptable" disease. The moralistic stance of an earlier era, to that extent at least, is still with us. Many--perhaps most of us--continue to experience conflicts about our use of alcohol. As we resolve those conflicts, a more rational individual and collective approach becomes possible.

Robert G. Niven, M.D., Director
National Institute on Alcohol Abuse
and Alcoholism

Alcohol and Health—An Overview

Alcohol is undoubtedly the most widely used—and abused—drug in America. In 1981, the latest year for which figures are available, the equivalent of 2.77 gallons of absolute (pure) alcohol was sold per person over age 14. Translated into alcoholic beverages, this is about 591 12-ounce cans of beer or 115 bottles (fifths) of table wine or 35 fifths of 80 proof whisky, gin, or vodka.¹ However, Americans are far from equal in their drinking habits. In national surveys, a third of adults report they don't drink. Another third report drinking just over 2 drinks per week (0.21 oz. absolute alcohol/day), and the remaining third report consuming an average of 14 drinks per week. But such averages are deceiving—a tenth of the drinking population consume half the alcoholic beverages sold.

While drinking is nominally restricted to adults, it actually begins much earlier. By ninth grade, more than half (56 percent) of high school seniors responding to an annual 1982 national survey had tried alcohol. But by their senior year, more than 9 out of 10 (93 percent) had done so. Almost all seniors (90 percent) had drunk alcoholic beverages in the previous year. Two out of 5 seniors (41 percent) reported they had had five or more drinks—enough to become drunk—on a single occasion in the 2 weeks prior to the survey. Six percent reported drinking on a daily or near daily basis. High school drinking patterns over the 7 years sampled have changed very little. Male seniors drink more often than females and are more likely to do so daily.

A third (31 percent) of the high school seniors did not disapprove of drinking one or two drinks daily, although two-thirds (65 percent) felt that as many as four or five drinks per day would be harmful.

Defining Alcoholism and Heavy Drinking

Previous editions of this report, like this one, describe in detail many health and social

¹ Assuming 0.6 oz. absolute alcohol = 1.5 oz. 80 proof spirits = 5 oz. table wine (12 percent alcohol) = 12 oz. beer (5 percent alcohol).

consequences of alcohol abuse. These consequences can be summarized most succinctly by saying that there is much evidence—on many grounds—for concluding that alcohol used heavily is costly in human as well as economic terms. New evidence of that cost will be discussed here. But the question of how much must be used to produce a given effect is far more difficult to answer. Research on humans and animals indicates large individual differences in susceptibility to the drug.

When the term "alcoholic," "alcohol abuser," or "problem drinker" is used to designate an alcohol abuser, it must be kept in mind that these designations are somewhat less than precise. What is usually meant by an alcoholic is an individual who has been formally diagnosed as such or has (or has had) serious alcohol problems that meet implicit or explicit criteria of alcoholism, whether or not these have ever been formally diagnosed. It is hoped that, in this report, context will clarify meaning. Similarly, the term "heavy use" sometimes means use that is statistically more frequent than is true of American users generally (as in: "The heaviest using third of the population consume an average of 14 drinks per week."). More often, it is used to indicate a level at which pathological (or adverse behavioral) changes occur more frequently. Some types of episodic or binge drinking may fit neither definition of heavy use, but may nevertheless have serious implications (e.g., drunk driving).

While we have indicated the drink equivalent of a particular amount of absolute alcohol, in reality typical drinks are by no means uniform, and we are forced to rely on rough approximations. As in describing other areas of real life (e.g., smoking habits), we are obliged to accept a certain lack of precision. But within those limits, meaningful observations are possible, as this and earlier reports demonstrate.

Alcoholism and Heredity

Is alcoholism inherited? New evidence concerning genetic susceptibility to alcoholism is

one of the exciting developments in recent research. The belief that alcoholism somehow "runs in families" is an old one. But growing up with an alcoholic parent as a role model has been the traditional explanation for the higher than normal rate of alcoholism in children of alcoholics. Evidence that alcoholics' children, despite having been raised by nonalcoholics, still have a higher rate of alcoholism is persuasive that genetics plays an important role. Moreover, specific biochemical and physiological characteristics in which heredity appears to be important have recently been identified in alcoholics.

A pioneering study of alcoholics who had half-siblings (i.e., brothers or sisters with whom they had only one biological parent in common) found that half-siblings who were also alcoholic were three times more likely to have had an alcoholic natural parent than the nonalcoholic half-siblings.

Research on children adopted at an early age also helps to clarify the role of heredity and environment. Researchers studied a matched sample of natural sons of alcoholics who were then adopted by others, comparing them with the natural sons of nonalcoholics who were also adopted. Both groups had been raised by nonalcoholic adoptive parents. The alcoholics' sons proved to be three times more likely to become alcoholics than the sons of nonalcoholic parents. When the sons of alcoholics were compared with their brothers who had remained in their alcoholic families of origin, the two groups had the same rates of alcoholism, a finding that heredity plays an important role in the development of alcoholism.

Although too few females were considered in the above studies to draw any conclusions about a genetic factor in women alcoholics, a more recent study of adopted women found that those whose natural mothers were alcohol abusers were four times more likely to become alcoholics than those whose mothers were not. Alcoholic fathers did not seem to have the same effect on their daughters. Interpreting this study is complicated by the possible role of the mothers' alcohol use while pregnant in affecting their daughters' later alcohol problems. While it is the first study to suggest a biological predisposition in women alcoholics, there is no way of knowing whether the predisposition is on an in utero developmental basis or a hereditary basis—or both.

A more recent study identified a male limited form of alcoholism where sons of alcoholic fathers are at ninefold higher risk for developing alcoholism themselves.

While the research just described has stressed the importance of genetics in the eventual development of alcoholism, it is certainly not a simple matter of "nature vs. nurture." Other studies suggest that with a genetic susceptibility toward becoming alcoholic, the additional factor of nurturance by an alcoholic parent doubles the chances of the child's becoming alcoholic. But for many, probably most, alcoholics, genetic factors are not apparent in their immediate family's history. However, this does not rule out heredity. Since studies have not been made of multiple generations, there is no way of knowing whether such a biological tendency was present in earlier generations.

Animal research in which systematic inbreeding for several generations has been done clearly indicates the important role of genetics in determining individual susceptibility to many of alcohol's biological effects. Strains of animals can also be selectively bred to prefer drinking alcohol while other strains do not.

Assuming that some inherited tendency increases the likelihood of a person's becoming alcoholic, there are many ways in which it might operate. To name a few: The individual could be more sensitive to certain kinds of stimulus overload, and alcohol may blunt this sensitivity—a mode of self-medication. The central nervous system might neurochemically function in a way that makes it more readily dependent on the drug. It could also account for a more rapid development of tolerance (the need for greater amounts to produce a given effect) and physical dependence. There is some evidence for all of these and other mechanisms as well.

Studies of human twins suggest that as much as half the variation in the rate at which alcohol is eliminated from the body may be genetically determined. The other half is probably related to how alcohol and other drugs are used, diet, and other personal habits. Twin studies also indicate genetically based variation in susceptibility to such medical complications as cirrhosis of the liver and alcohol-induced mental disorders.

Researchers have recently found that one form of the genetically determined liver enzyme aldehyde dehydrogenase is absent in many Orientals. This likely accounts for the higher rate of facial flushing observed after drinking among many of these individuals. The facial flushing is often accompanied by nausea, vomiting, and a drop in blood pressure. These unpleasant symptoms are similar to the reaction that occurs when a person taking

disulfiram consumes alcohol. Such built-in negative responses to alcohol may partially explain why individuals from similar backgrounds often differ so widely in their alcohol consumption.

The certainty that heredity plays a significant role in the development of harmful drinking behaviors and in affecting individual sensitivity to alcohol's injurious effects offers the possibility of better defining biological subtypes of alcohol abusers. If the initial optimism about finding biochemical markers is justified by further research, it may be possible to identify potential alcoholics early—before they develop serious alcohol problems or alcoholism.

Alcohol and the Brain

Alcohol's effects on the brain are among its most seductive—and destructive—properties. Its pleasure-giving potential, along with many of its behavioral hazards, has been recognized since antiquity. Its natural occurrence through spontaneous fermentation probably makes it our most ancient mind-altering substance. But it is only very recently that we are beginning to understand the complexity of alcohol's effects and their underlying neuroanatomical and physiological basis.

Effects of Alcohol on Skilled Performance

Amounts often drunk socially (two or three drinks in an hour) can cause significant impairment in the skills required in driving, flying, and other complex performance. Recent evidence also indicates that time of day can make a difference in how seriously one's performance is affected. Decrements typically persist for many hours after drinking in the evening. Alcohol combined with fatigue has a more pronounced effect than either alone. Recent evidence also suggests that alcohol and tobacco have a greater combined effect on auditory alertness than when used separately.

Overall, there is compelling evidence that alcohol alone and in combination with other commonly used drugs has serious effects on many kinds of performance. The decrements are generally dose-related—the greater the amount consumed, the greater the impairment that results. Further documentation of this can be found in earlier editions of this report.

Alcohol and Brain Damage

Chronic brain injury caused by alcohol is second only to Alzheimer's disease as a known cause of mental deterioration in adults. Many of the symptoms—loss of ability to think abstractly, speech difficulty, and decreased coordination—are similar in the two types of disease. Both groups of patients show brain atrophy (shrinkage) and similar abnormalities in brain electrical functioning. However, Alzheimer's disease is invariably progressive, whereas alcoholic mental deterioration is not. If the patient stops drinking, the deterioration is arrested and substantial recovery can occur.

(Even in alcoholics without obvious evidence of mental deterioration, CAT scans—computerized techniques for visualizing and measuring the brain—have revealed abnormalities). Another advanced computerized method (average evoked response or AER) measures the response of the brain to light and sound stimulation. Recent work indicates that alcoholics respond differently than do non-alcoholic persons. Alcoholics are more sensitive to the stimulation. One theory is that their sensitivity leads them to drink in an effort to reduce their stimulus overload. Possible evidence of this is the recent discovery that those with family histories of alcohol use—even though they were not themselves alcoholics—were different in their AERs from those who had no alcoholics in the family. If this finding is confirmed, it may provide another means for early identification of those at risk of becoming alcoholics.

Other advances in brain measurement have found that alcohol alters brain activity in parts of the brain involved in memory, emotion, and higher level functioning. Microscopic study of the brains of patients who have died with Korsakoff's syndrome, an alcohol-induced disease characterized by severe memory loss and impaired learning, has disclosed brain injury near nerve pathways involved in these functions. These brain lesions are very like those found in patients who have died of acute vitamin B₁ (thiamine) deficiency, possibly indicating that a similar vitamin deficiency occurs after chronic heavy alcohol use.

Debate took place in the past over whether the brain injury found in alcoholics is the result of alcohol as such or of the dietary deficiencies that are so common in advanced alcoholism. It is now known that alcohol itself injures brain tissue, although the combination of excessive drinking and poor diet may accelerate the process.

Neurochemistry--the study of minute quantities of chemicals in the brain that govern how nerve cells transmit their messages--is also advancing our understanding of alcohol. But the effects of the drug on these neurotransmitters is not simple. They seem to vary depending on the part of the brain involved as well as the dose.

Dose-related opposing effects have been found on the neurotransmitter norepinephrine. At low doses alcohol increases norepinephrine release, but at higher doses release of the chemical is inhibited. This seems to correspond to the everyday observation that alcohol is initially stimulating in small amounts but has a depressant effect as more is consumed.

Another neurotransmitter, GABA, inhibits neuronal firing and can control the tendency toward certain types of convulsions. Animal research indicates that animals chronically given alcohol have a reduced number of receptor sites for GABA. This suggests that GABA may play a role in the seizures often seen in alcoholics.

Other research, on the neurocellular level, is probing alcohol's effects on cell membranes. It may explain how tolerance for alcohol--its decreased effect when used regularly--develops and the neurocellular basis for physical dependence.

Earlier research has found that alcohol can affect parts of the brain involved in reward or pleasure. There is now heightened interest in other mechanisms by which alcohol and similar dependency-producing drugs operate. Naturally occurring opiate-like compounds have been found in the brain. Both these chemicals and externally derived opiates seem to have similar sites of action--the opiate receptors. Chronic doses of alcohol in test animals may alter the function of these opiate receptors. This finding has led scientists to speculate that alcohol and other psychoactive drugs may act similarly in the brain. Some support for this theory comes from the observation that narcotic antagonists--drugs that can block the effects of an opiate by occupying opiate receptor sites--also block some, but not all, of alcohol's effects.

Another provocative preliminary hypothesis is that a group of chemicals called tetrahydroisoquinolines, or TIQs, may play a role in habitual heavy drinking. TIQs are formed when alcohol is metabolized. In some animal experiments, when these chemicals were injected into the brains of animals, their preference for alcohol increased significantly.

All of these preliminary neurophysiological observations fall short of adequately explaining the action of alcohol. Additional research is needed to sort out some of these conflicting--and still clearly incomplete--explanations.

Other Health Hazards

Even a casual observer notices some of the effects of heavy drinking on the brain and the complex behavior it controls. But there are other, more insidious, consequences for other parts of the body as well. And many of these are not apparent even to knowledgeable drinkers.

The Digestive Tract

Cancers of the mouth, tongue, pharynx, and esophagus are more common in alcoholics than in nonalcoholics. While the exact cause or causes are unknown, alcohol's direct irritation of mucous membranes is well established. This, combined with the known carcinogenic properties of tobacco so often smoked by heavy drinkers, is likely to be jointly responsible. Vitamin A and B deficiencies because of poor diet and/or alcohol's interference with the vitamins' absorption may also play a role. Animals that are vitamin A deficient are known to be more susceptible to skin, mouth, and esophageal cancers.

Alcohol alters stomach acid secretion, which along with its irritating gastric lining probably accounts for the stomach problems so common in alcoholics. It weakens the stomach wall, making it more susceptible to bleeding. The use of aspirin by drinkers may increase the likelihood of bleeding from the already weakened wall, sometimes leading to hemorrhage.

Alcohol has multiple effects in the intestines. It impairs vitamin absorption, is an irritant, and results in increased gastrointestinal motility. This often leads to diarrhea in heavy drinkers, which may contribute to their poor nutritional state.

Chronic pancreatitis is common in alcoholics. Seventy-five percent of the cases in the United States are believed to occur in alcoholics. Although pancreatitis often results in abdominal pain and vomiting, half the alcoholic population show alteration in pancreatic function without obvious symptoms. Recent evidence suggests that alcoholics may have

more of a specific genetically determined antigen—a chemical that activates the immune system, which suggests a genetic mechanism behind the vulnerability to this disorder. Pancreatic cancer is also twice as frequent in alcoholics—75 percent of those who contract the disease are moderate to heavy drinkers.

Perhaps the best known effects of excessive alcohol use are those on the liver. These range from fatty liver, the most common—and reversible—problem, to cirrhosis, which is life-endangering and irreversible. While it was once thought that liver damage could be averted by an adequate diet, it is now known that damage occurs regardless of how nourishing the heavy drinker's diet is. Alcoholic hepatitis also results from heavy drinking. The inflammation and later destruction of liver cells from this disease kills 10 to 30 percent of those who develop it. Alcoholic cirrhosis is the most dangerous consequence to the liver from drinking, causing at least 11,000 deaths annually in the United States.

Alcohol and the Heart

Alcohol when used heavily may have detrimental effects on the heart. Cardiac myopathy—damage to the heart muscle—often occurs after 10 or more years of heavy drinking. Symptoms of this disorder range from chronic shortness of breath and ankle swelling to heart failure. Degenerative changes in heart muscle cells can be seen with the electron microscope. If the damage is not too extensive, recovery is possible, although it may require 5 or more years of abstinence.

Alcohol also interferes with the heart's ability to contract. Heart beat irregularities (cardiac arrhythmias), which can lead to heart failure, are common in alcoholics. Two ounces of whisky drunk by an individual who already has heart disease can suppress the heart's pacemaking abilities.

Effects on Other Muscles

The effects of alcohol on muscle tissue are not confined to the heart. Muscular weakness and severe pain from muscle cramping are fairly common in heavy imbibers. Mild symptoms of these myopathies, which may not be severe enough to come to medical attention, occur in about a third of alcoholics. Alcohol also affects involuntary smooth muscle contractions.

Alcohol and the Blood

Excessive drinking causes blood abnormalities. Both enlarged red blood cells and anemia are produced. These are probably the combined result of vitamin deficiency, alterations in fat metabolism (because of liver damage), and other still unknown or poorly understood mechanisms. Abnormally large cells are so common (found in 90 percent of alcoholics) that a measure of this, the mean corpuscular volume or MCV, has been suggested as a means of detecting alcoholism. Four or more months of abstinence may be required before the MCV returns to normal.

Many alcoholics also have reduced white blood cell counts. These cells play an important role in the body's immune response. A diminished immune response has now been reported in alcoholics. The higher rates of infectious disease common in this group are probably attributable to this lowered resistance.

Alcohol and Sexuality

Alcohol interferes with male sexual functioning. That was known in Shakespeare's time—and probably before. But recent research provides both confirmation and an explanation. Impotence and/or reduced sexual drive are found in from 70 to 80 percent of alcoholics. The same percentages have been reported to show testicular atrophy and infertility. Alcoholics have much lower levels of the principal male hormone testosterone than do nonalcoholics, along with increased levels of female hormones. Because of this, 50 percent of male alcoholics develop feminine pubic hair patterns, and 20 percent have breast enlargement.

Like other effects of alcohol, these changes in sexuality were once believed to arise from liver injury. More recent evidence clearly indicates that alcohol reduces testosterone levels and causes direct gonadal injury. It also affects sexual functioning indirectly through its impact on the brain's hypothalamus and the pituitary, the so-called master gland. Recent research suggests that the increase in estrogen levels found in alcoholic men is also partly due to adrenal changes. The adrenal glands produce estrogen precursors—chemicals from which estrogens are later formed, although the mechanisms involved are not yet known.

The alcoholic female's sexuality is also affected by her drinking. Severe gonadal fail-

ure—an inability to produce adequate quantities of female hormones—leads to loss of such secondary sexual characteristics as fat deposits in the breasts and other parts of the body, reduced (or absent) menstruation, and infertility. As with men, the control of hormone production by the brain and the pituitary gland is affected.

Alcohol and Pregnancy

Clinical and experimental research over the past decade underscores the threat to the developing fetus that maternal alcohol misuse represents. The term fetal alcohol syndrome (FAS), first used 10 years ago to describe a set of symptoms in the newborn infant believed to be caused by heavy maternal alcohol abuse, has recently been more carefully standardized. The new standard demands that three kinds of characteristics be found in the newborn to justify being classified as a case of FAS: (1) growth retardation before or after birth, (2) abnormal features of the face and head such as unusually small head circumference and/or flattening of facial features, and (3) evidence of central nervous system abnormality (e.g., mental retardation, abnormal behavior, etc.).

Other birth anomalies are regarded as alcohol related if there is evidence of heavy or frequent maternal drinking during pregnancy and if the specific anomalies occur in greater frequency, after control for confounding variables, among the children of heavier than lighter drinkers or abstainers. Some studies suggest a risk for outcomes including decreased birth weight and increased spontaneous abortion at levels of alcohol consumption as low as two drinks per day, although some investigators question whether these self-reported consumption levels are not in actuality higher. Isolated instances of heavy drinking may also pose significant hazard.

Women's alcohol use during pregnancy has been described by one research group as "the most frequent known teratogenic cause of mental retardation in the Western World." However, the prevalence of fetal alcohol syndrome or of other alcohol-related birth defects is not easy to specify. Moreover, since heavy drinkers often underestimate (or underreport) levels of drinking, it is difficult to be certain how much alcohol consumption is required, at what point or points in pregnancy, to produce abnormalities. Because developing fetuses probably differ in their sensitivity to alcohol as well, the pattern of alcohol use that

will result in congenital anomalies cannot be specified with precision.

One somewhat encouraging finding is that many women who usually drink heavily markedly decrease their drinking while pregnant. Such a reduction might be expected to decrease the risk of congenital defects.

Current estimates are that FAS affects somewhere between 1 and 3 births per 1,000, but other alcohol-related birth defects probably add significantly to that number. A recent calculation suggests that 5 percent of total birth defects may be alcohol related.

Animal research, which can be more carefully controlled than that on humans, leaves little doubt that alcohol ingestion during pregnancy has serious consequences. Birth defects closely resembling those found in humans have been produced in many animal species. Scientists who administered two doses of alcohol to mice on one day early in pregnancy (an animal model resembling human binge drinking) found abnormal facial features in offspring like those reported in human FAS. Extensive animal—and human—findings amply justify discouraging women from drinking while pregnant.

Lowered birth weight is the most consistent result of alcohol use during pregnancy. Since low birth weight is associated with more frequent neonatal deaths and is frequently associated with mental retardation and neurological defects, this finding is important.

Several studies have found low IQ and motor development scores related to maternal alcohol use. Most recently (1983), 4-year-olds whose mothers drank during their gestation were found to have decreased attention spans and slow reaction times. Children with FAS and animals prenatally exposed to alcohol have been found to show hyperactivity.

Paternal Drinking

Although it is known that long-term alcohol use by men can lead to reduced sperm counts, decreased sperm motility, and higher rates of sperm abnormalities, there is no evidence from either animal or human studies that heavy alcohol use leads to congenital defects in the children of such men.

Adverse Social Consequences

Alcohol abuse plays a role in many kinds of social problems. In some—traffic accidents,

for example--what is known about alcohol's effects on complex skills makes it reasonable to ascribe a causal role to the drug. In other problems--child and spouse abuse, for example--excessive alcohol use is probably not the primary cause although it may contribute significantly, perhaps by reducing inhibitions that might otherwise curb expression of anger.

Traffic Accidents

Traffic accidents are the fifth leading cause of death in the United States and its leading cause among those under age 35. In the latest year for which data exist (1981), such tragedies killed 49,000 and permanently disabled another 150,000 persons. The consensus is clear--alcohol is responsible for up to half of these tragedies. A review of 23 studies found a third or more of drivers in fatal accidents had blood alcohol concentrations (BAC) above the usual legal standard for drunk driving of 0.10 percent. Five or six drinks consumed in the 2 hours before driving can cause this level in a 155-pound person. Drivers with blood alcohol concentrations above 0.10 percent have been estimated to be 3 to 15 times more likely to have a fatal accident than nondrinking drivers. Other estimates have concluded that even lower BAC levels--from 0.05 to 0.099 percent--increase the risk from 1.25 to 3.25 times. This is the level that results when a 155-pound person has had three to four drinks or a 120-pound person as few as two to three drinks within 2 hours. Unfortunately, many people are not aware of these risks. A recent Massachusetts survey found that 17 percent of respondents believed the fiction that you can have six or more drinks without becoming too drunk to drive. (Six drinks in a 155-pound person would result in a BAC above 0.10 percent, even if the drinks were consumed during a 3-hour period before driving.)

Pedestrians who have been drinking also have a much higher risk of being injured or killed in a traffic accident than do nondrinkers. In one recent study, more than a third (36 percent) of injured pedestrians and nearly half (45 percent) of those who died from being struck by a motor vehicle had blood alcohol concentrations above 0.10 percent. Only 13 percent of a control sample of uninjured pedestrians passing the same accident sites at a similar time had that high a BAC. As with motorists, the higher the blood level, the higher the risk of accident involvement. Compared with that of the nondrinking pedestrian,

the risk of being hit was twice as high at blood levels above 0.10 percent, five times higher if the BAC was above 0.20 percent.

Industrial Accidents

Less is known about the relationship of alcohol to industrial accidents than to traffic accidents, although such a connection is predictable. A 1982 Maryland study of workers who died in job-related accidents found that 11 percent had BACs above 0.08 percent. While this may not be nationally representative, it indicates a relationship that should be further examined.

Other Accidents

It is hardly surprising that the heavy imbibor is at greater risk in other types of accidents as well. Accident statistics are consistent with this expectation. Alcoholics are 5 to 13 times more likely to die from falls than nonalcoholics. Alcoholics are also much more likely to die in fires--a tenfold increase over nonalcoholics. Heavy drinkers had 2.7 times the accidental death rate (omitting traffic accidents) of other Kaiser-Permanente members during a 10-year followup period. While such statistics do not prove that alcohol played a direct role in the particular hazard, the presumption cannot be dismissed.

Alcohol and Crime

Although many statistical associations have been made between alcohol use and criminal behavior, a direct causal link is more tenuous. One of the earlier homicide studies (1958) found that either the murderer or the victim had been drinking in two-thirds of the slayings reviewed. Subsequent research has also found that a majority of murderers, their victims, or both had been drinking prior to the crime. Whatever the role of drinking in such studies, it is confounded by such factors as a failure to control for age, sex, and race, all of which are related to both violence and drinking. The most that can be concluded is that alcohol is a contributing cause but is probably only one of several factors involved.

Rape

The role of alcohol in rape is even more difficult to assess. Not only is rape very underreported--authorities agree that only a

minority of attacks are reported—but intoxication may be offered as an excuse or extenuating circumstance by the rapist. Studies of rapists, however, indicate that they often drank heavily prior to the crime, and that their rate of alcoholism is two to three times that of the general population. Whether alcohol plays a disinhibiting role, or serves as a justification for the behavior, or plays some other part is unclear.

Alcohol and the Family

Alcohol abuse undoubtedly affects family life. It is noteworthy that a third of persons interviewed in a 1982 survey felt that alcohol caused problems in their families. But the precise ways in which it does so are more difficult to document. The rate of separation and divorce among alcoholics is seven times that of the general population. Two out of five domestic relations court cases involve alcohol.

While few doubt that heavy drinking plays some role in family violence and the abuse of spouses and children, just how and to what extent is again hard to specify. Most studies report that alcoholism or excessive drinking is involved in about half the cases of spouse abuse. As with rape, drinking may be used as an excuse for the violence involved. Early reviews of child abuse have described associations between it and alcohol in as many as 38 percent of cases. However, a recent review has concluded that alcohol involvement in child abuse is no higher than in the general population.

A 1983 review of the effects of parental alcoholism on children indicates that they are more likely to have school problems and to display antisocial behavior. Other studies report that such children have less self-esteem, more anxiety symptoms, more aggression, and more psychosomatic symptoms.

Alcohol and Suicide

Given the high rate of depression in alcoholics, it is not surprising that they have a high rate of suicide. But here, too, it is unclear whether the depression contributes to the drinking and suicide, or the alcohol use causes the depression and ensuing self-destruction. Nevertheless, as the Fourth Special Report noted, as high as four out of five of those who attempt suicide had been drinking at the time. Alcoholics commit suicide from 6 to 15 times more frequently than the general population.

Economic Costs

General agreement exists that alcohol abuse results in lost work productivity and an increase in industrial accidents. In one study of railroad companies, problem drinkers had twice the absenteeism of other employees. Much less is known about the costs associated with episodic drinking on or off the job as it affects work performance.

Estimating the cost of alcohol abuse to American society is difficult. Many of the variables that should be taken into account are simply not known with sufficient accuracy. But even making very conservative assumptions about these factors, a recent calculation places the annual national loss at about \$49.4 billion. The bulk of this amount—\$36.8 billion—represents the value of lost productivity. The cost of various kinds of medical care for alcohol-related illness and injury totals \$6.4 billion. The remaining \$6.2 billion includes such added costs as traffic accidents, fires, crime, and other miscellaneous losses attributable to alcohol.

Perhaps the highest cost is the incalculable pain and misery associated with alcohol abuse for the abusers, their families, and the larger society. There is no disagreement that those costs are profound.

Treatment Trends

A basic problem in treatment is deciding just who is an alcoholic and just what is alcohol abuse. Failure to agree on definitions is the basis for much of the confusion regarding the exact prevalence of alcohol abuse and its implications. The latest revision of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-III) represents an important advance in conceptual and diagnostic clarity. Using a multi-dimensional matrix, it takes into account alcohol-induced symptoms, psychosocial stress, the patient's level of adaptive functioning, and related personality disorders. It is hoped that the new manual will ensure uniform standards that will in turn permit increased comparability of treatment and research findings.

A related development in diagnosis is the improvement in relevant sections of the International Classification of Diseases (ICD) resulting from collaborative effort between the U.S. Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) and the

World Health Organization (WHO). Central to the WHO approach is the concept of a dependence syndrome, an interrelated cluster of cognitive, behavioral, and physiological symptoms.

One of the most promising new developments is the emergence of a group of biochemical markers to assist in identifying alcoholics. While each of these tests has limitations, several studies have now found that a profile of multiple blood tests can quite accurately differentiate alcoholics from non-alcoholics.

The new Munich Alcoholism Test uses both clinical signs and symptoms noted by the examining physician. When combined with self-reporting instruments and the biological marker approach, such testing promises to more usefully discriminate between different types of alcohol-dependent patients. In preliminary trials of this approach, psychosocial problems were most evident in young abusers, with clinical signs and symptoms more common in older alcoholics.

Early Intervention

Early identification through the sophisticated techniques now available offers the possibility of early intervention. And there is now increasing evidence that it works. Even a 35-minute counseling session in a general hospital setting has been found to reduce drinking in a significant number of newly identified problem drinkers who were followed up for 1 year.

A recent Swedish study using a biochemical marker—elevated GGTP scores—to identify heavy drinkers has also found that early intervention can be valuable. Those identified were told their GGTP results and their significance. They were then repeatedly retested, given feedback on their progress, and encouraged to moderate their drinking. The group had lower work absenteeism, fewer hospitalizations, and a lower death rate during the 6-year followup.

In France, a combination of two biochemical tests and a clinical examination is now being used on a nationwide scale to detect early alcohol abuse in industrial, health care, and court settings. When a problem is found, the individual is referred to local early intervention clinics for care. The system, which has yet to be evaluated, illustrates the feasibility of large-scale intervention.

Work-based alcoholism treatment intervention as an alternative to disciplining the

worker has also shown definite promise. Several studies have found that it works as well as voluntarily sought treatment when measured by abstinence and improved job performance.

Detoxification

Detoxification—the process of withdrawing the alcohol-dependent patient from alcohol and controlling his or her withdrawal symptoms—has traditionally been done in a hospital setting. In recent years, partly because of the high cost of in-hospital detoxification, other settings have been tried. Although these alternatives have not been systematically evaluated, a review of the evidence suggests that detoxification can be done humanely, safely, and efficiently in nonhospital settings. It may, however, be important to develop clear criteria of what types of alcohol abusers are most successfully treated by the new alternatives.

Treatment Benefits

A number of studies testing the feasibility of treating alcoholics through medical insurance plans have now been completed. All have found that alcoholics and their families are initially more expensive to treat, as they require more care than those without alcohol problems. However, following treatment for alcoholism, demand for services drops, and the treatment is unquestionably cost-effective in reducing total medical expenses. The median reduction in sick days and accident benefits was 40 percent in one review of 12 programs.

Research comparing inpatient and outpatient treatment settings has not found significant differences in treatment outcome. Since patients are not usually randomly assigned to each type of setting, it is not yet known whether differences in the types of patients normally sent to these two settings are important. (Seriously ill patients with medical complications may still be more appropriately treated in a hospital.)

Client-Program Matching

The problem of developing programs suited to special populations such as women, ethnic minorities, and the elderly has become important. As this and earlier reports indicate, groups such as Native Americans have much higher rates of illness and death from alcohol-related illness than does the general population. It is critical that treatment programs

be designed to overcome cultural, economic, and other barriers that deter some groups from seeking treatment. A survey of California facilities found that women alcoholics were less likely to seek treatment if programs lacked child care and aftercare arrangements and professional staff. More and more programs are being designed to meet these and other needs of special populations.

Treatment Approaches

Several experimental approaches to treatment have been extensively evaluated since the Fourth Special Report. Aversion therapy, which links the sight, smell, and taste of alcohol with a nausea-producing drug, appears to be effective with stable, well-motivated alcoholics, while the same approach substituting electrical shock appears not to be. A related technique—covert sensitization—that pairs verbally induced nausea with imagined alcohol consumption produces greater improvement than insight-oriented therapy, based on a 4-year followup.

A recent study of disulfiram (Antabuse) not discussed in the Fourth Special Report found the drug slightly more effective in producing abstinence after a year than a vitamin B preparation. Another study found that additional training in role playing, communication, and stimulus control along with the use of disulfiram was effective with married clients, but not with the unmarried. Further training in drink refusal, social skills, muscle relaxation, and job and recreational counseling for the single group raised their abstinence levels, however. Closely supervised use of disulfiram in an industrial setting was effective in reducing absenteeism.

Traditional psychotherapy has been found not to be generally effective with alcoholics, but may be useful with some types. Family therapy is also being tried, although it has not yet been fully evaluated.

Early findings suggested that some "definitely alcoholic" clients were capable of drinking moderately 6 months after treatment and up to a year later. However, a followup 4 years later has found that those who were abstinent at 18 months were less likely to have drinking problems at 4 years than those who drank moderately at 18 months.

Patients affiliated with such aftercare groups as halfway houses and Alcoholics Anonymous have been found to have better therapeutic outcomes than those who remain unaffiliated.

Prevention

Alcohol abuse prevention is becoming more important as awareness grows that alcohol problems are present in the entire drinking population. While problems occur at lower rates in groups that drink less, they are rarely totally absent.

There is little question that alcohol education programs can increase knowledge concerning alcohol and may also alter attitudes toward the substance. But the question of the extent to which they modify actual drinking behavior is not so easily answered. Even when such changes have been assessed—and most programs have not tried to do so—they are difficult to interpret. Changes in economic conditions, minimum ages at which drinking is permitted, and law enforcement policy are all likely to overshadow program effects.

A 1982 study found that teaching 7th through 10th graders about alcohol improved their knowledge and also reduced their use. A recent review of prevention programs emphasizes that improved decisionmaking is likely to lead to a reduction in pro-drinking attitudes, although it is overly optimistic to expect significant use reduction based on such limited interventions.

Nontraditional programs emphasizing interactive learning, which involves students in the actual design of the prevention program, seem to be most successful in altering attitudes and possibly drinking behavior.

Intervention—between 6th and 9th grades—to teach youngsters to develop resistance to later use of alcohol (and tobacco) is a promising prevention strategy, although it has not yet been followed up with longitudinal studies.

Because the college years are important in developing long-term drinking habits, a number of programs have been directed toward these students. Improvements in knowledge occur and there is evidence that attitudes shift, but no changes in actual drinking have been found.

Increased sophistication is evident in programs tailored to meet the needs of women (especially during pregnancy), minorities, and other special populations such as the elderly. These new programs need to be tested for effectiveness.

Mass media campaigns are probably too weak an intervention to significantly alter drinking behavior unless they are closely coordinated with local education and training efforts. However, they can be useful in generating heightened interest in alcohol prob-

lems and in mobilizing community resources to deal with the problem.

Lowering alcohol consumption levels is associated with reduction in a number of adverse effects of drinking such as alcohol-related traffic accidents (especially by youth) and diseases such as cirrhosis of the liver. Some effective efforts, documented through research, are:

- Increasing taxes on alcoholic beverages
- Increasing the legal age for purchase of alcoholic beverages
- Altering the number and location of outlets for purchase of alcoholic beverages.

Future Directions

New directions are evident in many parts of this report. Among the most promising are improved early identification of potential problem drinkers and alcoholics and expanding present basic knowledge of just how and why alcohol abuse is so destructive. Basic research may result in developing strategies that reduce the likelihood of those who are geneti-

cally more vulnerable becoming alcohol dependent. It may also enable them to drink moderately with less hazard.

New evidence of the serious threat alcohol poses to the developing fetus argues persuasively for enhanced efforts at preventing maternal drinking by making women more fully aware of the risk. The evidence that many individuals are many times more vulnerable to alcohol's destructiveness demands that better prevention and treatment be developed for those at high risk. Better targeted prevention efforts are also implicit in early detection of genetic vulnerability to alcohol through the use of biological markers.

Treatment offers many opportunities for increased innovation. One is to tailor programs to fit the needs of different types of clients. Many approaches that have been used with reported success have not been adequately evaluated. The cost-effectiveness of early intervention in health maintenance organizations and industry argues for more aggressive efforts by both.

Alcohol problems have plagued most societies throughout history. But never before have we had as much basic knowledge as we now possess, with the promise of still greater understanding to come.

Chapter I

Epidemiology of Alcohol Abuse and Alcoholism

Epidemiological research is useful in identifying many of the social, environmental, behavioral, and biological factors associated with alcoholism and alcohol abuse. New insights and understanding of these factors are complicated by the lack of standard and uniformly applied definitions. Terms such as alcohol abuse, alcohol misuse, problem drinking, alcoholism, and alcohol dependence are often used interchangeably. The development of uniform operational definitions should lead to continued advances in the epidemiology of alcohol-related conditions. Meanwhile, researchers and policymakers must rely on current terminology and the best data available to understand the problems associated with alcohol abuse and alcoholism. The data presented here indicate the scope and magnitude of alcohol abuse and alcoholism in this country and provide a framework for discussing the effects of the excessive consumption of alcoholic beverages.

Consumption of Alcoholic Beverages Measured by Alcohol Sales

Sales of alcoholic beverages are often used as an indirect measure of alcohol consumption. But per capita consumption figures based on sales and excise tax data do not take into account the amount of alcohol consumed in one State but purchased in another, the amount of alcohol purchased but not consumed in any given year, sales of alcohol that go unreported, and the consumption of illegally produced alcohol (e.g., moonshine).

Figure 1 shows the estimated per capita alcohol sales for beer, wine, distilled spirits, and the three beverage types combined. The estimates are expressed in gallons of absolute alcohol per person, per year, for the United States. For statistical purposes, this population is defined as the estimated population 15 years of age or older for years up through

1969, and 14 years of age or older for years 1970 through 1981. For 1981, the average estimated consumption is 2.77 gallons per year or approximately 1 ounce of absolute alcohol per day for each person in this population. Fifty-one percent of the absolute alcohol consumed in 1981 was beer (1.40 gallons per person), 36 percent distilled spirits (1.01 gallons per person), and 13 percent wine (0.35 gallons per person).

Figure 2 displays estimated per capita consumption in 1981 for the three alcoholic beverage types combined for each State and the District of Columbia (NIAAA 1982a, d, e). This map indicates that substantial variation exists across States in quantity of alcohol sold. Statistical data for each State also indicate considerable variation in the relative sales of each type of alcoholic beverage. A number of factors may influence the variation in beverage sales and apparent per capita consumption across States, including:

- Difference in State taxes for each type of beverage
- Difference in the legal drinking age within each State
- Differences in State legislation regarding the location, type of outlets, and hours of operation for selling alcoholic beverages
- Differences in cultural and social habits across geographic regions.

U.S. alcohol per capita sales have increased approximately 35 percent since the early 1960s, but only 7 percent since 1971. While estimated per capita sales of beer rose 22 percent and of wine rose 13 percent, sales of distilled spirits have dropped 10 percent since 1971. Considerable variation in sales rates occurs among States, e.g., a decrease of 17 percent in the District of Columbia and an increase of 36 percent in Hawaii. These data

must be interpreted cautiously, however, because the States are differentially affected by such factors as drinking age, degree of urbanization, tourism, and out-of-State purchasers.

Surveys of Self-Reported Consumption Among Adults

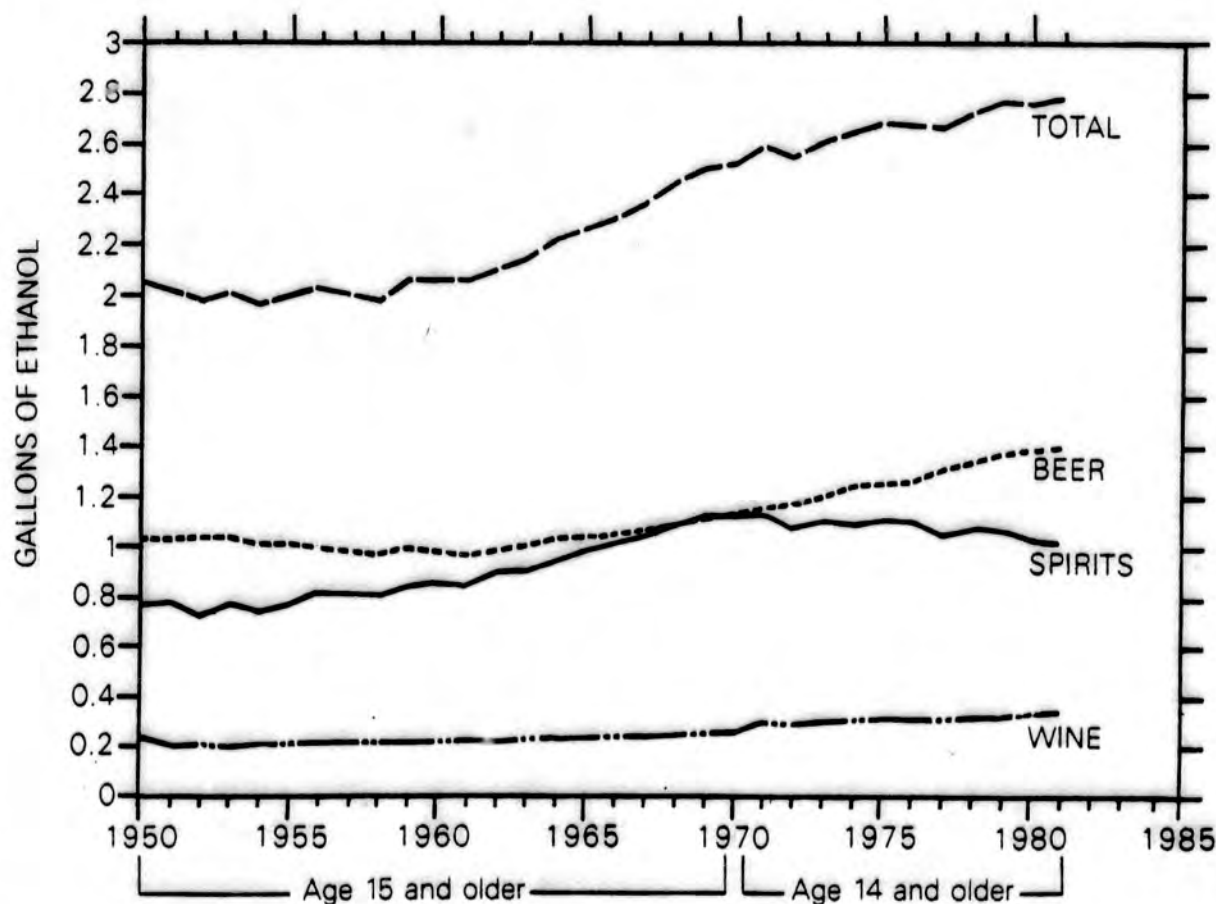
The National Institute on Alcohol Abuse and Alcoholism (NIAAA) has sponsored a series of national surveys that characterize the self-reported drinking patterns of the U.S. adult population. Results across these surveys conducted in the 1970s are similar. Approximately one-third of the adult population described themselves as alcohol abstainers (consumed not a single drink in the year prior to the survey). Another third described themselves as

light drinkers (consuming up to 0.21 ounces of absolute alcohol per day on the average), while the remaining third were moderate (0.22-0.99 ounces) or heavier drinkers (1.0 ounces or more), the latter (heavier drinkers) consuming the equivalent of approximately two drinks or more every day.

Men drink significantly more than women, and younger adults more than older adults (see figure 3). The most recent national survey (1979) confirms these sex and age variations. In addition, the 1979 data indicate that abstaining from alcohol is less common in the New England and Pacific regions and more common in the South, and that the proportion of abstainers falls as income rises and years of schooling increase.

Findings from other national household surveys also confirm that alcohol consumption

Figure 1. Apparent U.S. Consumption of Alcoholic Beverages in Gallons of Ethanol Per Capita 1950-1981



SOURCE: Data from NIAAA 1982b.e.f

is greater among younger adults than among older adults. During the years 1974 through 1982, the annual prevalence of alcohol use among younger adults, 18 to 25 years old, was approximately 22 percent greater than among adults 26 years and older. Overall, the annual prevalence of alcohol use reveals a slight but gradual increase between 1974 and 1982.

The survey data suggest that a substantial proportion of all alcohol is consumed by a relatively small fraction of the total drinking population (see figure 4). This figure shows that 50 percent of the alcohol is consumed by 10 percent of the population.

Surveys of Alcohol Consumption Among Youth and Young Adults

NIAAA has also sponsored a number of national surveys to assess alcohol consumption

patterns and trends among the youth and young adult population. Two NIAAA surveys in 1974 and 1978 (Rachal et al. 1975, 1980) were followed in 1980 by the NIAAA-sponsored Gallup Youth Survey. In addition, the National Institute on Drug Abuse (NIDA) sponsors an annual survey of high school seniors and a biennial household survey (NIDA 1983a) that collects data on alcohol consumption of the youth population. These surveys showed a small decrease in the drinking levels among 16- to 18-year-olds for the years 1974, 1978, and 1980 (Zucker and Harford in press). The NIAAA data reveal some increase in the number of abstainers and a slight decrease in the proportion of moderate and heavy drinkers between the years 1978 and 1980.

Similar conclusions can be drawn from the national surveys of high school seniors sponsored by NIDA since 1975 (NIDA 1983b). In a sample of approximately 130 public and pri-

Figure 2. Apparent Consumption of Ethanol from All Alcoholic Beverages in U.S. Gallons Per Capita of the Population Age 14 and Older, 1981

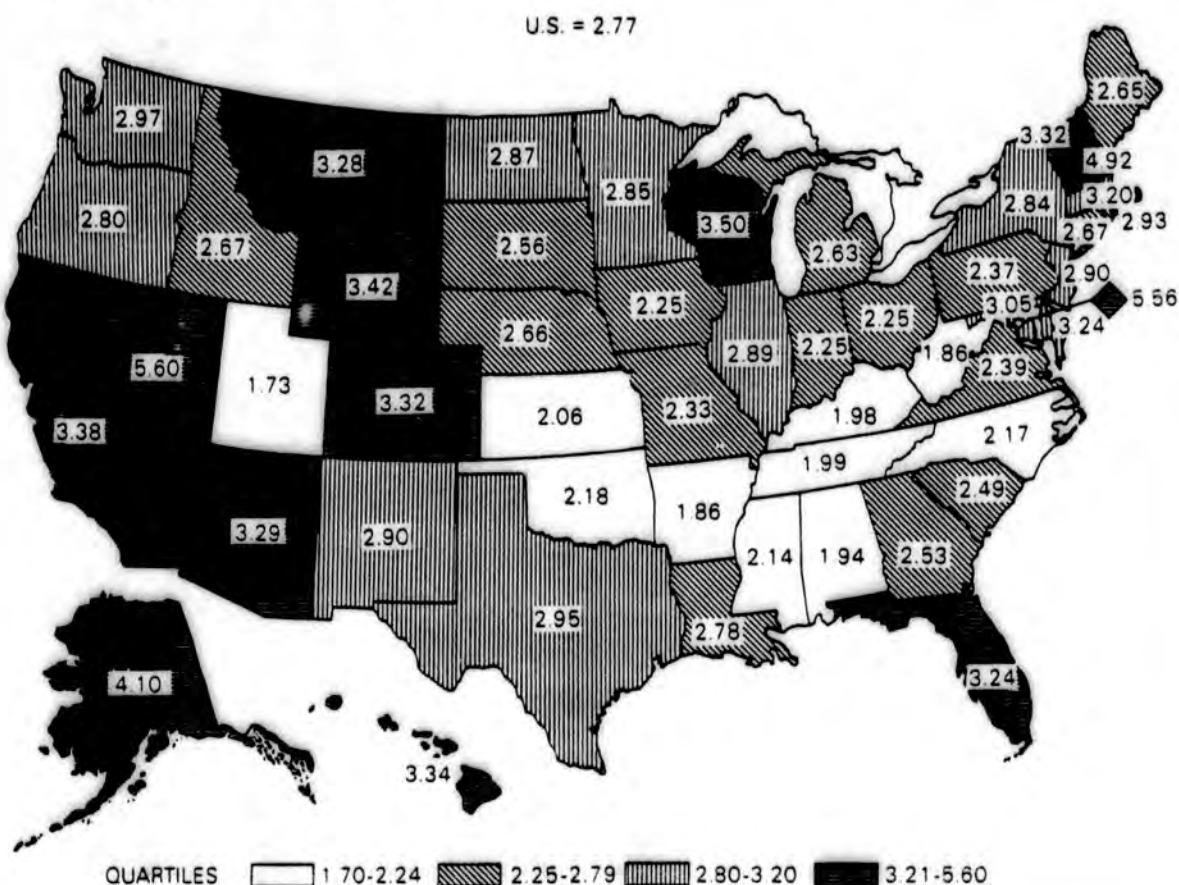
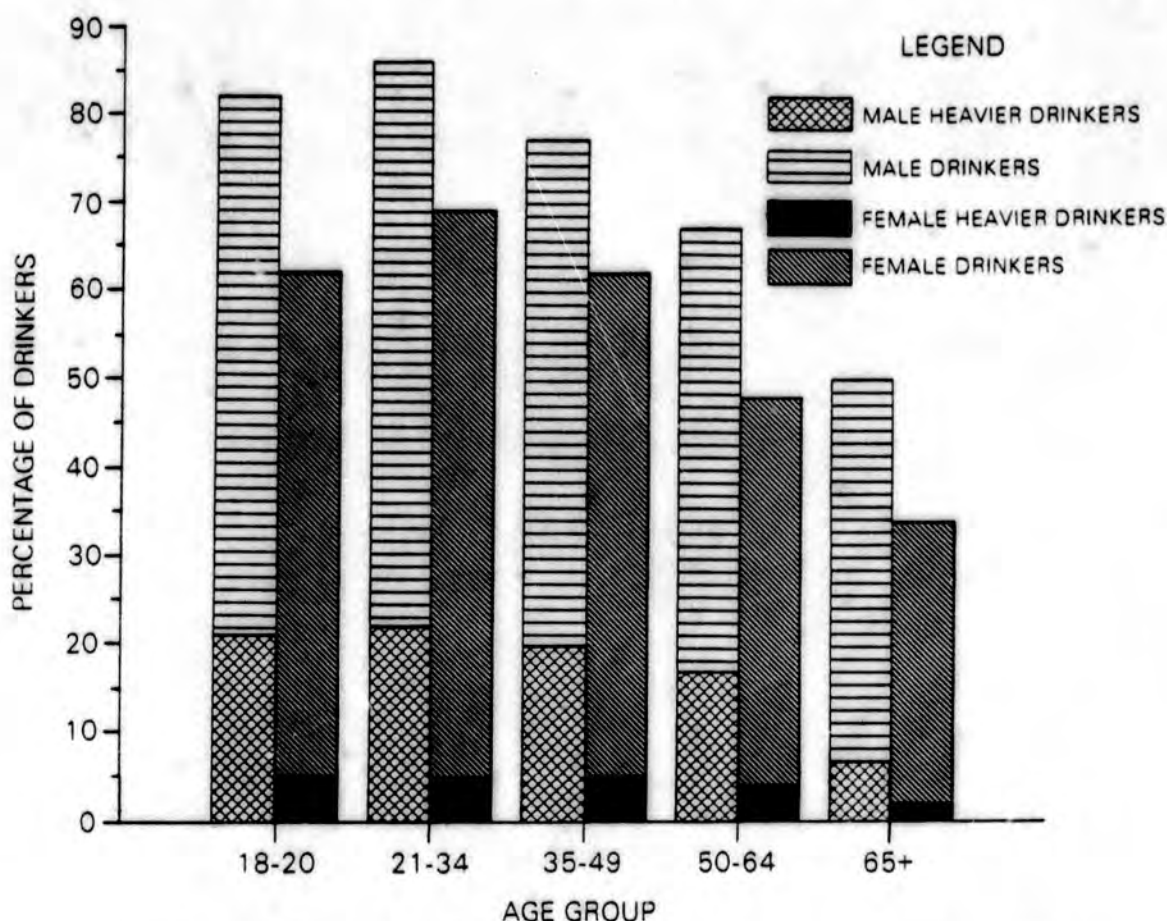


Figure 3. Percentage of Drinkers by Age Group and Sex Averaged for the Period 1971-1976



SOURCE: Data from Clark, W.B. and Midanik, L. Alcohol Use and Alcohol Problems Among U.S. Adults: Results of the 1979 National Survey. Alcohol and Health Monograph No. 1 NIAAA, 1982. DHHS Publication No. (ADM) 82-1190

vate high schools selected to produce national estimates of drug-taking behavior among high school seniors, alcohol consumption among high school seniors has remained relatively stable from 1975 through 1982. The data on specific consumption show that more than 90 percent of surveyed seniors reported having used alcohol at least once during their lifetimes, and almost 90 percent reported using it in the past year. Six percent reported daily or nearly daily use during the month prior to the survey, and a significantly greater percentage reported occasional heavy drinking. Approximately 41 percent of the 1982 sample of high school seniors stated that, on at least one occasion during the 2-week period prior to the survey, they drank five or more drinks.

In general, young males report more drinking episodes and more daily use than females, and consumption of larger quantities of alcohol on a single drinking occasion. High school seniors from the South and the West apparently consume less alcohol than do those from the Northeast and the North Central regions.

These surveys of high school seniors also identified the grade at which an alcoholic beverage is first consumed. Approximately 10 percent of those surveyed had their first drink by the 6th grade. About 30 percent began drinking by the 8th grade, about 56 percent by the 9th grade, and about 75 percent by the 10th grade. By senior year (12th grade), fully 93 percent of those surveyed had had a drink. The surveys show very little change in this

pattern over time.

The surveys collected attitudinal information about alcohol consumption. In the 1981 survey, 22 percent believed consumption of one or two drinks daily to be harmful; 36 percent saw significant risk in having five or more daily drinks once or twice each weekend; and 65 percent believed that consumption of four or five drinks daily would result in significant harm. Thirty-one percent of the 1981 high school seniors did not disapprove of taking one or two drinks nearly every day. Little variation in these attitudes occurs over the 1975-1981 period (NIDA 1983a).

Finally, the NIDA survey data show a steady decline (except for the year 1979) in the 12- to 17-year-olds who reported taking a drink in the 30-day period prior to the survey. The drop from 37 percent in 1979 to 26 percent in 1982 may reflect recent changes in the legal age for purchasing alcohol in the majority of States. Future monitoring of the trends in alcohol consumption among teenagers and young adults will clarify these findings.

More detailed results of the NIDA surveys are summarized in Alcohol and Health Monograph No. 1 (Rachal et al. 1982).

Surveys of Alcohol Consumption During Pregnancy

Recently, national surveys have been conducted of a sample of married women who

gave birth to live infants in 1980, as well as a sample of married women whose pregnancies terminated in a reported fetal death. These two surveys conducted by the National Center for Health Statistics (NCHS) collected information from married mothers, hospitals, physicians, and the birth or death certificates (Prager et al. in press). Data were collected on prenatal care, previous pregnancies, diagnostic and other procedures performed during pregnancy, and drinking and smoking behavior before and during pregnancy. (Additional data and discussion are included in the chapter on alcohol and pregnancy outcome.)

Preliminary analysis of 4,405 mothers giving live births show that women substantially reduce their alcohol consumption after they become pregnant (table 1). While 45 percent of these women abstained from alcohol use before pregnancy, approximately 61 percent abstained during pregnancy. The percentage of all mothers who were moderate/heavy drinkers (Level 2) declined from 12 percent before pregnancy to 2 percent during pregnancy.

Table 1 also shows changes in drinking from before pregnancy to during pregnancy. Of the 516 women who drank 0.25 ounces or more of absolute alcohol per day (Level 2) before pregnancy, only 16 percent continued to consume that amount during pregnancy, while 67 percent consumed less than that amount (Level 1), and 17 percent stopped drinking altogether. Similarly, of the 1,908 light drinkers (Level 1), 66 percent remained light drinkers,

Table 1. Number and percentage distribution of change in drinking behavior from before to during pregnancy, 1980

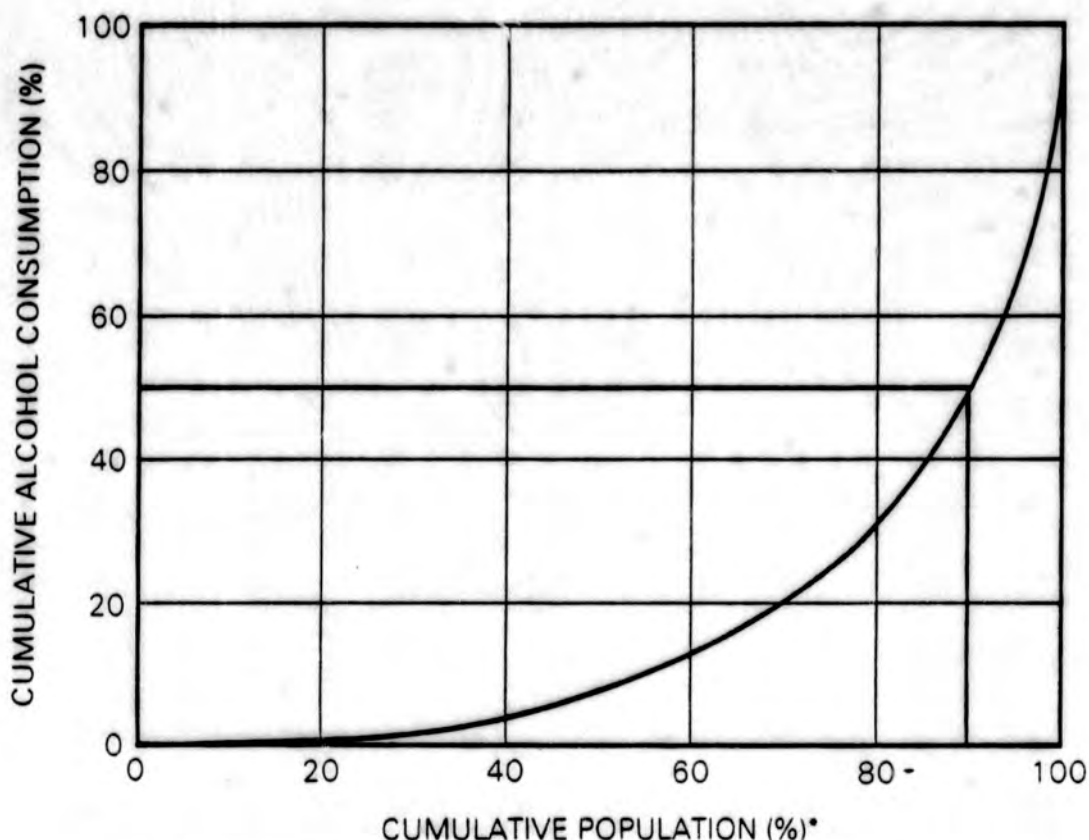
(Married mothers giving live births)

	Before pregnancy		During pregnancy		
	Number	Percent	Nondrinker	Level 1	Level 2
Nondrinker	1,981	45	99	1	1
Level 1	1,908	43	33	66	1
Level 2	516	12	17	67	16
Total	4,405	100	61	37	2

NOTE: Nondrinkers consumed less than one drink less than once a month. Level 1 drinkers consumed less than 0.25 ounces of absolute alcohol per day on the average. Level 2 drinkers consumed 0.25 or more ounces per day.

Source: Prager et al. in press.

Figure 4. Cumulative Distribution of Alcohol Consumption



*Drinkers only, aggregated from several U.S. national surveys, 1971-1975

SOURCE: AEDS data from HANES I Medical History Questionnaire and Louis Harris and Associates Surveys for 1972-1974

while 33 percent stopped drinking. These data confirm other research showing similar decreases (Little et al. 1976; Rosett et al. 1983).

This research also describes drinking behavior before and during pregnancy for several sociodemographic characteristics of married mothers giving live births. Black mothers drink less before and during pregnancy than white mothers. Hispanic mothers drink less than non-Hispanic mothers. Women with less education and from families with lower incomes drink less than women with more education or higher family incomes.

Alcohol-Related Mortality Attributed to Alcoholism, Alcoholic Psychosis, and Liver Cirrhosis

Three important causes of death attributed to excessive alcohol consumption are alcoholism, alcoholic psychosis, and cirrhosis of the liver. By definition, all deaths from alcoholism and alcoholic psychosis are alcohol related; however, alcohol is not the exclusive cause of cirrhosis of the liver. The 1979 U.S. mortality rate for alcoholism was 1.8 per

100,000 population, or approximately 4,000 deaths. The mortality rate in 1979 for alcoholic psychosis was 0.2 per 100,000 population, or about 440 deaths. Cirrhosis of the liver, the eighth leading cause of death in the United States in 1979, accounted for about 29,000 deaths, or 13.2 deaths per 100,000 population.

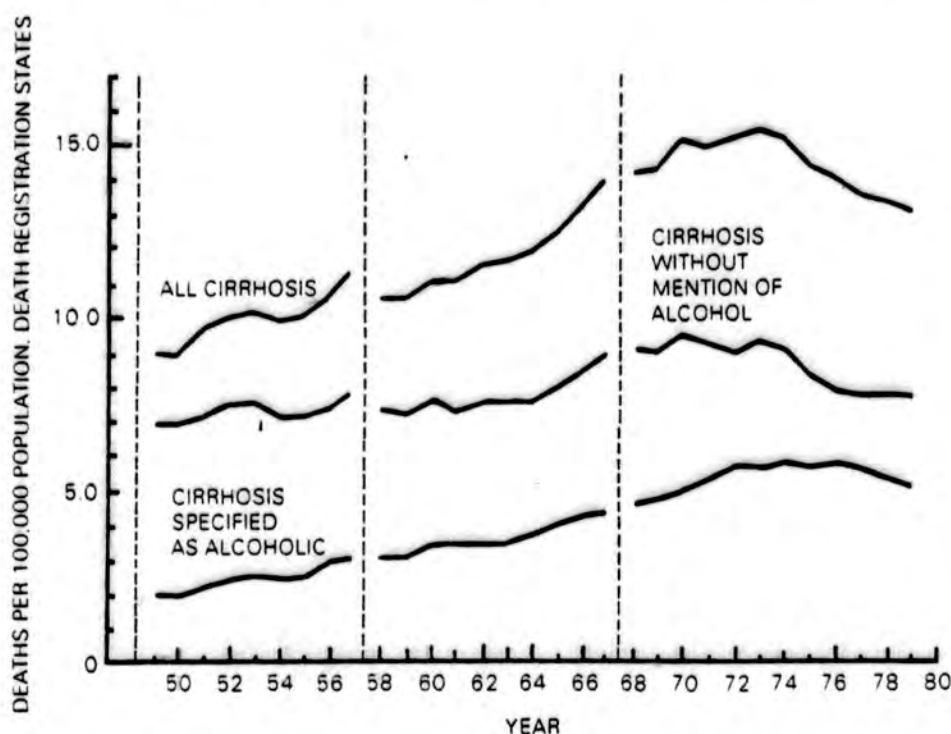
Since 1949, the death rates attributed to alcoholic psychosis and alcoholism have remained relatively stable, while the death rate attributed to cirrhosis of the liver rose until about 1973 and then began to decline (see figure 5). The U.S. mortality rate for cirrhosis decreased 12 percent between 1973 and 1979. The overall decline in the cirrhosis death rate appears to be due to factors other than alcohol; alcohol-related cirrhosis death rates have remained stable at approximately 5 deaths per 100,000 population (Malin et al. 1982a).

Alcohol-Related Causes of Hospitalization¹

The national vital statistics record system of the National Center for Health Statistics (NCHS) collects and tabulates mortality information by cause of death for the entire U.S. population, but no comparable data system exists to collect and tabulate statistics on morbidity (disease) for the entire population. The Hospital Discharge Survey (HDS) operated by NCHS approximates a national morbidity surveillance system by sampling more than 225,000 records from over 400 participating hospitals on an annual basis.

¹ This section summarizes various reports prepared by the National Center for Health Statistics. These reports have been cumulated in the references.

Figure 5. Trends in Cirrhosis Mortality Rates With and Without Mention of Alcohol in the United States, 1949-1979



SOURCE: Malin (1982) and personal communication with Mortality Branch, National Center for Health Statistics

National estimates have been made for the years 1971 through 1980 on the numbers and rates of patients discharged with diagnoses of alcoholism, alcoholic psychosis, and cirrhosis of the liver. Because of sampling variability in the HDS from year to year and the relatively low frequency of some diagnoses, monitoring trends over time must be viewed with caution. Nonetheless, the data suggest a significant increase in the number of persons hospitalized for alcoholism during the 1970s. For example, there were an estimated 200,000 alcoholism discharges in 1971 compared with an estimate of 519,000 alcoholism discharges in 1978, an increase of more than 160 percent. During this same period, the national mortality rates remained relatively stable.

When HDS data are considered by sex, the rates for discharges with alcoholism are 3-1/2 to 4-1/2 times greater for males than for females. While the numbers and rates of discharges with alcoholism have increased for both sexes, this ratio has remained fairly constant. The male rate for hospital discharges for cirrhosis of the liver has remained stable through the 1970s at about 1-1/2 times the female rate.

Alcohol-Related Problems in Veterans

Data from the Veterans Administration (VA 1982) show that a substantial fraction of the nearly 1 million discharges from VA hospitals in 1980 had an alcohol-related disorder, including alcoholic psychosis, alcoholism, organic brain syndrome, and alcoholic cirrhosis of the liver. Such disorders constitute the second largest category of diagnoses (next to heart disease) among patients discharged from VA hospitals. The proportion rose from 15 percent in 1970 to 19 percent in 1974 and 1975 and has dropped slightly to 17 percent in 1977-1980. Nearly two-thirds of these discharges had a principal diagnosis that was alcohol related.

Periodically, the VA conducts a census of hospitalized patients (VA 1982). During the 1970s, the rate of patient hospitalizations with an alcohol-related principal diagnosis was relatively stable at about 8 to 10 percent each year. In some years, the VA has also estimated the number of problem drinkers, who constitute an additional 5 to 6 percent of the patient census. When problem drinkers are added to those patients identified as alcoholic, about 25 percent of the entire VA patient load have alcohol-related problems that contribute to their medical disabilities.

Since 1970, the proportion of VA patients with alcoholism or problem drinking has more than doubled for those under age 35 (15 percent to 35 percent). This marked increase reflects the growth in alcohol-related disabilities from the Vietnam era. The reasons for this substantial increase remain to be identified. It is not clear whether (a) this increase is specific to the VA beneficiary program, (b) the statistics reflect a more general increase among all men of comparable age, (c) younger veterans have a greater proportion of alcohol problems simply because the incidence of other health conditions such as cancer or stroke is less in this population, or (d) the increases are attributable to some combination of these and other reasons. The trend over time does reflect, in part, the aging of this group, increased years of drinking, and a greater probability of being diagnosed as alcoholic. In response to alcohol problems, the VA has promoted specialized alcohol dependence treatment programs, which have multiplied from 8 in 1970 to 100 in 1980.

Alcohol-Related Problems Among Native Americans

Alcohol-related mortality is a major problem among Native Americans, with cirrhosis of the liver the fourth leading cause of death. Accidents are the leading cause, and the contribution of alcohol to fatal mishaps is substantial. Death rates attributable to major alcohol-related causes of death (alcoholism, alcoholic psychosis, and cirrhosis of the liver with mention of alcoholism) are about eight times greater among Native Americans than for the U.S. population as a whole (Indian Health Service 1982a).

Hospital discharge rates from the Indian Health Services (IHS) hospital system for alcohol-related diagnoses are about three times the rates for the entire United States and double the rates for races other than white. This higher IHS alcohol-related discharge rate applies to both males and females. For ages 15 to 44 years, generally years of high productivity, the IHS hospital discharge rate for alcohol-related diagnoses is more than four times that of the rate for the total United States (Indian Health Service 1982b).

Table 2 shows age-specific hospital discharge rates for the IHS and for the United States as a whole in 1981. IHS discharges are from IHS and general hospitals under contract to the IHS, while U.S. discharges are from

non-Federal short-stay hospitals. The alcoholic psychosis rate for all ages for IHS discharges is four times as great (11.8 vs. 2.9 per 100,000) as the discharge rate for the United States as a whole. The discharge rates for nondependent abuse of alcohol and for alcoholic liver disease are 3.4 times as great (5.8 versus 1.7 and 6.4 versus 1.9, respectively), and the alcohol dependence syndrome rate is nearly double that for the total United States (35.8 versus 19.7). The table also shows these comparisons for specific age groups where the differences are even greater.

Alcohol-Related Motor Vehicle Fatalities

Motor vehicle accidents have claimed between 45,000 and 55,000 lives annually over the past decade. While the death rate per 100 million vehicle miles has in general declined by more than 25 percent (perhaps as the result of the post-oil-embargo lower speed limit and more rigorous enforcement), motor vehicle crashes have become one of the Nation's leading causes of death for all age groups and the leading cause of death for persons aged 15 to 24 years. In this age group, motor vehicle fatalities account for about 40 percent of all deaths.

The National Highway Traffic Safety Administration (NHTSA) maintains national sur-

veillance of all traffic crashes involving one or more fatalities, the Fatal Accident Reporting System (FARS). For every fatal accident, FARS provides data on each vehicle, each driver, and each person involved in the accident, including a subjective characterization of alcohol involvement when it is known. In 1981, the blood alcohol concentration (BAC) was known for only 30 percent of the 62,120 drivers involved in fatal traffic crashes (see table 3). Among these 18,540 drivers, 6,349 (34 percent) had no detectable BAC at the time of the testing; 2,450 (13 percent) had BACs between 0.01 and 0.09 percent; while the remaining 9,741 (53 percent) had BACs of 0.10 percent or higher, the level of legal intoxication in all but three States. In addition, of the 48,069 deaths that occurred in 1981, 20,658 (43 percent) were known to involve alcohol.

Alcohol involvement in accidents is especially common in single-vehicle crashes, in which young people are disproportionately involved (see table 4). The 16- to 24-year-old age group accounts for only 16.5 percent of the U.S. population but 41 percent of the single-vehicle accident fatalities and 45 percent of all single-vehicle fatal accidents involving alcohol. In contrast, the 55-and-older age group represents 21 percent of the population but accounts for only 11 percent of all single-vehicle accident fatalities and 5.5 percent of the single-vehicle accidents involving

Table 2. Discharge rates per 10,000 from Indian Health Service and contract general hospitals and from non-Federal short-stay hospitals by first-listed diagnosis and age, 1981

Age at admission	Alcoholic psychosis		Alcoholic dependence syndrome		Alcoholic nondependent abuse of alcohol		Liver disease	
	IHS rate	U.S. rate	IHS rate	U.S. rate	IHS rate	U.S. rate	IHS rate	U.S. rate
All ages	11.8	2.9	35.8	19.7	5.8	1.7	6.4	1.9
Under 15 years	0.0	0.0	0.6	0.6	0.9	0.4	0.0	0.0
15-44 years	19.0	3.1	50.5	22.6	8.6	2.1	8.0	1.1
45-64 years	20.1	6.3	83.2	38.3	8.9	2.3	18.9	5.2
65 years and over	4.9	2.0	21.7	13.6	4.4	1.6	4.2	2.4

Source: Indian Health Service 1982b.

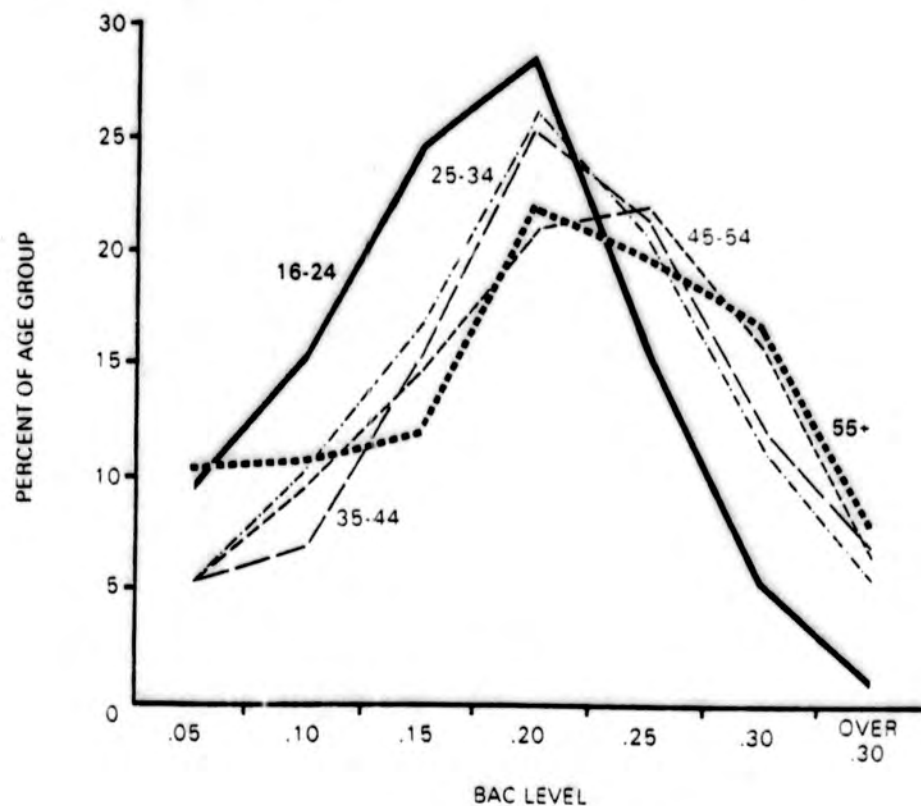
Table 3. Alcohol involvement by performance measure and by alcohol test results (BAC) of drivers in fatal traffic accidents, 1981

Alcohol involvement determined by performance measure ^a	Alcohol test results (BAC)			Persons tested		Drivers in fatal accidents
	0	.01-.09	.10 and +	Number	Percent	
No	6,136	2	2	6,140	14	42,878
Yes	213	2,448	9,739	12,400	64	19,242
Total	6,349	2,450	9,741	18,540	30	62,120

^a When suspected of drinking by an investigating officer, a driver's poor response to performance measures, such as the ability to walk a straight line, generally leads to a label of "alcohol involvement" on the investigative report.

Source: NIAAA 1983.

Figure 6. Percentage of Drivers With Positive Blood Alcohol Concentration (BAC) by Age Group in Single Vehicle Accidents, 1981



SOURCE: Malin et al. 1982b.

alcohol. Young drivers are even more disproportionately involved in single-vehicle accidents when other factors such as average miles driven and proportion licensed to drive are considered. Fewer young drivers are licensed than their older counterparts and they drive less on average.

Figure 6 shows the percentage of drivers in single-vehicle fatal accidents in each age group at various levels of BAC. Greater percentages of young drivers have lower BACs than older drivers. This suggests that younger drivers become involved in fatal accidents at lower BAC levels than older drivers (Malin et al. 1982b).

Drivers involved in alcohol-related fatal crashes have a higher frequency of previously recorded accidents, license suspensions and revocations, and convictions for driving while intoxicated (DWI), as well as a higher proportion of previously recorded speeding convictions and "other harmful moving violations." For the 62,120 drivers involved (but not necessarily killed themselves) in fatal traffic crashes in 1981, data were collected on their previous convictions for DWI. Among the drivers who were tested and found to have no detectable BAC, 2 percent had a previous DWI conviction. Among the drivers whose BAC was in the range from 0.01 to 0.09 percent, 5 percent had a previous DWI conviction. Among the drivers with BACs of 0.10 or greater, 11 percent had previous DWI convictions, a rate 5.5 times greater than the group without detectable BAC (NIAAA 1983).

Alcohol- and non-alcohol-related traffic fatalities appear to follow similar monthly variations. For both groups, fatalities are higher in summer months when more vehicle miles are driven, while in winter they tend to fall below the average monthly rate.

Figure 7 displays the day of week and the time of day for all fatalities in 1981. Fatalities in accidents with no known alcohol involvement peaked between 4 p.m. and 8 p.m. on Sunday through Thursday. In contrast, the alcohol-related fatalities peaked later in the evening (8 p.m. to 4 a.m.) for Monday through Thursday. Similarly, on Friday and Saturday, the greatest number of non-alcohol-related fatalities occurred between 4 p.m. and 4 a.m., while alcohol-related fatalities occurred later (midnight to 4 a.m.) and were much higher than the weekend maximums for fatalities with no known alcohol involvement (NIAAA 1983).

Summary

In summary, it can be said that the acquisition of new knowledge about the epidemiologic factors affecting alcohol abuse and alcoholism is increasing. Advances in knowledge have been hampered by a lack of uniformly applied definitions of terms such as alcoholism and alcohol abuse, but there are encouraging signs of progress.

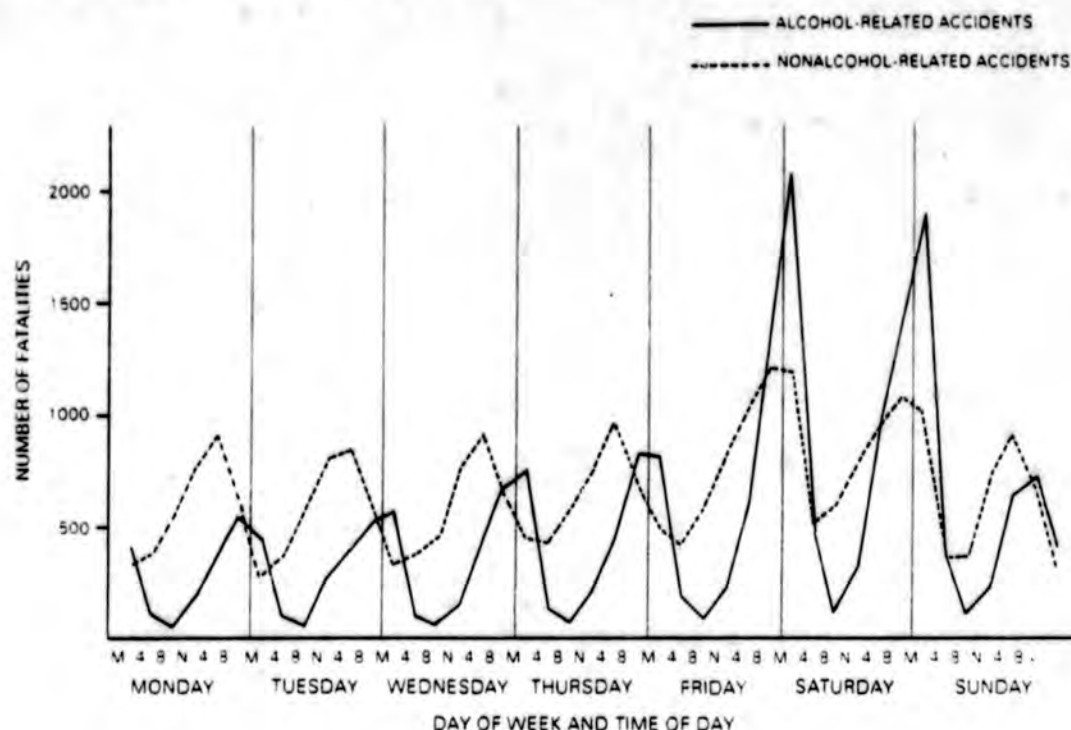
The per capita alcohol consumption continues to rise, although not as steeply as in

Table 4. Fatal single-vehicle accidents by age of driver and alcohol involvement, 1981

Age group	U.S. population (percent)	Number single- vehicle accidents	Total (percent)	Number accidents with alcohol	Alcohol-involved accidents (percent)
16-24	16.5	10,295	41.0	3,190	44.6
25-34	16.8	6,977	27.8	2,193	30.6
35-44	11.5	3,165	12.6	902	12.6
45-54	9.9	2,002	8.0	476	6.6
55+	21.1	2,656	10.6	397	5.5
Totals		25,095	100.0	7,158	100.0

Source: Malin et al. 1982b.

Figure 7. Number of Fatalities by Day of Week, Time of Day, and Alcohol Involvement, 1981



SOURCE: AEDS data from NHTSA Fatal Accident Reporting System (FARS) for 1981

earlier decades. About a third of the total population abstains from alcohol consumption during the typical year, another third consumes an average of less than one drink every other day, while the remaining third drinks more heavily.

Women substantially reduce their alcohol consumption after they become pregnant. While 45 percent abstain before pregnancy, 61 percent are abstainers during their pregnancy period. Similarly, 12 percent are moderate to heavy drinkers before pregnancy, while only 2 percent continue drinking to this extent after they become pregnant.

Overall mortality from major alcohol-related causes of death has remained relatively stable. Alcohol-related disease appears to have fallen from a high point in 1973, but liver cirrhosis has decreased only slightly.

Within the Veterans Administration hospital system, alcohol-related disorders have dropped from previous high levels in the 1970s. However, the proportion of veterans under age 35 with alcohol-related problems has increased

substantially. Alcohol-related problems among Native Americans continue to be a major source of both morbidity (disease) and mortality, with alcohol-related disorders among Native Americans being several times higher than for the U.S. population as a whole.

A substantial fraction of the Nation's traffic fatalities continues to be associated with alcohol consumption. More than half the drivers involved in fatal accidents are intoxicated. Drinking drivers involved in fatal crashes tend to have poorer driving records, including a higher frequency of previously recorded accidents, a higher frequency of previously recorded license suspensions and/or revocations, and a higher proportion of previously recorded speeding convictions than nondrinking drivers in similar accidents.

Epidemiological research continues to clarify the nature and extent of alcohol abuse and alcoholism. Increased knowledge and application of that knowledge to prevention and treatment could help reduce the individual and social costs of alcohol abuse and alcoholism.

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Chapter II

Genetics and Alcoholism

One of the most keenly debated issues in alcoholism research has been whether genetic factors play an important part in the development of alcoholism. In other words, is susceptibility to alcoholism inherited, at least in some individuals? If so, what are the predisposing factors? To what extent do environmental influences determine the expression and severity of the disorder?

An affirmative answer to the first question began to emerge 10 years ago with the Goodwin et al. (1973) study on adopted-out sons of alcoholics, although the results were initially greeted with skepticism. Impressive evidence now indicates that heritable factors influence susceptibility to alcoholism as well as to a number of physiological and biochemical responses to alcohol consumption. Furthermore, research has documented that environmental and hereditary factors interact to produce the alcoholic state in some individuals.

Heritability of Alcoholism— Early Studies

The notion that alcoholism runs in families dates back centuries. Reports before 1900 on the familial nature of alcoholism were primarily anecdotal. In the past 80 years, however, more than 100 studies have examined the familial incidence of alcoholism (Goodwin 1971). In reviewing 39 studies conducted over the past four decades, Cotton (1979) summarized statistics on the families of 6,251 alcoholics and 4,083 nonalcoholics. The most striking finding was that, regardless of the nature of the nonalcoholic comparison population, alcoholics were more likely than nonalcoholics to have an alcoholic father, mother, sibling, or distant relative. On the average, almost one-third of any sample of alcoholics had at least one parent with an alcoholism problem. Alcoholic patients were six times more likely than nonpsychiatric patients and two times more likely than psychiatric pa-

tients to report parental alcoholism. Thus, the high rate of parental alcoholism appeared to be not a general characteristic of a disturbed population but a specific correlate of alcoholism. Alcoholism was more prevalent in male relatives, in the families of female alcoholics, and in near relatives than in distant relatives.

The results of family studies do not unequivocally support genetic transmission. A family shares a common environment as well as common genes, and familial patterns of alcoholism can be explained just as readily by behavioral and sociocultural theories as by genetic ones. Although evidence in support of environmental theories is tenuous, such factors cannot be ignored. It is notable that, in the family studies summarized by Cotton (1979), 45 to 80 percent of the alcoholic subjects did not have an alcoholic parent or other relative. This suggests that in many individuals environmental factors influence the expression and severity of the disorder.

To separate the influence of heredity from that of environment, studies are needed comparing special populations in which the influence of either heredity or environment differs (e.g., comparing rates of alcoholism among identical versus fraternal twins or between half-siblings, or comparing such rates among adopted children of alcoholics versus those who are raised by their biological parents). All of these special population groups have been used in alcohol-related research. A number of studies have compared identical and fraternal twins with regard to alcohol-drinking practices, alcohol metabolism, and the effect of alcohol on brain waves as measured by electroencephalogram (EEG). None specifically investigated clinically defined alcoholism, however.

In 1972, Schuckit and coworkers reported on a study of alcoholism in half-siblings. The 69 probands (alcoholic subjects who brought their families into the study) were hospitalized patients who had half-siblings and had been diagnosed as having primary alcoholism, i.e.,

additional 42 men and 50 women whose biological mothers had been reported for alcohol abuse were included as well. The subjects were compared with four control groups selected from the same population on the basis of age, sex, age at adoption, occupational category of the adoptive parents, and ages of the biological and adoptive parents when the child was born.

Male adoptees whose fathers were reported as having severe alcoholism showed a 20 percent incidence of alcohol abuse compared with 6 percent in the controls. In the adopted men whose biological mothers had been reported for alcohol abuse, 33 percent were reported for alcohol abuse as compared with 19 percent in the control group—however, the difference is not statistically significant. On the whole, these findings again confirm the data of Goodwin and coworkers (1973) concerning a genetic influence on alcoholism or alcohol abuse in the sons of male alcoholics.

Adopted women whose biological parents were reported for alcohol abuse, as well as adopted women with non-alcohol-abusing biological parents, had low rates of alcohol abuse. Because of this outcome, a conclusion about the presence or lack of genetic influence on alcohol abuse in women could not be made.

Researchers at the University of Iowa (Cadoret and Gath 1978; Cadoret et al. 1980) have contributed two reports on alcoholism in American adoptees. The first study focused on male and female adoptees who had been separated at birth from biological parents who showed evidence of psychiatric or behavior disturbance. Biological parents of the control group adoptees were not mentally disturbed. The experimental and control groups were matched on age, sex, time spent in foster care, and age of biological mother at birth of her child. Data were collected on 84 of 173 adult adoptees by interview, either with the adoptive parents or with both adoptee and adoptive parents. The remainder of the identified adoptees (51 percent) either could not be located or refused to be interviewed.

Two or more social or medical complications of excessive alcohol use or hospitalization for detoxification constituted a diagnosis of alcoholism (Feighner et al. 1972). The alcoholism rate was low in both the experimental and control groups. Three adoptees with primary alcoholism were associated with 6 alcoholic biological parents versus 1 alcoholic adoptee from 78 biological parents without alcoholism. Seven adoptees had sec-

ondary alcoholism (alcoholism occurring with and preceded by adult psychiatric disorders), but none of them had alcoholic biological parents. Adoptee alcoholism was found to be unrelated to psychiatric diagnoses in biological parents or to a variety of psychosocial and environmental variables in postnatal life. It was, however, significantly correlated with childhood conduct disorders in the adoptees and with alcoholism and alcohol abuse in the biological parents.

In the second Iowa study, only male adoptees were studied, but the sample was enlarged to include adoptees whose second-degree relatives (e.g., grandparents, aunts, uncles, cousins) had psychiatric or behavior disturbances. A matched control group was also recruited. Out of the 167 male adoptees 18 years and older thus identified, data were collected on 92 men (55 percent) by interview with the adoptee, the adoptive parent, or both. The studies were marred by high dropout rates; as measured by available information on participants and nonparticipants, however, sample bias in the two studies was estimated to be minimal. Of the 92 male adoptees, 23 were alcoholic and 22 had experienced childhood conduct disorders. Evidence for alcoholism was present in 15 first and second-degree relatives. Statistically significant associations existed between adoptee alcoholism and an alcoholic family (biological) background and between childhood disorder and the development of alcoholism in adulthood. None of the environmental factors, including psychiatric or alcohol problems in the adoptive family as well as its socioeconomic status, predicted alcoholism.

Both studies confirm the conclusions of Goodwin and coworkers "that genetic factors importantly affect alcoholism development." But both failed to demonstrate an independent effect of environmental factors in the development of alcoholism. Also, the association of childhood conduct disorders with alcoholism in adult life is in accord with previous reports suggesting that childhood conduct disorder and hyperactivity may predict subsequent alcoholism (Schuckit et al. 1972; Goodwin et al. 1975).

Environmental-Genetic Influence on Alcoholism

The adoption studies described here clearly demonstrate that genetic predisposition is an