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Pre-pregnancy and Prenatal Alcohol use Among American Indian and Alaska Native and Non-Hispanic White Women: Findings from PRAMS in Five States

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Abstract

Introduction Estimates of prenatal alcohol use among American Indian and Alaska Native (AI/AN) women are limited. This study sought to characterize pre-pregnancy and prenatal alcohol use among AI/AN women in the Pregnancy Risk Assessment Monitoring System (PRAMS) dataset, evaluate variation in alcohol use by state and rural/urban residence, and evaluate associations between potential risk factors and prenatal alcohol use among AI/AN and non-Hispanic white (NHW) women.

Methods We pooled PRAMS data from five states (Alaska, New Mexico, Oklahoma, South Dakota and Washington) from 2015 to 2017. We estimated the prevalence of pre-pregnancy and pregnancy risk factors, and alcohol use by race and examined alcohol use by state and rural/urban residence among AI/AN women. We conducted bivariate and multivariable logistic regression modelling to estimate the association between each risk factor of interest and the odds of prenatal alcohol use for AI/AN and NHW women.

Results AI/AN women were less likely to report pre-pregnancy alcohol use compared to NHW women (56% vs. 76%, $p < 0.0001$). Among women who reported drinking pre-pregnancy, AI/AN women were more likely than NHW women to report drinking 1 or more drinks during pregnancy (4.3% vs. 2.4, $p = 0.0049$). For AI/AN women, older age and experiencing homelessness (aOR = 2.76; 95% CI 1.16–6.55) increased odds of prenatal alcohol use. For NHW women, having a college education (aOR = 4.06; 95% CI 1.19–13.88) and urban residence (aOR = 1.88; 95% CI 1.40–2.53) increased odds of prenatal alcohol use.

Conclusions Factors associated with prenatal alcohol use differ between AI/AN women and NHW women, suggesting the need for tailored interventions.

Keywords PRAMS · Pregnancy · Prenatal alcohol use · American Indian · Alaska Native

Significance

American Indian and Alaska Native (AI/AN) populations experience higher levels of fetal alcohol spectrum disorder but current estimates of prenatal alcohol use among AI/AN women offer mixed results on drinking behaviors. While AI/AN women are more likely to abstain from alcohol use in general compared to NHW women, among those women who do drink during the prenatal period, AI/AN women drink at higher levels relative to white women. The observed risk factors for prenatal alcohol use for NHW women are typically associated with socioeconomic advantage, whereas those risk factors for AI/AN women are associated with disadvantage.

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Introduction

The amount of and frequency with which it is safe to consume alcohol while pregnant is unknown. What is known is that prenatal alcohol exposure can lead to fetal alcohol spectrum disorders (FASD), which represent a range of physical, behavioral and neurodevelopmental conditions(Williams & Smith, 2015). In lieu of safe consumption guidelines, the Centers for Disease Control and Prevention (CDC) and U.S. Surgeon General therefore recommend complete abstention from alcohol while pregnant (U.S. Surgeon General, 2005). The CDC's Healthy People 2020 initiative set a national target of 98.3% of pregnant women abstaining from any alcohol use, and 100% abstaining from binge and heavy drinking, the two forms of use known to increase FASD risk (United States, 2019). These 2020 targets have not been achieved among the general population of women and variability by demographic subgroup exists.

Women who identify as American Indian and Alaska Native (henceforth AI/AN women) are frequently omitted from national surveillance reports, such as the Healthy People initiatives, due to inadequate sample sizes. Thus, information on pre-pregnancy and prenatal alcohol use among AI/AN women is limited. At the same time, AI/AN women may be at risk for use during these periods, particularly patterns which are considered risky (i.e., binge or heavy drinking). Although abstention rates are higher among AI/AN adults compared to the general U.S. population and while rates of current drinking vary by community (Beals et al., 2003; Beauvais & LaBoueff, 1985), binge and heavy drinking and alcohol use disorder are more common (May & Moran, 1995; Szlemko et al., 2006). Among AI/AN women in particular, some community-based studies have found relatively high alcohol use (May, 1996; Muckle et al., 2011), including during pregnancy. In a sample of 322 pregnant AI teens, one quarter reported any substance use during pregnancy, with prenatal alcohol use being the most common (14% reported using) (Barlow et al., 2010). In a 2003 study of pregnant women, AI women were more likely to be at high risk for drinking during pregnancy compared to women of other ethnicities (Leonardson & Loudenburg, 2003). A study of women in Washington from 1989 to 2004 found that AI/AN women were more likely to both drink and binge-drink during pregnancy compared to other women (Grant et al., 2009). Elevated rates of FASD (Fox et al., 2015) among AI/AN children relative to their peers underscores the importance of better understanding alcohol use among pregnant AI/AN women. While genetic factors, including differential metabolism of alcohol by race/ethnicity may contribute to disparities related to FASD (Green & Stoler, 2007; Jacobson et al., 1996; Liyanage et al., 2017; Shankar et al., 2007), behavioral factors may also play a role.

To add to our understanding and provide an updated analysis of prenatal alcohol use among AI/AN women, this study had the following aims: (1) characterize pre-pregnancy and prenatal alcohol use among AI/AN women in Pregnancy Risk Assessment Monitoring System (PRAMS) data from five states with the largest samples of births to AI/AN women, evaluating variation by state and rural/urban residence; and (2) evaluate associations between potential risk factors and prenatal alcohol use among AI/AN and NHW women.

Methods

This study used data from five states participating in the PRAMS from 2015 to 2017. The 2015 cycle used the Phase 7 questionnaire, while cycles 2016 and 2017 used the Phase 8 questionnaire. The Phase 7 and Phase 8 questionnaire included slight differences in response options for question including number of drinks per week. Data from Alaska, New Mexico, Oklahoma, South Dakota and Washington were used, as these five states have the most sizable samples of AI/AN women in their PRAMS efforts. Women who identify as non-Hispanic white (henceforth referred to as NHW women) serve as a comparison group as they had the largest number of births for each state used. This study was not reviewed by an institutional review board as it did not meet the federal definition of human subjects research at 45 CFR 46.102 as all data in this public use dataset was deidentified (Code of Federal Regulations, title 46, 2019). This study was reviewed by the PRAMS Working Group.

PRAMS Data

Initiated in 1987, the Pregnancy Risk Assessment Monitoring System (PRAMS) is an ongoing collaborative surveillance project between the CDC and individual state and tribal health departments. Each year PRAMS collects information from recently postpartum women to cover 83% of all births in the United States. PRAMS uses state-issued birth certificates as a sampling frame in order to sample women who have recently given birth. PRAMS oversamples women from underrepresented groups, including racial and ethnic minorities, to produce reliable estimates among women and infants who are at both normal and high risk for maternal, neo- and postnatal health complications.

Each month, state PRAMS programs sample between 100 and 250 recent live births to comprise that month's sample of postpartum women. Following this approach, each participating state yields a sample size ranging from 1000 to 3400 respondents annually. Respondents can complete the PRAMS questionnaire in either English or Spanish. PRAMS survey responses are linked to birth certificates in order to

include the respondent's demographic and medical information. Once participating PRAMS state health departments submit their birth datafiles for a given calendar year, the CDC estimates and applies survey weights to correct for non-response. Additional details about the PRAMS design and methodology can be found elsewhere (Shulman et al., 2018).

Measures

Maternal socio-demographic information was largely drawn from linked birth certificate data. Maternal age was categorized using five age groups (< 19 years, 20–24 years old, 25–29 years, 30–34 years, 35 years and older). For analysis, highest education received was collapsed into less than high school, high school graduate, some college or Associate's degree, college graduate or more. Marital status was categorized as currently married or not, as captured on the birth certificate. Women could select multiple racial categories. To maximize representation of AI/AN women, women who selected AI/AN and any other race were categorized as AI/AN in the current analysis. Parity prior to the index pregnancy was categorized as 0, 1, 2, 3–5 or 6 or more previous births. Number of prenatal care appointments attended was categorized as ≤8 visits, 9–11 visits, or 12 or more. Pre-pregnancy and prenatal smoking were also assessed from the birth certificate. Maternal urban or rural residence was defined using the maternal address listed on the birth certificate.

Survey Measures

The PRAMS survey asked several questions related to pre-pregnancy and prenatal health and behaviors. All participants were asked whether they had experienced depression or anxiety or intimate partner violence (IPV) in the year prior to becoming pregnant. The survey also included a question regarding pregnancy timing that asked participants to think back to just before they became pregnant, and whether they wanted to become pregnant at that time, later, sooner, never, or not sure. For analysis, these categories were collapsed into a measure of pregnancy intendedness, for intended (wanted to become pregnant at that time), unintended/mistimed (wanted to become pregnant later, sooner, or never) and ambivalent (not sure). The survey also asked respondents whether they had experienced homelessness or violence from a partner or ex-partner while pregnant.

Alcohol-Related Measures

Women were asked about their drinking before and during pregnancy. First, they were asked about any alcohol use during the two years before their most recent pregnancy. Those women who indicated any use were then asked how much they drank in a typical week during the three months before they became pregnant. Responses to these questions for the Phase 7 questionnaire were "didn't drink then," "less than 1 drink a week," "1–3 drinks a week," "4–6 drinks a week," "7–13 drinks a week", and "14 or more drinks a week." The Phase 8 questionnaire used the following categories "didn't drink then," "less than 1 drink a week," "1–3 drinks a week," "4–7 drinks a week," "8–13 drinks a week", and "14 or more drinks a week." For analysis, we collapsed pre-pregnancy drinking into "didn't drink then", "0–3 drinks per week" and "4 or more drinks per week". Pre-pregnancy and prenatal binge drinking was assessed asking how many times respondents drank 4 alcoholic drinks or more in a 2 h time span; these measures were dichotomized (0 or 1 or more times) for analysis. To measure alcohol use during pregnancy, we collapsed responses to the question of how much alcohol they drank during the last trimester of pregnancy, into "didn't drink then", "less than 1 drink per week" and "1 or more drinks per week." An additional dichotomous variable of prenatal alcohol use, measuring whether any alcohol was consumed during the last trimester of pregnancy, was also created.

Statistical Analyses

We limited all analyses to women who identified as AI/AN or NHW. We estimated descriptive statistics with proportions to describe the sample, stratified by race/ethnicity. We estimated the prevalence of pre-pregnancy and pregnancy risk factors, and alcohol use stratified by race/ethnicity. We then examined alcohol use stratified by state and by rural/urban residence among AI/AN women only. Differences by race/ethnicity and by state and urbanicity were evaluated using chi squared tests of association. We estimated crude odds ratios of the association between each risk factor of interest and the odds of prenatal alcohol use, stratified by race/ethnicity. We then conducted multivariable logistic regression modeling, stratified by race/ethnicity. Separate models were fit for AI/AN and NHW women. Goodness of fit for each model was evaluated using Akaike and Bayesian information criteria. Final multivariable models, and the variables contained therein, were selected based on their informativeness and goodness of fit.

All analyses were weighted and accounted for PRAMS complex sampling design, using analysis weights estimated by CDC PRAMS and recommended for use. Analysis was conducted using Stata Version 15 (StataCorp,

2017) with an alpha level of 0.05 used to indicate statistical significance.

Results

AI/AN and NHW women differed on all demographic measures (Table 1). More AI/AN women were age 24 and younger compared to NHW women (40% vs. 23%). AI/AN women also had lower educational attainment than NHW women, with 9% having at least a college degree compared to 38% of NHW women. Fewer AI/AN women were nulliparous before the current pregnancy, compared to NHW women (33% vs. 42%). Nearly 60% of AI/AN women lived below the federal poverty level, compared to 26% of NHW women and AI/AN women were more likely to live in rural areas compared to NHW women (72% vs. 43%).

Table 1 Characteristics of American Indian/Alaska Native and non-Hispanic white women, PRAMS 2015–2017, stratified by race

	NHW (n=10,004)	AI/AN (n=4172)	p-value
Age			< 0.0001
< 19 years old	4.0	11.4	
20–24 years	19.0	28.7	
25–29 years	30.8	31.5	
30–34 years	30.4	19.1	
35 years and older	15.6	9.3	
Education			< 0.0001
Less than high school	7.4	20.9	
High school graduate	22.0	38	
Some college	32.7	31.7	
College graduate or more	38.0	9.3	
Marital status			< 0.0001
Married	70.4	36.7	
Not married	29.6	63.3	
Parity			< 0.0001
0	41.3	33.5	
1	32.4	27.4	
2	15.0	19.3	
3–5	10.3	17.5	
6 or more	1.1	2.4	
% of Federal Poverty Level			< 0.0001
0–99% FPL	25.8	59.5	
100–199% FPL	22.1	24.2	
200–299% FPL	14.2	7.3	
300% or more FPL	38.0	9	
Residence			< 0.0001
Rural	42.9	71.9	
Urban	57.1	28.1	
State			< 0.0001
Alaska	6.5	17.2	
New Mexico	6.4	25.2	
Oklahoma	31.8	41.9	
South Dakota	2.1	3.2	
Washington	53.1	12.4	

AI/AN and NHW women differed on a number of pre-pregnancy and prenatal risk factors, and pre-pregnancy and prenatal alcohol use (Table 2). While reports of depression were similar before pregnancy, AI/AN women were more likely to report smoking (14% vs. 10%) and experiencing IPV in the year before pregnancy (6% vs. 3%) compared to NHW women. Nearly one-third of AI/AN women received 8 or fewer prenatal care appointments compared to less than one fifth of NHW women. Pregnancy intendedness also differed across groups; 37% of AI/AN women reporting their pregnancy was intended compared to 46% of NHW women; while comparable numbers reported their pregnancy was unintended, AI/AN women were more likely to report they were not sure whether they wanted to become pregnant at that time compared to NHW women (26% vs. 16%). AI/AN women were also more likely to report experiencing IPV (5% vs. 2%), homelessness (6% vs. 2%), and smoking during their pregnancy (14% vs. 10%) compared to NHW women.

AI/AN women were less likely to report having drank alcohol in the 2 years before getting pregnant compared to NHW women (56% vs. 76%). Among those women who drank alcohol in the past 2 years, AI/AN women were more likely to report they did not drink during the three months before they became pregnant (19% vs. 15%) compared to NHW women. In the last trimester of pregnancy, similar percentages of AI/AN and NHW women reported not drinking (89% and 87%, respectively), but 4% of AI/AN women reported drinking 1 or more drinks per week compared to 2% of NHW women.

Among AI/AN women, alcohol use varied by state and urban vs. rural residence (Table 3). Abstention from alcohol in the 2 years before becoming pregnant was highest in New Mexico, where 57% of AI/AN women reported not drinking, and lowest in Washington where 32% reported not drinking. AI/AN women living in urban areas were significantly more likely to drink alcohol compared to their counterparts living in rural areas (65% vs. 53%). Among those women who reported drinking alcohol in the three months before pregnancy, drinking 4 or more drinks a week was highest in New Mexico and South Dakota (21% each) and lowest in Oklahoma (15%); this measure was also higher among AI/AN women in urban areas compared to rural areas (21% vs. 16%). Binge-drinking in the three months prior to pregnancy did not vary significantly by state or rural/urban residence, nor did alcohol intake during the last trimester of pregnancy. In Alaska, the only state that asked about prenatal binge-drinking, 11% of those women who drank during pregnancy

Table 2 Pre-Pregnancy and prenatal factors and alcohol behaviors among American Indian/Alaska Native and non-Hispanic white women, PRAMS 2015–2017, stratified by race

	NHW	AI/AN	p-value
Pre-pregnancy factors			
Depression or anxiety	14.4	13.0	0.1297
Smoking	10.2	14.2	< 0.0001
Past year IPV	2.7	6.2	< 0.0001
Prenatal factors			
Number of prenatal visits			< 0.0001
≤ 8 visits	17.8	31.7	
9–11 visits	31.5	29.8	
12 or more visits	50.7	38.4	
Pregnancy intendedness			< 0.0001
Unintended	38.1	37.6	
Intended	46.4	36.5	
Not sure	15.5	25.9	
Stressors during pregnancy			
Experienced IPV	2.1	4.6	< 0.0001
Experienced homelessness	2.3	5.8	< 0.0001
Smoking during pregnancy			< 0.0001
Did not smoke	90.2	86.4	
Smoked	9.8	13.6	
Alcohol use behaviors			
Drank alcohol past 2 years before pregnant			< 0.0001
Yes	75.7	56.4	
No	24.3	43.6	
Among those who drank in 2 years before pregnancy			
Alcohol use in 3 months before pregnancy			0.0006
Did not drink then	14.6	19.3	
< 1 drink per week	38.8	39.6	
1–3 drinks per week	28.3	23.7	
4 + drinks per week	18.4	17.3	
Alcohol use during last trimester of pregnancy			0.0049
Did not drink then	86.5	88.7	
Less than 1 drink/week	11.1	7.0	
1 or more drinks/week	2.4	4.3	

reported binge-drinking at least once; this measure did not differ by urban rural residence.

Among AI/AN women, no sociodemographic factors were associated with prenatal drinking in bivariate logistic regression analyses (Table 4). Among AI/AN women, reports of depression (OR = 2.1; 95% CI 1.0–4.4) or IPV (OR = 2.5; 95% CI 1.0–5.9) prior to pregnancy were associated with increased odds of drinking while pregnant. Experiencing homelessness while pregnant was also associated with more than double the odds of prenatal alcohol use among AI/AN women (OR = 2.9; 95% CI 1.1–7.6). In multivariable regression, being aged 25–29 years [adjusted odds ratio (aOR) = 3.4; 95% CI 1.1–10.1], or aged 35 years or older (aOR = 4.2; 95% CI 1.1–16.9) was associated with prenatal alcohol use, compared to women aged 19 or younger. Experiencing homelessness while pregnant was also associated with prenatal alcohol use, compared to AI/AN women who were stably housed throughout their pregnancy (aOR = 0.8; 95% CI 1.2–6.6).

Among NHW women, many socio-demographic factors were associated with prenatal drinking, including age, education, marital status, parity, poverty level, and residence (Table 4). Smoking prior to pregnancy (OR = 0.3; 95% CI 0.2–0.6) and experiencing IPV in the year before becoming pregnant (OR = 0.4; 95% CI 0.2–1.0) were each significantly associated with *reduced* odds of prenatal alcohol use. Compared to women who attended 8 or fewer prenatal appointments, attending 12 or more prenatal care appointments was associated with increased odds of drinking while pregnant (OR = 1.5; 95% CI 1.0–2.1). Women who reported their pregnancy was intended (relative to unintended) had higher odds of drinking (OR = 1.3; 95% CI 1.0–1.7). Consistent

Table 3 Alcohol use by state and rural/urban among AI/AN women by state and urban/rural residence, PRAMS 2015–2017

	Alaska	New Mexico	Oklahoma	South Dakota	Washington	p-value	Rural	Urban	p-value
Drank alcohol past 2 years before pregnant						<0.0001			<0.0001
Yes	55.4	43.5	61.3	52.0	68.1		53.3	64.8	
No	44.6	56.5	38.7	48.0	32.0		46.7	35.2	
Alcohol use in 3 months before pregnancy						0.0415			0.0005
Did not drink then	23.8	20.4	18.0	19.2	16.8		22.2	12.8	
0–3 drinks per week	57.2	58.5	67.5	59.9	65.2		62.0	66.6	
4 or more drinks per week	19.0	21.2	14.5	20.9	18.0		15.7	20.5	
Among those who drink, binge-drinking (4 or more drinks in 2 h) in 3 months before pregnancy						0.0596			0.1278
Did not binge drink	56.0	66.1	46	58.3	60.3		62.8	57.7	
Binge drank one or more times	44.0	33.9	54	41.7	40.7		37.3	42.3	
Alcohol use during last trimester of pregnancy						0.5729			0.0849
Did not drink then	93.2	86.0	87.7	84.4	87.7		90.4	85.9	
Less than 1 drink per week	4.4	7.4	8.3	10.5	7.2		7.0	6.8	
1 or more drinks per week	2.4	6.6	4.0	5.1	5.1		2.7	7.3	
Among those who drank during pregnancy, binge-drinking (4 or more drinks in 2 h) during pregnancy									0.8847
Did not binge-drink	88.7						88.4	89.3	
Binge-drank one or more times	11.3						11.6	10.7	

with results of smoking before pregnancy, smoking while pregnant, however, was associated with decreased odds of drinking among NHW women (OR = 0.3; 95% CI 0.1–0.6). In adjusted analyses, a college education (aOR = 4.1; 95% CI 1.2–13.9) and living in an urban area (aOR = 1.9; 95% CI 1.4–2.5) were associated with increased odds of prenatal drinking.

Discussion

This study found that AI/AN and NHW women differed substantially in their demographic characteristics, pre-pregnancy (e.g. smoking, IPV) and prenatal (e.g. prenatal visits) factors, and their alcohol use. AI/AN women experience greater homelessness, IPV, and less frequent prenatal care than NHW women. AI/AN women are more likely to smoke both before and during pregnancy compared to NHW women. In addition, fewer AI/AN women reported that their most recent pregnancy was intended, and more reported they were unsure about whether they wanted to become pregnant at the time of their most recent pregnancy, compared to NHW women. AI/AN women were less likely to report alcohol use in the three months prior to pregnancy compared to NHW women. Among those women who drank in the three months before becoming pregnant, however, AI/AN women were more likely to report drinking 1 or more drinks per week during the last trimester of pregnancy than were NHW women. While pre-pregnancy drinking varied by state and urban vs. rural residence among AI/AN women, pre-pregnancy binge-drinking and prenatal alcohol use did not. Regression analyses showed that factors associated with prenatal alcohol use differed between NHW women and AI/AN women.

The findings from this study provide updated information about pre-pregnancy and prenatal alcohol use among AI/AN women, relative to NHW women. The sociodemographic characteristics of these groups of women are very different, which aligns with findings from other studies that indicate major disparities in the socioeconomic and health status of the general AI/AN population compared to the general US population (Castor et al., 2006). While older age and experiencing homelessness were associated with increased odds of prenatal alcohol use among AI/AN women, higher education and living in an urban area increased odds of prenatal drinking among NHW women. These results suggest the need to consider risk factors and develop possible interventions for these different groups very differently, as the observed risk factors for prenatal alcohol use for NHW women (higher education, urbanicity) are typically associated with socioeconomic advantage, whereas those risk factors for AI/AN women (homelessness) are associated with disadvantage. The Oglala Sioux Tribe (OST) CHOICES program is an example of a culturally tailored adaptation of the evidence-based Centers for Disease Control and Prevention Project CHOICES for American Indian women. Project CHOICES used motivational interviewing and contraceptive counseling and focused on women in the pre-conception period to reduce alcohol exposed pregnancies (Floyd et al., 2007). It has shown promise for reducing risky drinking and increasing contraceptive use among non-pregnant AI/AN women of childbearing age in that setting (Hanson & Jensen, 2014;

Table 4 Odds ratios (ORs) and adjusted odds ratios (aORs) from logistic and multivariable logistic regressions assessing the association between sociodemographic, pre-pregnancy and prenatal factors and drinking during pregnancy among American Indian and Alaska Native women (n = 4172) and non-Hispanic white women (n = 10,004), PRAMS 2015–2017

Demographic characteristic	American Indian/Alaska Native		non-Hispanic white	
	OR	aOR	OR	aOR
Age				
< 19 years old	Ref	Ref	Ref	Ref
20–24 years	1.40 (0.50–3.89)	1.90 (0.58–6.27)	.90 (0.31–2.61)	0.65 (0.21–2.06)
25–29 years	2.52 (0.98–6.45)#	3.38 (1.13–10.14)*	1.90 (.0.70–5.13)	0.99 (0.33–2.95)
30–34 years	1.89 (0.63–5.68)	2.90 (0.81–10.36)	4.86 (1.83–12.93)**	1.84 (0.61–5.52)
35 years and older	2.75 (0.80–9.39)	4.22 (1.06–16.88)*	5.46 (2.03-14.70)**	1.99 (0.66–6.01)
Education				
Less than high school	Ref		Ref	Ref
High school graduate	1.41 (0.72–2.76)		1.97 (0.67–5.79)	1.56 (0.45–5.42)
Some college	1.73 (0.89–3.37)		3.21 (1.14–9.01)*	2.37 (0.71–7.89)
College graduate or more	1.33 (0.47–3.75)		7.99 (2.89–22.08)***	4.06 (1.19–13.88)*
Marital status				
Married	0.96 (0.50–1.84)	0.91 (0.46–1.80)	2.09 (1.51–2.91)***	
Not married	Ref	Ref	Ref	
Parity				
0	Ref		Ref	
1–2	1.52 (0.77–3.00)		1.00 (0.79–1.28)	
3 or more	1.90 (0.80–4.49)		0.53 (0.32–0.88)*	
% of Federal poverty level				
0–99% FPL	Ref		Ref	
100–199% FPL	1.27 (0.60–2.69)		1.55 (0.96–2.49)	
200–299% FPL	0.66 (0.14–2.98)		2.27 (1.38–3.72)**	
300% or more FPL	0.75 (0.28–2.03)		3.92 (2.63–5.84)***	
Residence				
Rural	Ref		Ref	Ref
Urban	1.54 (0.82–2.88)		2.45 (1.85–3.24)***	1.88 (1.40–2.53)***
Pre-Pregnancy factors				
Depression or anxiety	2.10 (1.00–4.38)*		0.75 (0.51–1.09)	
Smoking	1.86 (0.90–3.82)#		0.29 (0.15–0.58)***	0.72 (0.34–1.51)
Past year IPV	2.48 (1.04–5.93)*	2.69 (0.83-8.74)	0.39 (0.16–0.97)*	
Prenatal factors				
Number of prenatal visits				
≤ 8 visits	Ref		Ref	Ref
9–11 visits	0.82 (0.42–1.62)		1.06 (0.71–1.57)	0.95 (0.62–1.45)
12 or more visits	1.15 (0.58–2.28)		1.45 (1.01–2.08)*	1.19 (0.81–1.76)
Pregnancy intendedness				
Unintended	Ref		Ref	
Intended	1.29 (0.64–2.62)		1.32 (1.01–1.71)*	
Not sure	1.08 (0.52–2.23)		1.02 (0.70–1.49)	
Stressors during pregnancy				
Experienced IPV	1.42 (0.66–3.04)	0.54 (0.14–2.10)	0.42 (0.15–1.16)#	
Experienced homelessness	2.91 (1.12–7.57)*	2.76 (1.16–6.55)*	0.39 (0.11–1.46)	
Smoking during pregnancy				
Did not smoke	Ref		Ref	
Smoked	1.49 (0.72–3.12)		0.27 (0.13–0.56)***	

OR Odds Ratio; aOR Adjusted Odds Ratio

# $p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Hanson et al., 2013, 2017) and is being further tested in a randomized control trial for its effectiveness with a larger sample of AI/AN women (Hanson et al., 2021). For interventions seeking to address pre-pregnancy and prenatal alcohol use among Native women, approaches that build upon cultural values, collectivism and family/peer support appear to hold the most promise (Montag et al., 2012).

Differences in drinking patterns found in the current study indicate that while AI/AN women are more likely to abstain from alcohol use in general compared to NHW women, among those women who do drink during the prenatal period, AI/AN women tend to drink at higher levels relative to NHW women. This finding adds to a growing but mixed body of evidence regarding alcohol use among AI/AN women. A previous study of women receiving prenatal care at federally qualified health centers in Minnesota found that AI/AN women had the highest rates of alcohol use in the year before pregnancy, which differs from pre-pregnancy rates of use found in this study (Harrison & Sidebottom, 2009). These results reinforce the need for programs to be tailored for those women most at risk for prenatal alcohol consumption and engage with community organizations and local services who are best positioned to identify which women should be prioritized most. Recent insights from the Safe Passage Study comparing pregnant white and AI women in the Northern Plains echo our results, finding that while white women are more likely to drink, binge-drinking is higher among AI women (Ye et al., 2020). Furthermore, Ye et al. found that the key risk factor for both prenatal alcohol use and prenatal binge-drinking among AI women was relocation in the past year, which reflected housing instability. While not the same, this indicator is similar to our finding regarding the experience of homelessness as a risk factor for prenatal drinking among AI/AN women. The PRAMS survey uses the term "homeless" on their questionnaire, which may not be an appropriate term for AI/AN women who experience housing instability but do would identify as "homeless."

The current study has a number of limitations. We focused on five states with sizable numbers of births to AI/AN women. We combined three years of PRAMS data to have a sample size large enough to conduct regression analyses. Although a number of studies have documented the reliability of self-reported measures of alcohol use (Simons et al., 2015; Williams et al., 1985), including during the prenatal period (Chang et al., 1999), both social desirability and recall bias may have led to underestimates in the reported prevalence of prenatal alcohol use. Because prenatal alcohol use was relatively rare, we did not have an adequate sample size to examine differences by alcohol use frequency. However, since adverse child outcomes are observed with drinking by pregnant women of just one drink per week (Brown et al., 2010), we can conclude that the associations found in the current study provide conservative estimates of factors contributing to risk of poor child health outcomes. In addition, response bias to the actual survey may also influence the accuracy of measured outcomes. For example, prior analyses have shown that PRAMS response rates are higher among NHW women compared to women of other races and ethnicities, and that response rates increase with increasing education (Shulman et al., 2006). Furthermore, given our findings that alcohol use among women who are AI/AN is associated with socioeconomic disadvantage while alcohol use among NHW women is associated with socioeconomic advantage, social desirability and response bias may interact here in that women who are AI/AN and drink are *less* likely to participate in the survey while NHW women who drink are *more* likely to participate. Lastly, having more information about women's childhood and current experiences of adversity and better measures of reproductive goals, beyond those measures available in the PRAMS dataset, would likely enhance our knowledge of the context in which prenatal alcohol use occurs and the risk factors that contribute to it. Specifically, measures such as the ACES (Felitti et al., 1998), measures that move beyond pregnancy intention such as reproductive autonomy (Upadhyay et al., 2014), and more detailed measures of mobility/instability, might strengthen this analysis.

This study also has a number of strengths. By combining data across multiple states and multiple PRAMS waves, we were able to assemble a robust sample size for a small population that is frequently omitted from large research efforts. By using PRAMS data to conduct a secondary data analysis, we leveraged existing data to conduct new analyses. Lastly, while response bias may be present, AI/AN women are oversampled in order to get representation from these women and state-based PRAMS teams work in partnership with tribal authorities to encourage participation, with tribes participating in steering committees and sending letters of support with survey mailings (Lohdefinck, 2021).

Conclusions for Policy/Practice

This study provides concrete information on women at risk for prenatal alcohol use, and how risk factors differ between AI/AN and NHW women. Future research is needed to validate these results and identify additional risk factors not included in the PRAMS dataset. Results from the current study can be used as a guide in the prioritization of resources for women most at risk and to provide support for both universal and targeted screening and counseling about alcohol use in the prenatal care setting. In addition, more public education programming around alcohol use during pregnancy may empower women to enact healthy behaviors in the prenatal period. Integration of support services for and prioritization of women facing homelessness may not only

help these women meet their basic needs, but may also have downstream effects for reducing prenatal alcohol exposure among infants born to AI/AN women.

Recent analysis of data from multiple states over forty years indicates that policies that target alcohol use among pregnant women directly are associated with an increase in poor birth outcomes including low birthweight, pre-term birth and lower APGAR scores, likely through women's avoidance of prenatal care. This same study showed that policies aimed toward reducing alcohol consumption in the general population were associated with improvement in use of prenatal care and birth outcomes (Subbaraman et al., 2018). These findings build on previous research indicating that broad policies to reduce risky drinking (such as raising the legal drinking age) are linked to improvements in infant health (Zhang & Caine, 2011). Regarding clinical practice, greater effort is needed to engage women of all racial and ethnic groups to discuss their reproductive goals and how best to meet them. These kinds of discussions between provider and patient may help empower women to meet their own health goals while also providing the opportunity to discuss how alcohol consumption relates to pre-pregnancy and prenatal health.

Our findings indicate that, though low, the percentage of women who report drinking during pregnancy is not insignificant and falls short of the abstention rate goals outlined in the CDC's Healthy People 2020 framework. Factors associated with prenatal alcohol use differ between AI/AN and NHW women, suggesting the need for tailored interventions that recognize the unique circumstances and risk factors contributing to alcohol use during pregnancy among different groups of women.

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