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Social and geographical disparities in adverse birth outcomes in Alaska: a retrospective cohort study

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ABSTRACT

Introduction Preterm birth (PTB) affects 1 in 10 births in the USA and is associated with near-term and long-term health consequences. This study assesses social and geographical disparities in adverse birth outcomes and associated risk factors in Alaska.

Methods We examined birth records for 218 222 singleton live births in Alaska between 2000 and 2020. We described the distribution of PTB, very PTB, and low birth weight by geographical region, assessed risk factors for adverse birth outcomes, investigated how racial and ethnic differences in birth outcomes may be related to behavioural and social risk factors, and investigated how the unique transportation network in the state may affect adverse birth outcomes.

Results There was an increased risk of PTB among births to mothers over 35 years of age (adjusted OR, AOR: 1.26; 95% CI: 1.20, 1.33), with prepregnancy diabetes (AOR: 3.42; 95% CI: 3.00, 3.90) or hypertension (AOR: 2.28; 95% CI: 2.08, 2.51), who used tobacco during pregnancy (AOR: 1.33; 95% CI: 1.27, 1.40), and who received <11 prenatal care visits (AOR: 2.66; 95% CI: 2.56, 2.77). Racial disparities in PTB persisted after adjustment for behavioural and healthcare-related risk factors. Nearly 40% of births took place outside the mother's community of residence, and there was an increased risk of PTB associated with travelling for birth.

Conclusions PTB continues to be a persistent issue in Alaska, particularly among non-white mothers. Our findings regarding prenatal care utilisation, pre-existing health conditions, and tobacco use during pregnancy can support public health interventions to decrease the risk of adverse birth outcomes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Preterm birth (PTB) is associated with near-term and long-term adverse consequences for infants. Factors such as maternal age, race and educational status, chronic conditions, and access to healthcare contribute to this adverse birth outcome. In Alaska, the rate of PTB among the American Indian/Alaska Native (AIAN) population has increased over the last decade. Understanding how known risk factors for PTB contribute to this disparity can support more effective prenatal care in a largely rural region.

WHAT THIS STUDY ADDS

⇒ This study provides insight into birth outcomes over a 20-year period in a US region with a large rural and AIAN population. We found that low prenatal care utilisation and tobacco use during pregnancy increased the risk of PTB, but the disparity in adverse birth outcomes by race persisted after adjusting for these risk factors. Our findings regarding travel for birth likely reflect the successful utilisation of a referral model to service hub facilities for high-risk pregnancies.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study can help Alaska, and other rural regions with a dispersed clinical care network continue to build supportive maternal health infrastructure and support targeted health interventions.

INTRODUCTION

In the USA, preterm birth (PTB)[1] occurred in 10.2% of pregnancies in 2019, and low birthweight (LBW) deliveries[2] occurred in 8.2% of births.[3] Both are associated with near-term and long-term adverse outcomes for infants.[1 2] PTB has acute consequences including respiratory and gastrointestinal issues[4] and is the leading cause of death globally in children below age 5.[5] Infants born very preterm (<32 weeks) have an even higher risk of morbidities including sepsis and respiratory distress syndrome,[6] as well as an elevated risk for cerebral palsy and lower function on motor or cognitive tests.[7] Very PTBs only account for 1.6% of live births in the USA but are associated with over half of infant deaths.[6] LBW is associated with a higher risk of respiratory issues and infections,[8] which contribute to a higher risk of mortality[2 8] and long-term impacts like type-2 diabetes.[9] Due to the cost of care for these morbidities, long-term costs such as special education, and losses to labour market productivity due to morbidity and mortality, Waitzman *et al* estimated the total direct and

indirect cost of PTB to be over US$25 billion for the 2016 US birth cohort.[10]

Several maternal characteristics have been identified as risk factors for PTB and LBW deliveries.[11–13] Sociodemographic risk factors include higher maternal age or educational attainment less than high school.[11] Maternal health status such as prepregnancy diabetes or hypertension increases risk.[11 12 14] Other factors that contribute to risk include tobacco use[11 15 16] or experiencing stress[11] during pregnancy.

In the USA, births to mothers who are Black have higher PTB incidence rates (16%–18%) compared with births to mothers who are White (5%–9%).[11 17 18] American Indian/Alaska Native (AIAN) women have higher risk of PTB nationally[17] and in Alaska, where AN mothers have the highest rate of PTB among racial groups, with an increasing annual rate over the past decade.[18] The higher PTB risk among minorities often persists after adjustment for socioeconomic, health, and behavioural factors.[19–22] Proposed mechanisms for this include higher preconceptional stressors,[23] neighbourhood deprivation,[24] and structural racism measured by income inequality and racial segregation.[25]

Living in a rural area can also contribute to adverse birth outcomes. Lack of providers or distance to a clinical care centre can reduce access to healthcare and lead to fewer prenatal care visits.[26] Living in a rural area can also lead to costly emergency transportation for birth.[26 27] A nationwide study examining rural counties that lost hospital-based obstetric services showed significant increases in PTB, out-of-hospital births, and low prenatal care use, likely due to increased travel time and costs for pregnant women.[28] Inequities in rurality and healthcare access can also intersect with racial inequities as seen in Montana, where expectant mothers who are AIAN travelled significantly greater distances to obstetric care compared with white mothers, even when living in similarly rural counties.[29]

In Alaska, classifying the degree of rurality of a community requires considering whether it is connected to the primary road system (the road network that connects Alaska to the contiguous USA through Canada). Approximately 20% of the Alaskan population lives in communities that are not on the primary road system, and travel to these communities requires transportation by plane, boat, or snowmobile.[30] As a result, for mothers living in these communities, childbirth often involves lengthy travel and prolonged stays away from home in the last month of childbirth.[31] If there is not a hospital or birthing centre in their home community, mothers are advised to travel to a hub community to give birth.[32] If the service hub hospital is not able to manage the pregnancy (eg, due to anaemia or being a first-time mother), or there is a risk of PTB, mothers are advised to deliver in an urban area (e.g. Anchorage), with recommended travel 2–4 weeks prior to their delivery date.[33]

Research on birth outcomes in Alaska is sparse. The Alaska Department of Health noted the PTB rate in the state rose to a 20-year high of 9.7% in 2019 with increasing rates of obesity, hypertensive disorders, and diabetes among mothers likely contributing.[18] Crude rates of PTB among all minority racial groups have been consistently higher than the rate of PTB among White mothers.[34] Additionally, PTB among AN mothers has increased over the past decade but not among other racial groups.[18 34] Access and uptake of prenatal care may contribute to PTB in Alaska; 28% of 2017 births received no first-trimester prenatal care, with the lowest rates among Asian/Pacific Islander mothers and in the Southwest region of Alaska.[18 34]

In this study, we assess trends in adverse birth outcomes, including PTB, very PTB and LBW, in Alaska between 2000–2020. We describe the distribution of adverse birth outcomes by geographical region, assess risk factors for adverse birth outcomes, investigate how racial and ethnic differences in birth outcomes may be related to identified behavioural and social risk factors, and investigate how the unique transportation network in the state may be associated with birth outcomes.

MATERIALS AND METHODS

Data

We identified a cohort of all live singleton births to Alaska residents occurring in Alaska between 2000 and 2020 (n=218 222) using birth records from the Alaska Department of Health, Health Analytics and Vital Records Section. Birth city and city of mother's residence were mapped to physical locations using a publicly available dataset of Alaska communities from the Alaska Division of Community and Regional Affairs[35] or Google Maps.[36] Geographical locations could not be assigned to three communities (Sourdough, Sunshine, and Unknown), and these records were excluded from analysis (n=82, 0.04%).

We assessed several maternal characteristics from the birth records. We categorised parity (1, 2–4 or 5+ previous births), mother's age at birth (<18, 18–34 and 35+) and educational attainment (less than high school, high school graduate, more than high school, and unknown). Self-reported race and ethnicity information was used to create six mutually exclusive race/ethnicity categories[37]: AIAN (non-Hispanic), Asian and Native Hawaiian or other Pacific Islander (non-Hispanic), Black or African American (non-Hispanic), Hispanic or Latino, White (non-Hispanic), and other/unknown (non-Hispanic). Pre-existing conditions including prepregnancy diabetes (yes/no) or hypertension (yes/no), tobacco use (yes/no/unknown), and the number of prenatal care visits were obtained from birth records. Prenatal care was coded as <11 visits or 11 or more visits based on prior work.[38]

In this study, we explore the issue of rurality and adverse birth outcomes by assessing access to birth facilities. We assessed each mother's access to a birth facility based on whether her residence community is

connected to a birth facility by road, and if connected, the driving distance (based on Google Maps) between her residence community and the nearest facility with 10 or more annual births.[39] Each residence community was categorised as 'low access' if not connected by road to a birth facility; 'medium access' if on the road system but >1-hour driving distance from a community with a birth facility; and 'high access' if the community contains a birth facility, or is on the road system and <1-hour driving distance from a community with a birth facility. Birth records in which specific birth location was ambiguous (eg, 'Balance of Matanuska-Susitna Borough') were characterised as 'unknown' access (n=799, 0.37%). We also created a variable ('travelled for birth') to describe whether a mother travelled outside of her residence borough or census area (county-level equivalents) to give birth in a different borough/census area.

The primary outcomes were PTB (gestational age <37 weeks), very PTB (gestational age <32 weeks) and LBW (<2500 g). Gestational age was calculated using obstetric estimated age at delivery,[40] which uses the best available information from ultrasound and last menstrual period.

Analysis

We created descriptive plots of the percentage of mothers receiving 11 or more prenatal care visits each year by race/ethnicity, and we assessed geographical variation in prenatal care by mapping the average number of prenatal care visits by the community. To assess trends in maternal travel for birth, we calculated the annual proportion of mothers who travelled outside of their residence borough/census area for birth overall and by race/ethnicity of the mother. We created maps of the travel-related births for the six service hubs (communities hosting a birth facility) that hosted the greatest number of travel births. For each service hub, we calculated the number of births to mothers residing in different communities based on their residence community and community of delivery.

We described geographical variation in adverse birth outcomes by mapping the overall percentage of births that were reported as PTB, very PTB or LBW by borough/census area. To assess temporal change in adverse birth outcomes by race, we plotted the annual PTB rate by race/ethnicity.

We examined univariate and multivariate associations between maternal social and behavioural characteristics and the occurrence of PTB, very PTB, and LBW. To assess the effect of access to a birth facility on birth outcomes, we added two variables to the fully adjusted model of maternal social and behavioural characteristics: level of access to a birth facility in a mother's residence community and whether a mother travelled outside of her residence borough/census area for birth. We included these as independent predictors and also ran a model with these variables included in an interaction term. For ease of interpretation of the interaction term, we used the margins command and postestimation tools in Stata[41] to calculate the absolute risk differences in adverse outcomes across levels of travel for birth and birth facility access. Independent variables in models were included based on relationships established in prior literature and when they were thought to be factors that could be addressed by policy or clinical interventions. We included a year of birth in the model as a fixed effect to account for potential changes in the standard of care over time. Model terms were checked for collinearity using a variance inflation factor.

We assigned community locations and created all maps with ArcGIS Pro (v10; Environmental Systems Research Institute (ESRI) 2010) using publicly available US Census TIGER/Line base maps.[42] Race/ethnicity variables were created using R (v4.2.2; R Core Team 2022), and all statistical analyses were performed in Stata (v18; StataCorp 2019).

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of our research.

RESULTS

Maternal characteristics

Most Alaskan births (84.6%, n=184 569) were to mothers aged 18–34 years, and 2.1% (n=4658) of births were to mothers under 18 years of age (table 1). Only 11.2% (n=24 386) of mothers had less than a high school education. Over half of the births (56.6%, n=123 593) were to White, non-Hispanic mothers, with AIAN, non-Hispanic births (23.2%, n=50 715) as the largest minority group. Births to Asian-Pacific Islander, non-Hispanic mothers accounted for 8.3% (n=18 191) of the births with smaller numbers of births to Hispanic (7.0%, n=15 233) and Black, non-Hispanic (3.8%, 8386) mothers. Prepregnancy diabetes and prepregnancy hypertension were seen in 0.8% (n=1654) and 1.9% of births (n=4163), respectively. Approximately 15.0% (n=32 431) of mothers reported tobacco use during pregnancy.

Prenatal care, access to a birth facility, and travel for birth

The proportion of mothers receiving 11 or more prenatal care visits varied by maternal race/ethnicity (figure 1a), with White, non-Hispanic mothers most likely to receive 11 or more visits and AIAN, non-Hispanic mothers least likely. Notably, prenatal care utilisation among AIAN, non-Hispanic mothers has been trending upward since 2010.

Mothers living in communities on the primary road system received eight or more prenatal visits on average (figure 1b). Utilisation of prenatal care was associated with access to a birth facility. Over half (54.3%) of births to mothers living in a community with high access received 11 or more prenatal care visits, compared with only 34.8% of births to mothers in communities with medium access, and 25.0% of births to mothers in communities with low access.

Table 1 Maternal characteristics, prenatal care use, proximity of maternal residence to a hospital birth facility and travel status for delivery of all live singleton births occurring in Alaska, 2000–2020 (N=218 222)

	n	%
Parity		
1st birth	89 276	40.9
2nd–4th birth	114 676	52.6
5th or higher birth	9403	4.3
Missing	4867	2.2
Maternal age	n	%
<18 years	4658	2.1
18–34 years	184 569	84.6
≥35 years	28 911	13.6
Missing	84	0.04
Maternal race/ethnicity	n	%
Alaska Native/American Indian (NH)	50 715	23.2
White (NH)	123 593	56.6
Asian/Pacific Islander (NH)	18 191	8.3
Hispanic/Latino	15 233	7.0
Black (NH)	8386	3.8
Other/unknown (NH)	2104	1.0
Maternal education	n	%
<High school	24 386	11.2
High school diploma	77 686	35.6
>High school	105 902	48.5
Unknown	10 248	4.7
Maternal prepregnancy diabetes	n	%
Prepregnancy diabetes (N)	216 568	99.2
Prepregnancy diabetes (Y)	1654	0.8
Maternal prepregnancy hypertension	n	%
Prepregnancy hypertension (N)	214 059	98.1
Prepregnancy hypertension (Y)	4163	1.9
Mother tobacco use during pregnancy	n	%
No	184 125	84.4
Yes	32 431	14.9
Missing	1666	0.8
Number of prenatal care visits	n	%
<11 visits	101 729	46.6
≥11 visits	102 124	46.8
Missing	14 369	6.6
Maternal access to hospital birth facility	n	%
High	184 988	84.8
Medium	5057	2.3
Low	27 296	12.5
Unknown	881	0.4
Mother travelled outside of residence borough/census area for birth	n	%
No	176 141	80.7
Yes	42 081	19.3
Birth outcome	n	%
Preterm (<37 weeks)	16 016	7.3
Very preterm (<32 weeks)	2070	1.0
Low birth weight (< 2500 g)	9992	4.6

NH, non-Hispanic.

Most births (84.8%, n=184 988) were to residents of communities with high birth facility access. Residential proximity to a birth facility showed strong variation by race, with AIAN, non-Hispanic mothers more likely to reside in communities with low access (43.3% of AIAN births), compared with 3.1% of births to White, non-Hispanic mothers and <7.0% of births to mothers of any other race/ethnicity group. Between 2000 and 2020, 19.3% (n=42 081) of mothers left their residence borough/census area for childbirth (table 1), and 39.1% (n=85 315) of births took place in communities other than the mother's community of residence (figure 2). Anchorage received the highest percentage of travelling mothers (42.7%, n=36 471 from 269 unique residence communities), followed by Fairbanks (15.9%, n=13 592 from 133 communities), and Palmer (12.9%, n=10 982 from 87 communities). Mothers from communities within all 30 boroughs/census areas were represented among Anchorage births, with most other birth locations reflecting travel from small communities to their nearest regional service hubs.

Adverse birth outcomes

There was substantial variation in rates of adverse birth outcomes by geographical region in Alaska (figure 3a–c). Areas with the highest rates of PTB, very PTB and LBW were boroughs/census areas in north, west, and southwest Alaska.

Temporal trends in the rate of PTB by race/ethnicity show that births to White, non-Hispanic mothers consistently have the lowest rate of PTB (figure 3d). Overall, minority populations have higher rates of PTB, with high variance among non-Hispanic Black or Asian mothers, and Hispanic mothers. Among the non-Hispanic AIAN population, the PTB rate increased from 8.2% to 12.8% since 2000.

Logistic regression results

All variables tested in univariate analyses were associated with PTB and were included in the fully adjusted model (table 2). In the fully adjusted model, the estimated risk of PTB associated with each predictor was attenuated for many of the independent variables tested. However,

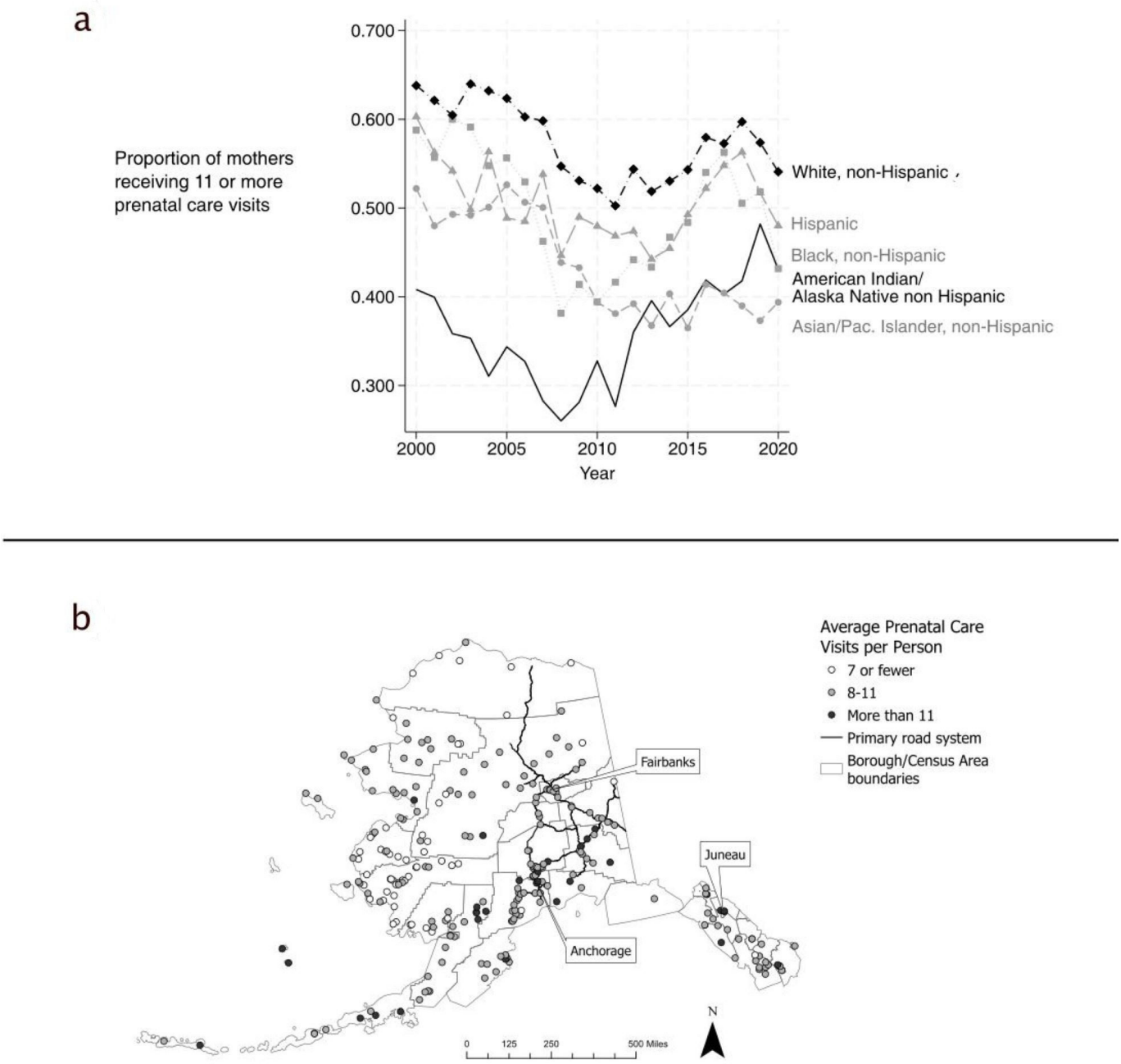

Figure 1 Patterns of prenatal care visits in Alaska, 2000–2020. (a) Proportion of mothers receiving 11 or more prenatal care visits by year and race/ethnicity. (b) Average number of prenatal care visits received by mothers by community. Communities with fewer than six births between 2000 and 2020 have been suppressed for confidentiality.

there were substantial changes in PTB risk associated with parity and maternal age.

Second, third, and fourth births had a lower risk of being preterm compared with first births (adjusted OR, AOR: 0.84; 95% CI: 0.81, 0.87), but fifth or higher births showed no evidence of increased risk after adjustment (AOR: 0.94; 95% CI 0.86, 1.01). Births to mothers 35 years of age or older had a higher risk of PTB compared with mothers 18–34 years of age in the adjusted model (AOR: 1.26; 95% CI: 1.20, 1.33), with no evidence of increased risk among mothers under 18 years of age.

All other risk factors showed similar patterns to the univariate models. All racial/ethnic minority groups continued to have a higher risk of PTB compared with White, non-Hispanic mothers. There was a decreased risk of PTB among mothers with a high school degree (AOR: 0.89; 95% CI: 0.84, 0.94) or greater than a high school degree (AOR 0.87; 95% CI 0.82, 0.92) compared with mothers with less than a high school degree. There was an increased risk of PTB in mothers with prepregnancy diabetes (AOR: 3.42; 95% CI: 3.00, 3.90) or hypertension (AOR: 2.28;

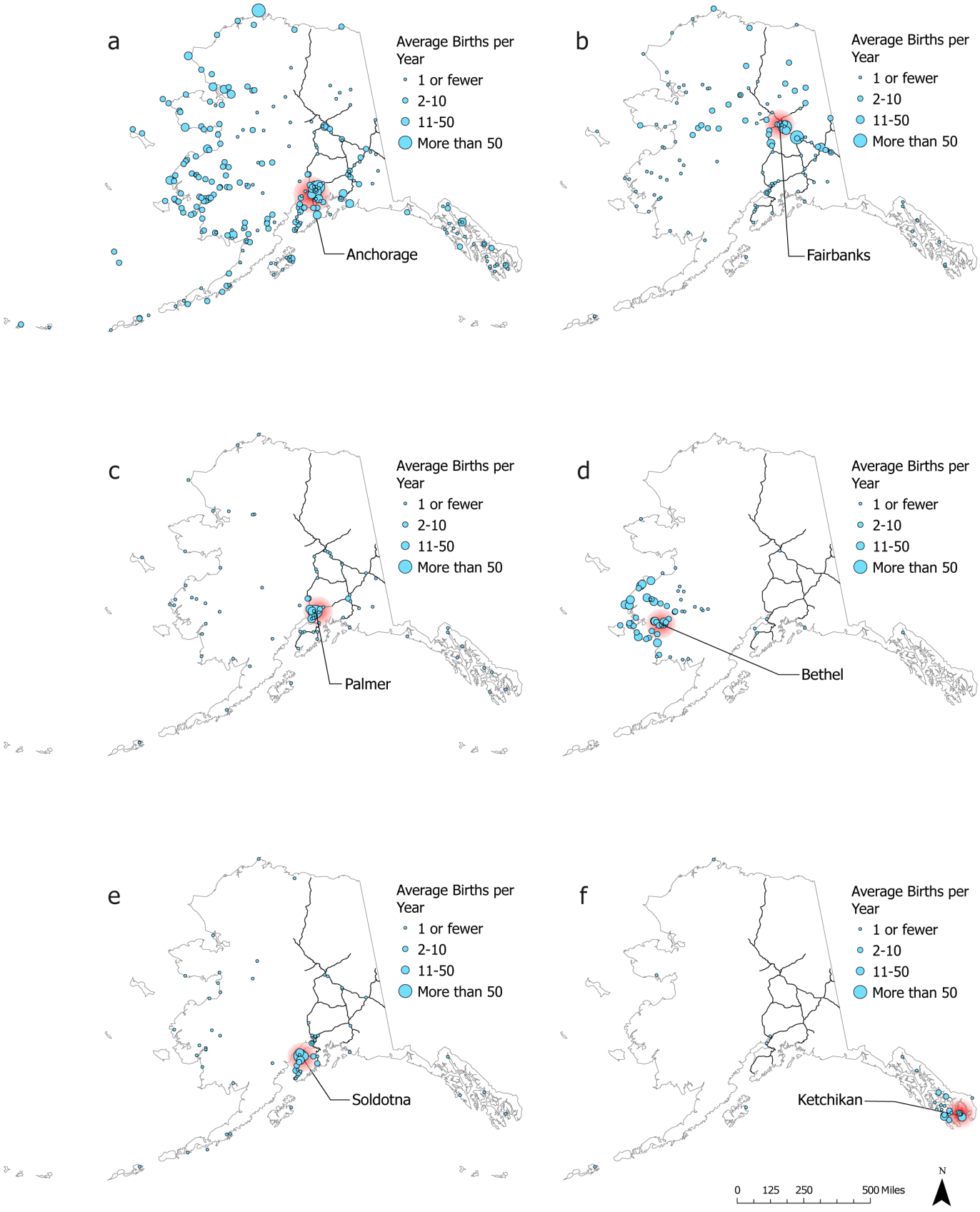

Figure 2 Maps of the number of Alaska births (2000–2020) that occurred in the six busiest service hubs (communities hosting a birth facility) to mothers who travelled outside of their residence community to give birth, where (a) Anchorage, (b) Fairbanks, (c) Palmer, (d) Bethel, (e) Soldotna, and (f) Ketchikan. Dots are placed on the residence community of the mothers who gave birth in each service hub, and they are proportional to the number of births to mothers from that community. The primary road system is shown on the map to provide context to the extent of travel that is often necessary to give birth in Alaska.

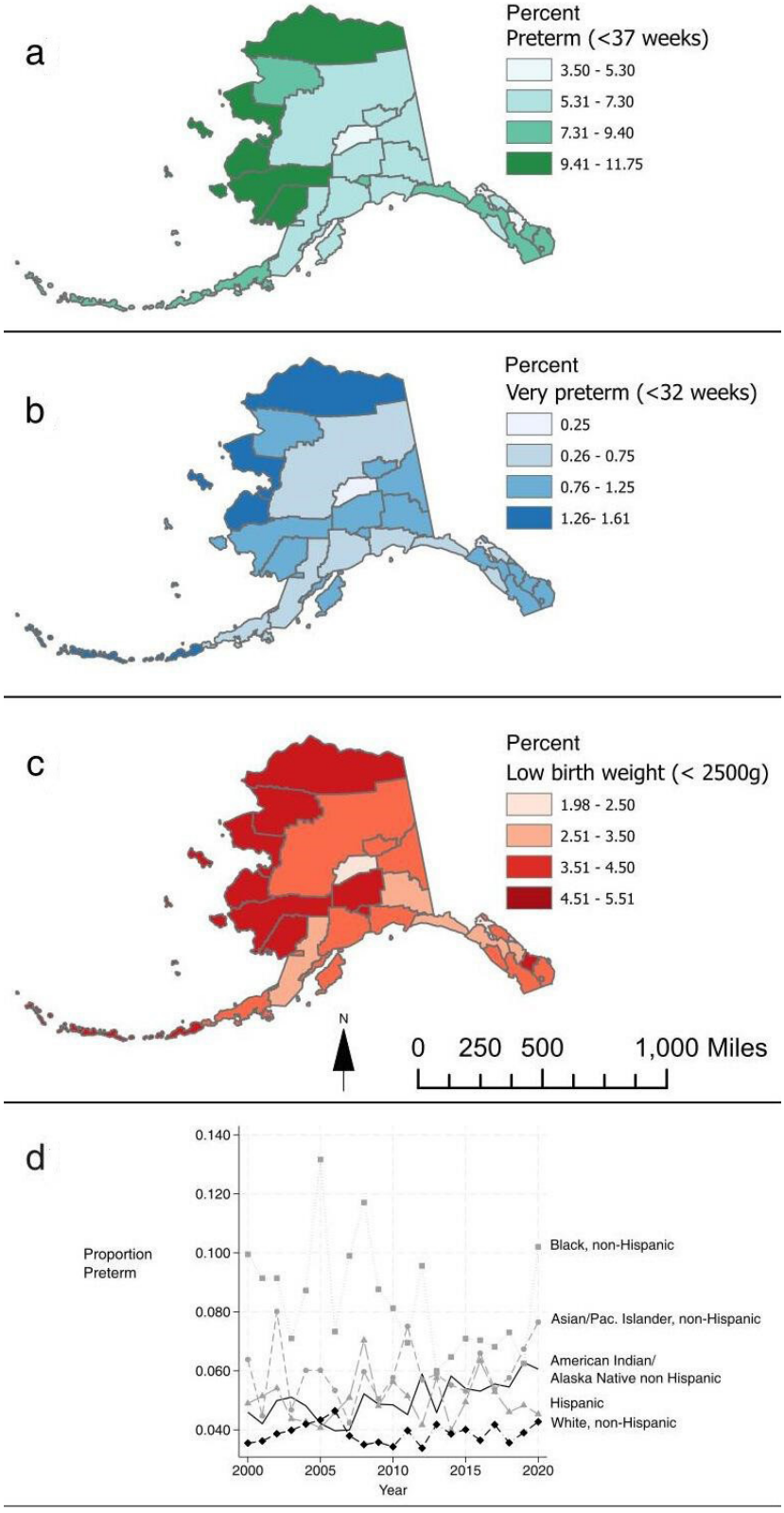

Figure 3 Patterns of adverse birth outcomes in Alaska, 2000–2020. Maps of the percentage of births that were (a) preterm (<37 weeks estimated gestational age), (b) very preterm (<32 weeks estimated gestational age) and (c) low birth weight (<2500 g), by borough or census area. (d) Proportion of births that were preterm birth by year and race/ethnicity.

95% CI: 2.08, 2.51) compared with mothers without these conditions. There was also an increased risk of PTB in mothers who used tobacco during pregnancy (AOR: 1.33; 95% CI: 1.27, 1.40) or who received fewer than 11 prenatal care visits (AOR: 2.66; 95% CI: 2.56, 2.77).

Table 2 ORs and 95% CIs for preterm birth among Alaskan mothers (2000–2020) (N=198 027)

	OR (95% CI)	P value	Adjusted OR (95% CI)*	P value
Parity				
1st birth	Ref		Ref	
2nd–4th birth	0.90 (0.87, 0.93)	<0.001	0.84 (0.81, 0.87)	<0.001
5th or higher birth	1.45 (1.36, 1.56)	<0.001	0.94 (0.86, 1.01)	0.095
Maternal age				
<18	1.29 (1.17, 1.43)	<0.001	0.91 (0.80, 1.02)	0.106
18–34	Ref		Ref	
≥35 years	1.24 (1.18, 1.30)	<0.001	1.26 (1.20, 1.33)	<0.001
Maternal race/ethnicity				
White (NH)	Ref		Ref	
Alaska Native/American Indian (NH)	1.59 (1.53, 1.65)	<0.001	1.16 (1.10, 1.22)	<0.001
Asian/Pacific Islander (NH)	1.36 (1.28, 1.44)	<0.001	1.27 (1.19, 1.35)	<0.001
Hispanic	1.22 (1.14, 1.30)	<0.001	1.18 (1.10, 1.27)	<0.001
Black (NH)	1.62 (1.50, 1.75)	<0.001	1.55 (1.42, 1.69)	<0.001
Other—unknown (NH)	1.71 (1.48, 1.98)	<0.001	1.39 (1.16, 1.66)	<0.001
Maternal education				
Less than high school	Ref		Ref	
High school diploma	0.80 (0.76, 0.84)	<0.001	0.89 (0.84, 0.94)	<0.001
>High school	0.67 (0.64, 0.70)	<0.001	0.87 (0.82, 0.92)	<0.001
Unknown	1.16 (1.07, 1.25)	0.001	1.06 (0.97, 1.16)	0.224
Maternal health status and health behaviours				
No response for given condition	Ref		Ref	
Prepregnancy diabetes	3.58 (3.18, 4.02)	<0.001	3.42 (3.00, 3.90)	<0.001
Prepregnancy hypertension	2.49 (2.29 2.71)	<0.001	2.28 (2.08, 2.51)	<0.001
Tobacco use during pregnancy	1.57 (1.51, 1.64)	<0.001	1.33 (1.27, 1.40)	<0.001
Number of prenatal care visits				
Prenatal care visits <11	2.67 (2.57, 2.77)	<0.001	2.66 (2.56, 2.77)	<0.001
Prenatal care visits ≥11	Ref		Ref	
Maternal access to a hospital birth facility				
Low	1.36 (1.30, 1.42)	<0.001	0.54 (0.50, 0.57)	<0.001
Medium	0.81 (0.72, 0.91)	<0.001	0.34 (0.30, 0.39)	<0.001
High	Ref		Ref	
Mother travelled outside of residence borough for birth				
Mother did not travel	Ref		Ref	
Mother travelled	2.13 (2.05, 2.20)	<0.001	2.40 (2.29, 2.52)	<0.001

*Multivariate results are adjusted for all other covariates in the table and year of birth.
NH, non-Hispanic.

Results for potential risk factors associated with very PTB (online supplemental table 1) and LBW (online supplemental table 2) were similar to those for PTB, with a few notable differences. AIAN, non-Hispanic mothers showed no difference in very PTB risk (AOR: 0.94; 95% CI: 0.82, 1.09) and slightly decreased risk of LBW (AOR: 0.87; 95% CI: 0.82, 0.93) compared with White, non-Hispanic mothers in the fully adjusted models. As with PTB, births to mothers of all other minority groups had an increased risk of very PTB and LBW compared with births to White, non-Hispanic mothers. While receiving fewer than 11 prenatal care visits was associated with an increased risk of PTB and LBW, the magnitude of this association was substantially higher for very PTB (AOR: 7.43; 95% CI: 6.36, 8.67).

A total of 9.6% of observations have missing values for either smoking status, parity, maternal educational attainment or age, and these were excluded from our

regression analysis. As a sensitivity analysis, we re-ran the analysis with a separate category for missing. Adjustment for this missingness does not change associations between the independent variables and PTB.

Effect of access to birth facility, travel for birth, and their interaction

After adjusting for maternal characteristics, living in a community with low access (AOR: 0.54; 95% CI: 0.50, 0.57) or medium access (AOR: 0.34; 95% CI: 0.30, 0.39) to a birth facility was associated with a decreased risk of PTB compared with living in a community with high access, and travel for birth outside of a mother's residence borough/census area was associated with an increased risk of PTB (AOR 2.40; 95% CI: 2.29, 2.52).

When examining the interaction of these two variables in a fully adjusted model, we found that mothers who travelled out of their residence borough/census area for birth had a consistently higher risk of PTB, and this association varied by level of access to a birth facility in their residence community (online supplemental eFigure 1). Among mothers who live in a community with low access to a birth facility, those who travelled for birth had an absolute 2.8% (95% CI: 2.3%, 3.3%) higher risk of PTB compared with those who did not travel (absolute risk for travellers: 7.6%, absolute risk for non-travellers: 4.8%). Among mothers living in a community with high access to a birth facility, those who travelled for birth had an absolute 8.3% (95% CI: 7.7%, 8.9%) higher risk of PTB compared with those who did not travel (absolute risk for travellers: 14.6%, absolute risk for non-travellers: 6.3%). There was no significant difference in risk for travellers compared with non-travellers among mothers who live in communities with medium access to a birth facility.

DISCUSSION

In this study of all live singleton births between 2000 and 2020 in Alaska, a largely rural state with over 77% of the US AN population,[43] we found substantial social and geographical disparities in PTB, very PTB, and LBW.

Our results demonstrate an increased risk of PTB, very PTB, and LBW related to a number of maternal sociodemographic and health characteristics. In our fully adjusted model, we found an association between adverse birth outcomes and higher maternal age, but not for mothers under 18, which differs from previous research showing a U-shaped trend with a higher risk of PTB for mothers under 18 and over 35 years of age.[44] Consistent with previous literature, we found that mothers with less than a high school education were at increased risk of PTB.[4] Compared with US numbers from 2011, Alaska has a similar proportion of mothers with less than a high school diploma (14% nationwide vs 11.2% in Alaska) but a lower proportion with higher education (48.5% of Alaskan mothers having some higher education, compared with 66% nationwide).[45] Our results align with prior work demonstrating that tobacco use during pregnancy,[46 47] and prepregnancy diabetes and hypertension are associated with risk of PTB, very PTB, and LBW.[14]

We found that receiving fewer than 11 prenatal care visits was associated with a higher risk of adverse birth outcomes. Despite variation in prenatal care utilisation over the study period, utilisation among White, non-Hispanic mothers was consistently highest and utilisation among AIAN, non-Hispanic mothers was generally the lowest. Additionally, mothers who reside on the primary road network receive more prenatal care. These differences in utilisation and access to care by race and place suggest the potential for interventions focused on these groups of mothers to improve adequacy of prenatal care, which is associated with healthier outcomes in both high-risk and low-risk pregnancies.[48 49]

The racial/ethnic composition of mothers in Alaska differs from the USA as a whole. The proportion of births to White, non-Hispanic mothers in Alaska (56.6%) is similar to the national average (52.1%)[50]; however, the proportion of Alaskan births to AIAN (23.2%) and Asian-Pacific Islander, non-Hispanic mothers (8.3%) is higher than the rest of the USA (AIAN=0.8%; Asian-Pacific Islander=6.8%). While almost a quarter of US births are to Hispanic mothers (23.7%) and 15.2% are to Black mothers, these proportions are much lower in Alaska (Hispanic: 7.0%; Black, non-Hispanic: 3.8%).[50]

We found that births to mothers who identify as AIAN, Asian/Pacific Islander, Black, or Hispanic had a higher risk of PTB compared with births to White, non-Hispanic mothers. For AIAN, non-Hispanic mothers, risk dropped substantially in the adjusted model, and for very PTB, there was no evidence of higher risk among this population. For LBW, the risk was lower among births to AIAN, non-Hispanic mothers than for White, non-Hispanic mothers. These results suggest confounding, perhaps due to the distribution of risk factors for adverse birth outcomes by race, in particular, tobacco use during pregnancy and access to healthcare.[17] Notably, within our cohort, 32.1% of AIAN, non-Hispanic mothers reported tobacco use during pregnancy compared with only 10.6% of White, non-Hispanic mothers. Further work to address this exposure could support healthier outcomes.[11 15 16] AIAN, non-Hispanic mothers received the fewest prenatal care visits on average, which aligns with the large proportion of AIAN mothers who live in rural areas with low access to birth facilities. The disparities in the distribution of these modifiable risk factors point to areas of potential interventions. However, the robustness of minority status as a significant predictor in the adjusted models suggests that race and racism may play a role in adverse birth outcomes by the process of weathering.[51 52]

While previous research into rural residence, travelling for birth, and birth outcomes is sparse, rural residence has been associated with higher risk of adverse outcomes.[53–56] Our results show that among mothers who live in a community with low access to a birth facility, those who travelled outside of their residence borough/

census area for birth had a higher PTB risk than mothers who did not travel. Similarly, we found that this comparison was even larger for mothers who live in a service hub community with a birth facility. This is likely a result of labour guidelines for Alaska clinicians that encourage mothers with a previous PTB or other risk factors living in low-access communities to travel to a service hub that can manage high-risk pregnancies. Only 141 PTB (0.06%) between 2000 and 2020 were to mothers who gave birth in a community without a birth facility. Among mothers who live in communities with high access to a birth facility and travelled outside of their residence borough/census area for birth, 84% of these deliveries occurred in Anchorage (the largest urban area in Alaska), suggesting that these mothers may have been seeking care for riskier pregnancies. This pattern suggests that despite the extreme rurality of many Alaska communities, most high-risk pregnancies are being routed to locations suitable to support the delivery.

Although these results suggest that the referral model used in Alaska for high-risk pregnancies is supporting biomedical health standards, travel and prolonged stays away from home introduce economic and emotional health issues that must be considered in prepartum and postpartum care. If a mother travels to a service hub for prenatal care or delivery, they will incur costs for flights, accommodation, food, and missed work, which may not be covered by insurance. They may need to have difficult conversations about whether their partner will travel with them or stay at home to work and care for other children. These stressors are compounded by a lack of social support and living in an unfamiliar place. A qualitative study of Alaska mothers' experiences with 'mandated maternal transport practices' found that among their interviewees, this practice is perceived to impact feelings of powerlessness over the birthing process, fear and potential avoidance of the medical system, bonding between parent and baby, and the prevalence of postpartum depression.[31] There is a need for additional studies on the medical and social costs and benefits of travelling for prenatal care and birth in Alaska. Additionally, programmes to support delivery of obstetric care in remote Alaska (e.g., through the Community Health Aide Programme[57] or telemedicine) and to provide culturally appropriate social and mental health services to travelling mothers are likely important components of providing holistic services to AN pregnant mothers in the state.

This study has several limitations. PTB is associated with many causes, and factors that contribute to adverse birth outcomes but were not measured here include models of prenatal care,[58] income or prior PTB,[59] short interpregnancy interval and low maternal body mass index,[60] air pollution,[61] prenatal depression[62] and diet quality.[63] We did not have information on college graduation status, which is associated with healthy birth outcomes.[64 65] Our use of the median number of prenatal visits is often used as an indicator of adequate prenatal care; however, other options for measuring prenatal care consider information that we did not have access to including the timing of visits during the pregnancy (eg, Adequacy Perinatal Care Utilisation Index).[49] Additionally, the number of visits could be misleading, as short-duration pregnancies might have fewer prenatal visits simply as the visits occur over a shorter time frame, or more complicated births might actually require additional visits for care. Although the birth dataset was obtained through official birth certificates, some of the variables relied on self-reporting (eg, tobacco use during pregnancy, maternal education). Additionally, there is likely variation in how the birth attendant or medical provider completed the birth certificate depending on the information they had available at the time of birth. For example, the number of prenatal care visits is based on the most recent prenatal records available, which may not capture all visits if a mother received care from multiple providers.

This study combines 20 years of individual-level data about mothers, their health, their place of residence and delivery, and their infants to investigate the complex factors associated with PTB in Alaska. Although this study provides insight into these relationships within the unique geographical and demographic characteristics of the state, our findings may also be generalisable for related populations. For example, a key gap in the literature addressed here is the potential role of lack of access to adequate prenatal care in the risk of adverse birth outcomes. Additionally, our findings regarding the interaction of birth facility access and travelling for birth suggest that the Alaska system for referral for high-risk pregnancy may be a model for other regions with large rural populations and a dispersed clinical care network. The detailed information on births in this dataset facilitated an assessment of confounding variables in relationship to adverse birth outcomes, particularly the role of tobacco use during pregnancy among the AIAN population. Conversely, the persistence of adverse birth outcomes among minority populations after adjusting for many confounders suggests that further work to address systemic racism and chronic stress is needed to support these populations in the state.

This study is the first to explore the multiple risk factors for PTB in Alaska, including the development of a novel method for classifying access to a birth facility. Although the Alaska healthcare system has been effective at identifying and referring at-risk pregnancies, PTB continues to be a persistent issue, particularly among non-White mothers. Our findings regarding prenatal care utilisation and tobacco use during pregnancy can support public health interventions to decrease the risk of adverse birth outcomes. Mobile access to culturally appropriate obstetric care,[66] identifying successful components of smoking cessation programmes among Indigenous populations in other regions (eg, tribal/community input into intervention design, individualised counselling sessions, and access to pharmacotherapy),[67]

and addressing food security as part of prenatal care to manage pre-existing health conditions,[68] may decrease the rate of adverse birth outcomes among the AIAN population in Alaska. Our geographical and demographic assessments of prenatal care utilisation and adverse birth outcomes can be used to effectively target these interventions.

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