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Bachelor of Arts
Washington University in St. Louis
2011

Thesis Committee Chair: Carol J. Hogue, PhD, MPH

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

Pre-pregnancy alcohol use and timing of prenatal care entry among American Indians and Alaska Natives

By Meghna Srinath

American Indians and Alaska Natives (AI/AN) experience among the highest rates of alcohol use and lowest rates of prenatal care use. We examined the association between pre-pregnancy alcohol consumption and timing of prenatal care entry among AI/AN in eight states using data from the Pregnancy Risk Assessment Monitoring System (PRAMS) from 2004-2011.

We examined questions about pre-conception alcohol use (and binge drinking) and prenatal care initiation during the first trimester (at or before 12 weeks gestation) among AI/AN respondents in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington. Pre-pregnancy alcohol users were grouped into non-drinkers, non-binge drinkers, light binge drinkers (1-3 times), and heavy binge drinkers (4+ times during the three months before pregnancy). Data were analyzed using logistic regression in SUDAAN to estimate odds ratios (OR) and 95% confidence intervals (CI) above and below 138% of the federal poverty line (FPL), adjusted for maternal age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at the time of conception.

At or below 138% FPL, there were no significant associations between quantity of alcohol consumed and timing of prenatal care entry. Above 138% FPL and among 25-34 year olds, heavy binge drinkers were 3.20 times as likely to enter prenatal care early ($p=0.007$), light binge drinkers were 3.94 times as likely ($p<0.0001$), and non-binge drinkers were 3.55 times as likely ($p=0.001$), compared to non-drinkers.

Among 25-34-year olds above 138% FPL, AI/AN women who drank pre-pregnancy were more likely to initiate early prenatal care compared to non-drinkers. Further research is required to elucidate these findings.

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Background

Benefits of preconception care

The Centers for Disease Control and Prevention (CDC) defines preconception health as “the health of women and men during their reproductive years. [Preconception health] focuses on taking steps now to protect the health of a baby they might have sometime in the future.”[1] The justification for encouraging preconception care is that preventive behaviors that begin before pregnancy can greatly reduce risky behaviors and poor outcomes during pregnancy, such as repeated pregnancy losses, congenital abnormalities, and low birth weight[2]. Although prenatal care is commonly recommended and practiced among women in the U.S., in the last few decades there has been growing emphasis on the expansion of preconception care[2]. Unfortunately, preconception care has not yet become a standardized part of the practice of family medicine[3].

One example of the benefits of preconception care is folic acid supplementation. Folic acid has been shown to help reduce the risk of neural tube defects in the fetus only if initiated at least one month prior to pregnancy[4]. The critical window during which folic acid supplementation is most beneficial is within 17 – 56 days immediately following conception[2]. However, since many women do not begin prenatal care until 11 or 12 weeks gestation, this window may be missed unless preconception care is emphasized[5]. (One reason health care providers encourage women to wait until 11-12 weeks gestation before beginning prenatal care is because miscarriages are common during the first several weeks of pregnancy. According to the American Pregnancy Association, miscarriages are most common around 13 weeks gestation, and can occur spontaneously within the first 20 weeks[6]. The chances of a miscarriage range from 10-25%[6]. Thus, health care providers advise women to wait until this high-risk period has passed before beginning routine prenatal checkups.) As such, timing is key. Other important examples of preconception care include vigilant management of lifestyle choices and medical conditions in the mother such as diabetes, obesity, sexually transmitted infections, etc. Over-the-counter and prescription medications, as well as poor nutrition and substance abuse can have detrimental health effects on the embryo during the key stage of organ development that immediately follows conception. This information can and should be shared during preconception counseling with all women[3-5].

Pre-pregnancy alcohol

One key element of preconception and prenatal care involves abstaining from alcohol use. It is well documented that maternal alcohol use during pregnancy can have serious negative health consequences for the developing fetus, including spontaneous abortion, malformations, pre- and post-natal growth retardation, central nervous system damage, low birth weight, and neurodevelopmental abnormalities[7]. These adverse outcomes associated with alcohol use are collectively known as Fetal Alcohol Spectrum Disorders (FASD)[7]. Of these, Fetal Alcohol Syndrome (FAS) is most severe, and is characterized by growth retardation, abnormal facial features, and deficits to the central nervous system that often manifest via behavioral and/or cognitive disabilities[8]. In the U.S., the prevalence of FAS is estimated to be 0.5 – 2.0 cases per 100,000 births, but FASDs are believed to occur at approximately three times that rate[9]. Given that FAS is the leading preventable birth defect with associated mental and behavioral impairment in the U.S., in 2005, the U.S. Surgeon General issued an advisory recommending that women who are pregnant or considering becoming pregnant abstain from using alcohol[9].

Generally, less attention has been directed toward studying the effects of pre-pregnancy alcohol use on fetal development. The literature indicates that more severe neurobehavioral and physical impairments are likely associated with moderate to heavy drinking during pregnancy[10]. However, there is also research showing that moderate alcohol use (3.5 drinks or more per week) and heavy alcohol use (at least one drink a day) during the first 8-10 weeks of gestation are associated with increased risk of spontaneous abortion as well as dysmorphic facial features[11,12]. Since some women may not realize that they are pregnant until as late as 4 to 6 weeks gestation[13], and many wait until 11 or 12 weeks gestation to enter prenatal care, it is likely that any alcohol consumption during these critical weeks may be adversely impacting the fetus.

Measurement of alcohol consumption

One issue inherent in research about alcohol consumption is that of measurement. Most national surveys use self-reported measures. Several factors influence self-reported responses, such as social and contextual factors, respondent characteristics (including recall bias), and task attributes (including question wording, etc.)[14]. Questions about alcohol consumption are often not phrased consistently across surveys. Some questionnaires ask respondents to report the quantity consumed in ‘standard drink’ units, where a ‘standard drink’ is equal to a 12-ounce can of beer (5% alcohol), a 5-ounce glass of wine (12% alcohol) or a 1.5-ounce shot of liquor (40% alcohol)[15]. Research suggests that responses based on use of a standard drink metric underestimate actual consumption, especially among heavier drinkers and those drinking beverages with higher alcohol content[16]. Misclassification has serious implications for FAS among pregnant women and women planning to become pregnant. For example, a study by da Costa Pereira et al., comparing pregnant women's reports of alcohol consumption assessed in different ways, found that responses varied greatly based on the time frame in question e.g. daily intake vs. weekly intake. Specifically, women reporting zero drinks per day would be classified as non-drinkers. But the same women reported 1-2 drinks per week, meaning they were no longer non-drinkers[17]. There is also greater stigma around drinking during pregnancy, which could suggest that pre-pregnancy alcohol estimates are somewhat more reliable[16].

Prevalence of pre-pregnancy alcohol consumption

In a cross-sectional study of 9,559 mothers of live-born infants in 48 U.S. states using 1988 data from the National Maternal and Infant Health Survey (NMIHS), Floyd et al. found that 45% of mothers reported any alcohol use periconceptionally (defined as during the three months prior to finding out about their pregnancy), and 1 in 20 women reported frequent alcohol use (six or more drinks per week) during that period[13]. Similarly, a study by D'Angelo et al. of 26 U.S. reporting areas from the 2004 Pregnancy Risk Assessment Monitoring System (PRAMS) found that 50.1% of mothers of live-born infants reported consuming alcohol during the three months prior to pregnancy[18].

In a study by Ethen et al., researchers analyzed 4,088 U.S. women who delivered a live born infant without malformations using data from the National Birth Defects Prevention Study, 1997-2002. Women were asked about alcohol consumption during eight time periods: third, second and first month preconception; first, second and third month of pregnancy; and 2nd and 3rd trimesters. During the three months prior to pregnancy combined, 39.7% of women reported drinking any alcohol, while 13.7%

reported binge drinking (four or more drinks on at least one occasion). Drinking during the three months prior to pregnancy was found to be strongly associated with alcohol use during pregnancy: compared to those who did not drink before pregnancy, those who drank alcohol but never binged during the three months pre-pregnancy were four times as likely to drink any alcohol during pregnancy (adjusted OR = 4.47, 95% CI (1.84-2.89)) and almost twice as likely to binge drink during pregnancy (adjusted OR = 1.84, 95% CI (1.12, 3.03)). The pattern was even more pronounced for binge drinking: compared to women who did not drink in the three months before pregnancy, women who binge drank during that time were eight times as likely to drink any alcohol during pregnancy (adjusted OR = 8.52, 95% CI (6.67-10.88)), and 36 times as likely to binge drink during pregnancy (adjusted OR = 36.02, 95% CI (24.63, 52.69))[19].

In a study of 1996-1999 PRAMS data from 15 states (n=72,907 women who had live births), Naimi et al. found that preconception binge drinkers (five or more drinks on one occasion) were more likely to drink and binge drink during pregnancy[20]. A comprehensive report based on Oklahoma PRAMS data from 1988-1994 revealed that 42% of women surveyed reported drinking alcohol in the three months before pregnancy. The yearly rate remained relatively consistent over the six year time period. Of women reporting alcohol use before pregnancy, 92% were “light drinkers” (less than 7 drinks per week). Women who drank less before pregnancy were also more likely to quit drinking during pregnancy[21].

There have been varied attempts in the literature to identify a “risk profile” of women who consume alcohol pre-pregnancy. The results seem to indicate that women who drank alcohol during the three months before pregnancy are more likely to report unintended pregnancy, tobacco use, low self-esteem, low income, higher education, not relying on public assistance, first pregnancy, being single, late/no entry into prenatal care, age over 20, white race, exposure to violence, and/or knowing “someone close” using drugs or who had been physically hurt by their husband/partner during the 12 months before delivery[13,20-22]. All of these factors should be considered among potential confounders of an association between pre-pregnancy alcohol and pregnancy outcomes. Of these characteristics, unintended pregnancy, tobacco use, low-self esteem, low income, less education, being single, late/no prenatal care, age over 35, and exposure to violence or abuse are associated with adverse pregnancy outcomes[23-26].

American Indian/Alaska Native historical and socio-cultural context

As of the 2010 U.S. Census, American Indians and Alaska Natives (AI/AN) (single race and mixed race) represented roughly 1.7% of the U.S. population, which translated to about 5.2 million people[27]. Of this, about 2.9 million were AI/AN only, and 2.3 million were AI/AN plus one or more races[27].

Disparities in measures of health and wellness between AI/ANs and other groups in the U.S. have persisted since colonization of the Americas began 500 years ago[28]. The first Europeans to arrive in the Americas brought with them new diseases that ravaged native populations[28]. In addition, AI/ANs were systematically displaced by new settlers, and forced to leave their native lands. The reservations that were created for AI/ANs in the mid 1800s were notorious for poor living conditions, isolation and inadequate government rations[28]. Chronic underfunding of policies or programs aimed to improve conditions for AI/ANs has resulted in little progress, and often, exacerbated existing conditions[28]. The same issue persists with the Indian Health Service (IHS), a federally funded agency that provides health services to AI/ANs. A U.S. Commission on Civil Rights report noted that the IHS is so underfunded that it spends just $1,914 per patient per year compared with $3,803 spent yearly on a federal prisoner[29]. Apparently, this has hardly changed over the last century[30].

Examples of the severe disparities experienced by AI/ANs today include the following: As of 2012, 78.8% of single-race AI/ANs had obtained at least a high school diploma, GED or similar certification, compared to 86.4% of the overall population[31]. 13.5% of AI/ANs had obtained a bachelor's degree or higher, compared to 29.1% of the overall population[31]. AI/ANs are also the poorest racial group in the U.S., with 29.1% in poverty compared to the national poverty rate of 15.9%[31]. The average household income for AI/ANs in 2012 was $16,000 less than the national average[31]. While nationally, 14.8% lacked health insurance coverage in 2012, among single-race AI/ANs, 27.4% were uninsured[31]. Additionally, AI/ANs are more likely to experience violence, trauma, abuse, and deaths from accidents, diabetes, alcoholism, liver cirrhosis, suicide, homicide, heart disease, pneumonia, influenza, and tuberculosis compared to other groups[32-34].

There are 566 federally recognized AI/AN tribes and 325 federally recognized reservations[31]. There are several different AI/AN tribes in each state. Overall, the majority of mixed-race AI/AN identify as Cherokee, while the majority of single-race AI/AN identify as Navajo[35]. Alaska has 230 federally recognized tribes, Minnesota has nine, Nebraska has six, New Mexico has 23, Oklahoma has 38, Oregon has 10, Utah has 8, and Washington has 29[36] (Figure 1).

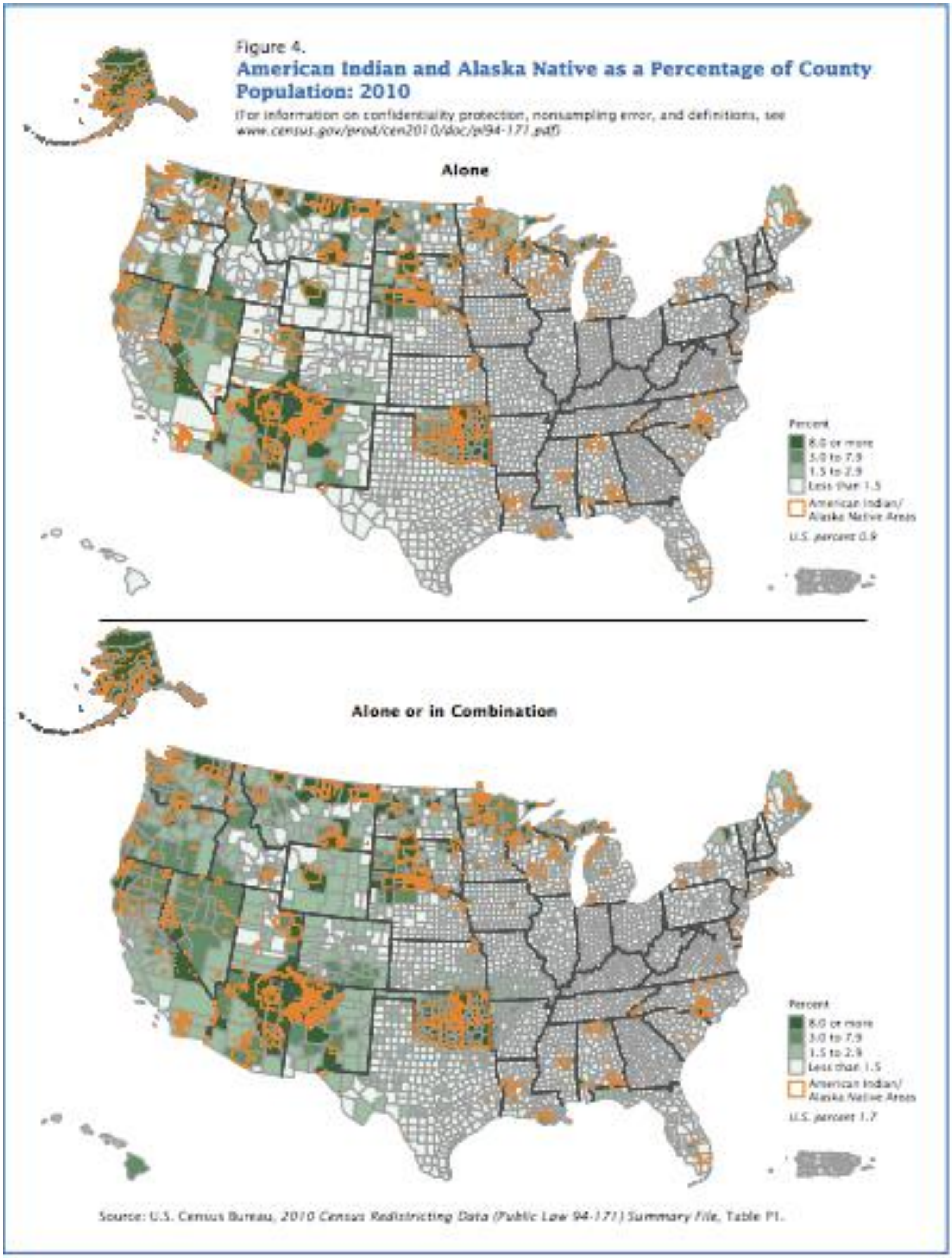

Figure 1. Geographic distribution of American Indians and Alaska Natives as a percentage of county population, 2010[37]

Alaska has by far the greatest diversity within its native population. AI/ANs make up almost 20% of the state population[38]. The largest tribal group is Yup'ik followed by Inupiat[35]. The indigenous peoples have at least 20 languages[39]. Additionally, although overall educational attainment among Alaska Natives is lower than that of the total population, across tribes, the percent having at least a high school education ranges from 70% to 82%[39]. Compared to other Alaskans, Alaska Natives are more likely to be poor and unemployed. They have among the worst health outcomes and highest incarceration rates in the U.S[39]. According to the Minority Rights Group International, the cultural perspective of Alaska Natives is ignored, and traditional languages and practices are vanishing as tribe elders pass away[39]. There has also been a significant fight to accommodate the Alaska Natives in the realm of politics. For example, in the 2008 presidential election, they fought to hold the government accountable for providing oral and written assistance with voting and ballots to help overcome language barriers[39]. Generally, Alaska Natives live in rural and coastal areas, as subsistence hunting and fishing make up a large chunk of their livelihood[40]. Art and celebrations involving feasts and dancing are common forms of celebrating establishment of new trading relationships, and marking the beginning and end of agricultural seasons. Villages operate somewhat independently, though there is sometimes collaboration. Within villages, there is a strong sense of community and family[40]. Morals and values are taught to children via storytelling[41]. Division of labor is gendered but not absolute. Traditionally, men would hunt and fish while women stayed home to clean, cook, sew, and take care of the children. However, many women also hunt. Women commonly were married at puberty and men once they became productive hunters. Marriages were not strictly monogamous. Open marriages, polygamy, divorce, and remarrying used to be common[42].

AI/AN comprise 12.9% of Oklahoma's population and 3% of Oregon's population[38]. The majority of AI/AN in both states claim Cherokee as their nationality[43,44]. The Cherokee are comprised of several clans. Medicine men and women are still an integral part of Cherokee culture today and use herbal medicines and remedies as well as verbal incantations to help treat ailments[45].

In New Mexico, about 10% of the population identifies as AI/AN[38,46], while in Utah, only 1.3% identified as AI/AN in 2000[47]. The majority of AI/AN in New Mexico and Utah are Navajo[48,49]. Navajos place high importance on ceremony and ritual. Most important acts or stages of life—such as house-building, crop-planting, etc.—are celebrated with multi-day ceremonies including dancing and art[50]. In the Navajo culture, women are expected to pass down cultural knowledge to their daughters. A rite of passage ceremony called a "kinaalda" is performed when girls reach womanhood "to ensure a blessed life of good health, emotional strength, prosperity, and a positive outlook."[51] Traditional Navajo values like respect for elders, balance, and rituals are threatened by urbanization and Western styles of instruction[51]. Specifically in Utah, the Navajo peoples were historically sheep herders[52]. The Navajo also use medicine men and women along with prayers, songs, and ceremonies to help cure illnesses. Some tribal members prefer hospitals on the Navajo Reservation, some prefer the traditional healers, while others use a combination of both. Navajos believe that medicine men and women are bestowed with supernatural healing powers[53].

In Washington, 3% of the population identifies as AI/AN[38]. The majority of AI/AN in the state identify as Puget Sound Salish, though there are several other main tribes as well[54]. The Puget Sound traditionally formed a complex society of interrelated villages and families in which the oral tradition of story telling and group ceremonial gatherings was common[55].

Only 1% of Minnesota's population identifies as AI/AN[56], and the majority are Chippewa[57]. Historically, within-clan identity was very important and marriages within-clans were forbidden. Although contact with Europeans resulted in the loss of many customs relevant to the hunter-gatherer lifestyle, traditional medicinal practices were retained[58]. An ethnography of Chippewa women revealed that forced assimilation by the government has eroded transmission of cultural practices across generations. For example, children were forced into boarding schools away from their families for several years[59]. Additionally, in the 1960s, the Bureau of Indian Affairs promised jobs and resources to AI/AN who moved to urban areas, but subsequently failed to provide adequate employment or income[59]. Culturally, gender roles are not particularly rigid. Although women generally stay at home, it is not uncommon for them to partake in hunting and other traditionally male-dominated activities as well[59]. Multiple monogamous marriages are also common, and in these cases, the children stay with their mother[59]. Health-related advice is sought from traditional healers and older family members[59].

AI/AN comprise only about 1% of Nebraska's population as well[60]. The majority of AI/AN in Nebraska are Sioux[61]. In Sioux culture, gender roles are more traditional and rigid. Men provide for the family by mostly farming or ranching, while women take care of the house. Children and family are considered sacred. The Sioux are also very spiritual, and to this day, perform several major religious ceremonies[62].

Overall, despite the variation in beliefs and practices across tribes, some common themes include a collectivist and community-oriented culture, prevalence of gender roles (enforced to varying degrees), values of balance and harmony, spirituality, oral transmission of lessons and traditions across generations, and use of traditional healers and medicine men/women.

American Indian/Alaska Native health

The AI/AN population formally includes people having origins in any of the original populations of North, Central, or South America who maintain tribal affiliation or community attachment[63]. The U.S. Census 2010 reported that AI/ANs comprise 1.7% of the U.S. population[27]. The AI/AN population is heterogeneous, with 566 federally recognized tribes[64]. The AI/AN community faces many health challenges including higher mortality rates from liver disease, diabetes and suicide, and higher prevalence of sexually transmitted infections, tuberculosis, heart disease, and injuries compared to other ethnic groups[63,65]. Results from an analysis of the 2004-2008 National Health Interview Survey (NHIS) revealed that AI/AN adults (10.3%) were more likely than Black, Hispanic, White, or Asian adults to not have received needed medical care due to cost of care. The trend of poor health among AI/ANs extends to maternal and child health outcomes as well. AI/ANs experience the highest rates of infant mortality, preterm birth and low birth weight, compared to Whites and Hispanics[66]. Although AI/AN adults under 65 are two to four times as likely as Black, Hispanic, Asian, or White adults to have public health insurance coverage, nearly 20% of them reported being uninsured (second to Blacks, and higher than Whites)[66,67].

The IHS is responsible for the provision of health services to AI/AN people in any of the 566 federally recognized tribes[68]. The IHS funds health programs in 37 states, including urban programs in Chicago, IL and Baltimore, MD, but most of these services are on reservations[69]. As such, the main reason more than 40% of AI/ANs do not have access to IHS services[70] is because nearly 78% of AI/ANs do not permanently live on a reservation[35]. Other factors that contribute to poor health among AI/ANs include geographic isolation, economic factors, suspicion toward traditional spiritual beliefs, and cultural barriers[71].

Alcohol and pre-pregnancy alcohol among AI/ANs

Although literature on AI/AN preconception health is sparse, indications are not encouraging. Denny et al. conducted a cross-sectional study of 54,612 women age 18-44 using data from the 2008 Behavioral Risk Factor Surveillance System (BRFSS), to assess presence of any of five individual pre-pregnancy risk factors, including at-risk drinking, smoking, obesity, diabetes, and mental distress. At-risk drinking was defined as having seven or more drinks per week or four or more drinks on one occasion in the past 30 days. AI/AN women had the highest prevalence of at-risk drinking, smoking, diabetes, and mental distress compared to Whites, Blacks, Asians, and Hispanics[72]. Prevalence of multiple risk factors (co-occurrence) was also highest among AI/AN women (they were 50% more likely to have multiple risk factors than white women)[72].

As indicated by the Denny et al. study, AI/ANs have among the highest rates of alcohol use compared to other ethnic groups in the U.S. The 2004-2008 NHIS analysis cited above revealed that along with White women (14.7%), AI/AN women (11.6%) were more likely than Black, Asian or Hispanic women to be moderate or heavy drinkers[63]. According to the 2011 NHIS analysis by CDC, AI/ANs experience the highest prevalence of liver disease compared to other ethnic groups (3.1%)[73]. They also have the second highest percentage of people who identify as “current regular” drinkers (at least 12 drinks in the past year) (44.1%), second only to Whites (54.9%)[73]. If those who identify as “AI/AN and White” are included, they would rank higher than AI/AN alone but below Whites at 48.1%[73]. A review by Whitesell et al. illustrates the prevalence of and variation in alcohol use among AI/ANs. AI/AN adolescents experience higher rates of alcohol use and earlier initiation compared to other U.S. adolescents[74]. Furthermore, those living on reservations and who have dropped out of school report the highest levels of use[75]. Other studies show that while frequency of alcohol consumption among current AI/AN adult drinkers is comparable to that of the U.S. population for women, it is in fact lower among AI/AN men than the U.S. frequency[76,77]. However, quantity of alcohol followed a different trend. AI/ANs reported consuming greater quantities of alcohol per drinking day (heavier, episodic drinking) than did the U.S. reference population[76,77].

Although specific information about alcohol use by tribe is limited due to confidentiality, research suggests that alcohol consumption also varies greatly across tribes and regions[76,77]. For example, Northern Plains Indians (e.g. Chippewa in Minnesota) have been found to have higher prevalence of alcohol use and dependence compared to Southwest Indian tribes (e.g. Navajo in Utah and New Mexico)[76-80]. More specifically, the odds of a Northern Plains Indian woman being a current drinker were twice that of U.S. females[77]. Furthermore, among Southwest Indian women, 18-29 year-olds had the highest prevalence of current drinkers, while among Northern Plains Indian women, 30-44 year-olds had the highest prevalence of current drinkers[76].

There are many possible explanations for the high prevalence of alcohol consumption among AI/AN. Biologically, it is known that AI/ANs are less likely than Whites to have certain gene variants essential for alcohol metabolism[81]. There have been efforts to investigate whether there might be genetically linked differences in drug dependence between the races, but to date, no clear evidence has been found[74]. AI/ANs could also be at higher psychiatric risk, since family history of substance use, personality traits, and psychiatric illnesses are all associated with substance use among AI/ANs[82-84]. Identifying this link could shed important light on contexts in which interventions may be more effective (e.g. paired with mental health counseling). Demographic factors, such as poverty and limited educational and employment opportunities, may explain the higher use pattern, but such attributions are challenging due to the broader context within which they operate[74]. Given the collectivist culture among AI/ANs, social networks could play an important role in influencing drinking behavior. Community context, in terms of access to alcohol, may also be an important factor given the geographical distribution of AI/ANs in rural vs. urban areas[74]. The limited availability of health services is also potentially a contributing factor to substance use issues in the AI/AN community. Not only does the IHS serve only tribal lands, but it is also underfunded and lacks coordination with other tribal systems, leaving substance use services (e.g. rehab) sparse for AI/ANs[74]. Taking an even broader perspective, one cannot ignore the traumatic impact that the legacy of colonization, forced assimilation, and systematic displacement and discrimination has likely taken[74]. Drinking may have been used as a coping mechanism for dealing with the separation from children sent to boarding schools, etc.

Aside from indicating that general preconception health was poor among AI/ANs, the Denny et al. article highlighted the issue of pre-pregnancy alcohol as one of particular concern among this group. According to the Substance Abuse and Mental Health Services Administration (SAMHSA), among Native Americans, FASDs affect 15 to 25 babies per 10,000 live births compared to the national rate of 5 to 20 per 10,000 live births[85]. A study of Southwestern Indians in 1982 showed that the total culture-adjusted rate of FASDs among women age 15 to 44 was 61 per 10,000 live births[86]. Specifically, the rates were 46 per 10,000 live births for Pueblo Indians, 53 per 10,000 for Navajos and 305 per 10,000 for Southwestern Plains Indians[86]. These estimates highlight that not only is alcohol use around pregnancy high among AI/AN women, but that rates vary greatly from tribe to tribe. Differing cultural norms and social cohesion across tribes may help explain this variation in part[86]. The estimates also underscore the need for vigilant monitoring of pre-pregnancy and prenatal alcohol use among AI/AN women. In a study of 125 Alaska Native women, Khan et al. found that 64% reported drinking during the month before pregnancy[87]. Of those, 59% reported also drinking during pregnancy, though the majority reported stopping after the first trimester[87]. Pre-pregnancy binge drinking was also found to be associated with binge drinking during pregnancy in this cohort[87]. In an analysis of 763 AI/AN women from the 1988 AI/AN oversample on the NMIHS, Westphal et al. found that 47% reported some alcohol consumption in the 12 months prior to delivery, though nearly 90% of those reported reducing drinking after learning of pregnancy[88]. Additionally, in a study of 177 Northern Plains Indians in the

Aberdeen area Indian Health Service (IHS), Kvigne et al. found that 82.5% drank before pregnancy, and 72.6% of those binge drank before pregnancy[89]. An analysis of Oregon PRAMS data in 2004 showed that AI/AN women had the highest rates of binge drinking during the three months before pregnancy compared to other races (26.3%) and the second highest rate of any alcohol use pre-pregnancy (58.8%)[90]. A Washington state PRAMS analysis of 2006-2008 data showed that among AI/AN women, 57% drank during the three months before pregnancy (second highest to Whites in Washington), and 31% binge drank before pregnancy (highest compared to all other races)[91]. A study by Kaskutas et al. looked at the association between pre-pregnancy alcohol drink size and average daily pre-pregnancy alcohol consumption among AI/ANs and Blacks. The findings showed that self-reported drink size was much higher than drink size measured by "standard" reference[16]. This suggests that women may be grossly underreporting alcohol consumption, which would potentially indicate more severe consequences for the fetus during early gestation[16].

Prenatal care

Prenatal care is one of the most commonly utilized preventive health care services in the U.S.[92] As of 1995, at least 40% of women were receiving some form of prenatal care[92]. As of 2011, there are indications that prenatal care use during the first trimester ranges from 59% to 87% across the U.S. states[93]. Prenatal care involves the early detection, treatment and/or prevention of adverse maternal and fetal outcomes as well as interventions to address stress, behaviors with negative consequences such as substance use, and adverse socioeconomic conditions[94]. Despite controversy surrounding whether prenatal care may help reduce rates of low birth weight, preterm birth or infant mortality[94,95], there are several advantages to prenatal care. Prenatal care provides primary prevention opportunities such as Rhogam to prevent creation of maternal antibodies against the fetus, antibiotic treatment to prevent congenital syphilis, antiretroviral drugs to reduce the risk of maternal-fetal HIV transmission, counseling about healthy lifestyle choices such as avoiding substance use, eating a nutritious diet and exercising, and maternal flu vaccines to prevent pregnancy complications[95]. It also provides several opportunities for secondary prevention such as early detection of gestational diabetes or hypertension which could decrease eclampsia, detection of intrauterine growth restriction followed by close monitoring and intervention in the case of fetal distress, and transfer of women with high-risk pregnancies to tertiary care facilities for more acute care[95]. Furthermore, prenatal care can help connect women with financial constraints and/or social risk factors to public services such as Women Infants and Children (WIC), caseworkers, supported housing, etc.[95] Due to the aforementioned preventive benefits associated with prenatal care, early entry into prenatal care (during the first trimester) is associated with better maternal and fetal outcomes, and is thus, recommended by healthcare and public health professionals[95,96].

There have been attempts in the literature to identify a “profile” for women who are more likely to enter prenatal care early versus late or not at all. While results vary across studies, some indicate that women more likely to receive prenatal care during the first trimester are more likely to be married, have received a higher level of education, be earning a higher income, have planned their pregnancy, and be enrolled in WIC[97]. Younger (18-24 year-old) women with less education, lower income, living alone, reporting service-related barriers (child care, transportation, long wait times, etc.), and with an unplanned pregnancy were least likely to start prenatal care in the first trimester[24,97,98].

AI/AN cultural beliefs surrounding pregnancy/childbirth

There is limited research on AI/AN cultural beliefs about pregnancy and childbirth. A qualitative study conducted by Long et al. of 52 AI/AN women in Oregon suggests that young and old AI/AN women believe that 1) pregnancy is a normal, natural event, often not requiring biomedical intervention 2) there is information unique to pregnancy that should be conveyed to pregnant women 3) childbirth is a negative time 4) an experienced person should attend to and assist with births 5) there is specific knowledge about childbirth that should be told to women and 6) caring for the baby begins during pregnancy[99]. A study of the Muckleshoot tribe of the Puget Sound Indians in Washington found that AI/AN women believed that prenatal care was meant for "pampering the mother[100]." Although AI/AN women with more traditional beliefs about health are more responsive to traditional healers, they reported that many traditional practices have been relinquished due to federal assimilation policies, the death of many traditional healers and increased accessibility to biomedical and Western medical interventions[99]. Prenatal care usage is also affected by substance abuse, domestic violence, and the cultural inappropriateness of the Western model of prenatal care, such as all providers being Caucasian men who are perceived as insensitive and disrespectful[99]. In general, women reported that they had trouble seeing the value of Western prenatal care[99].

An ethnography about the Chippewa Indians revealed that elders and grandmothers are considered wise and powerful and are often consulted for advice about family decisions[59]. When a woman becomes pregnant, elders teach her how to care for herself and her infant during and after pregnancy. Moreover, childcare responsibilities are shared by the extended family[59].

During pregnancy, it is also common for AI/AN women to limit their activities and take special care with their diet and behavior. For example, the Cherokees avoided certain foods that they believed affected the fetus, such as raccoon or pheasant, which could make the baby sick or cause death. Speckled trout was thought to cause birthmarks, and eating black walnuts was associated with the baby having a big nose. Pregnant Cherokee women also avoided wearing neckerchiefs because they were thought to cause umbilical strangulation, and lingering in doorways, which slowed delivery. Daily rituals during pregnancy, like washing hands and feet and having medicine men perform rites, were believed to make the deliveries easier as well. Before labor began, it was common for many indigenous women to drink herbal remedies to speed up the delivery[101]. Navajo cultural practices suggest that pregnant women should avoid consuming milk and foods high in salt, as well as attending funerals, sick people, crowded places, and touching taxidermy trophies, tying knots, weaving rugs, making pottery, or butchering animals[102].

Prenatal care among AI/ANs

The literature shows that AI/AN women generally enter prenatal care late and receive "inadequate" prenatal care, as determined by a validated measure (e.g. Kessner Index). For example, Baldwin et al. conducted a cross-sectional study of 148,482 live, singleton AI/AN births using National Center for Health Statistics (NCHS) linked birth-death data from 1989-1991. Adequate prenatal care was defined using a modification of Kessner's Index (month that prenatal care began and number of prenatal care visits, adjusted for gestational age). Results showed that the inadequate pattern of prenatal care use among AI/ANs was similar to the rate among Blacks, and more than twice that of Whites[103]. A similar study by Grossman et al. used the same data but restricted it to infants whose mothers or fathers lived in an urban (metropolitan) area. Urban AI/ANs were of interest in this study since they often do not receive health benefits provided by the IHS. Results showed that adequacy of prenatal care varied by city, with rate ratios of inadequate prenatal care among AI/AN compared to White women as high as 8.5 in Minneapolis, MN[104]. A different study by Grossman et al. of AI/ANs in Seattle, WA showed that urban and rural AI/AN women shared a similar prenatal risk factor profile (adolescent age, unmarried, use of tobacco and alcohol during pregnancy)[34]. However, urban women were significantly more likely than rural women to have late or no prenatal care[34].

A study of 763 AI/AN women living in metropolitan counties from the 1988 NMIHS oversample by Sugarman et al. indicated that they were less likely than Whites to obtain prenatal care during the first trimester, but at a rate comparable to Blacks[105]. A greater percentage of AI/ANs and Blacks reported obtaining no prenatal care compared to Whites. Among those who did receive prenatal care, AI/AN women reported fewer prenatal care visits than Whites. The study indicated that AI/AN women may share a similar prenatal care risk profile to that of Black women[105].

According to an NCHS 2006 report, from 1990-1998, although the proportion of infants whose moms entered prenatal care early increased, the rate for AI/AN women lagged behind that of other ethnic groups[106]. The rate for AI/AN women increased from 58% to 69%, while for Whites it increased from 83% to 88%[106]. AI/ANs are still 3.6 times as likely as Whites to enter prenatal care in the third trimester or not at all[106]. AI/ANs consistently recorded the highest rates of inadequate prenatal care use, according to Vital Statistics reports from 1997 and 2004[107,108]. A study from the National Perinatal Mortality files at NCHS on infants born 1995-1997 or 2000-2002 to AI/AN or White mothers conducted by Johnson et al. revealed that from 1995-1997, 46.2% of AI/ANs received inadequate prenatal care compared to 24.8% of Whites[106]. In 2000-2002, the numbers were 44.6% for AI/ANs compared to 23.9% for Whites[106]. These disparities also varied by region of the U.S., with the Midwest having the widest AI/AN-White disparity in both late and inadequate prenatal care[106].

Finally, an analysis of 400,000 AI/AN infants born between 1990-1999 from NCHS and Urban Indian Health Organizations showed that AI/AN moms received late or no prenatal care at twice the frequency of all mothers combined[33]. This pattern could be explained by the AI/AN traditional cultural beliefs surrounding pregnancy and childbirth, skepticism of Western medicine, as well as lack of proper access to health services.

Need

As evident from the review of literature, preconception health is an important component of ensuring healthy mothers and babies. Specifically, alcohol consumption during this period has especially dangerous consequences for fetal development. AI/ANs in the U.S. generally have poor health outcomes and preconception health, and rank among ethnic groups with the highest rates of alcohol consumption.

Above and beyond the benefits of preconception health, early entry into prenatal care (during the first trimester) also provides many preventive benefits to mother and child. Perhaps due in part to cultural beliefs surrounding pregnancy, AI/ANs generally appear to enter prenatal care late (after the first trimester) and receive inadequate prenatal care, which could contribute to the poorer birth outcomes they experience.

As of yet, there is no research exploring any connection between the high rates of pre-pregnancy alcohol use and low rates of early prenatal care. Therefore, there is a need to study whether pre-pregnancy alcohol consumption among AI/AN women may be associated with timing of entry into prenatal care.

Mansucript

Pre-pregnancy alcohol use and timing of prenatal care entry among American Indians and Alaska Natives

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Abstract

Background

American Indians and Alaska Natives (AI/AN) experience among the highest rates of alcohol use and lowest rates of prenatal care use. We examined the association between pre-pregnancy alcohol consumption and timing of prenatal care entry among AI/AN in eight states using data from the Pregnancy Risk Assessment Monitoring System (PRAMS) from 2004-2011.

Methods

We examined questions about pre-conception alcohol use (and binge drinking) and prenatal care initiation during the first trimester (at or before 12 weeks gestation) among AI/AN respondents in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington. Pre-pregnancy alcohol users were grouped into non-drinkers, non-binge drinkers, light binge drinkers (1-3 times), and heavy binge drinkers (4+ times during the three months before pregnancy). Data were analyzed using logistic regression in SUDAAN to estimate odds ratios (OR) and 95% confidence intervals (CI) above and below 138% of the federal poverty line (FPL), adjusted for maternal age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at the time of conception.

Results

At or below 138% FPL, there were no significant associations between quantity of alcohol consumed and timing of prenatal care entry. Above 138% FPL and among 25-34 year olds, heavy binge drinkers were 3.20 times as likely to enter prenatal care early

(p=0.007), light binge drinkers were 3.94 times as likely (p<0.0001), and non-binge drinkers were 3.55 times as likely (p=0.001), compared to non-drinkers.

Conclusions

Among 25-34-year olds above 138% FPL, AI/AN women who drank pre-pregnancy were more likely to initiate early prenatal care compared to non-drinkers. Further research is required to elucidate these findings.

Preventive behaviors that begin before pregnancy (e.g. folic acid supplementation, management of chronic medical conditions and medications, ensuring proper nutrition and avoiding substance use) can greatly reduce risky behaviors and poor outcomes during pregnancy, such as repeated pregnancy losses, congenital abnormalities, and low birthweight[2].

It is well established that maternal alcohol use during pregnancy can result in adverse fetal outcomes such as Fetal Alcohol Syndrome (FAS). FAS is characterized by growth retardation, abnormal facial features, and deficits to the central nervous system that often manifest via behavioral and/or cognitive disabilities[8]. Since FAS is the leading preventable birth defect with associated mental and behavioral impairment in the U.S., in 2005, the U.S. Surgeon General issued an advisory recommending that women who are pregnant or considering becoming pregnant abstain from using alcohol[9]. Although less attention has been directed toward studying the effects of pre-pregnancy alcohol use on fetal development, research suggests that moderate alcohol use (3.5 drinks or more) during the first 8-10 weeks of gestation is associated with increased risk of spontaneous abortion as well as dysmorphic facial features[11,12]. Since some women may not realize that they are pregnant until as late as 4 to 6 weeks gestation[13], and many wait until 11 or 12 weeks gestation to enter prenatal care (after the high-risk period for miscarriage[6]), it is likely that any alcohol consumption during these critical weeks may be adversely impacting the fetus.

Prevalence of pre-pregnancy alcohol consumption

Several studies report that 40-50% of women self-report drinking alcohol during the three months prior to pregnancy[13,18,21]. Drinking and binge drinking before pregnancy have been found to be significantly associated with a higher likelihood of drinking and binge drinking during pregnancy[19-21].

Research suggests that women who consumed alcohol pre-pregnancy are more likely to report unintended pregnancy, tobacco use, low self-esteem, low income, higher education, not relying on public assistance, first pregnancy, being single, late/no entry into prenatal care, age over 20, white race, exposure to violence, and/or knowing "someone close" using drugs or who had been physically hurt by their husband/partner during the 12 months before delivery[13,20-22]. Of these characteristics, unintended pregnancy, tobacco use, low-self esteem, low income, less education, being single, late/no prenatal care, age over 35, and exposure to violence or abuse are also associated with adverse pregnancy outcomes,[23-26] while the other characteristics are generally associated with better pregnancy outcomes. As such, all of these factors should be considered among potential confounders of an association between pre-pregnancy alcohol and pregnancy outcomes.

American Indian/Alaska Native health

The U.S. Census 2010 reported that AI/ANs comprise 1.7% of the U.S. population[27]. The AI/AN community faces many health challenges including higher mortality rates from liver disease, diabetes and suicide, and higher prevalence of sexually transmitted infections, tuberculosis, heart disease, and injuries compared to other ethnic groups[63,65]. The trend of poor health among AI/ANs extends to maternal and child health outcomes as well. AI/ANs experience the highest rates of infant mortality, preterm birth and low birthweight, compared to Whites and Hispanics[66,67].

The Indian Health Service (IHS) is a federal agency responsible for the provision of health services to AI/AN people in any of the 566 federally recognized tribes[68]. Most IHS services are provided on reservations, but since over half of AI/ANs do not permanently live on a reservation[71], more than 40% of AI/ANs do not have access to IHS services[70]. Other factors that contribute to poor health among AI/ANs include geographic isolation, economic factors, suspicion toward traditional spiritual beliefs, and cultural barriers[71].

Alcohol and pre-pregnancy alcohol among AI/ANs

AI/ANs have among the highest rates of alcohol use compared to other racial/ethnic groups in the U.S[63,72,73]. AI/ANs also consume greater quantities of alcohol per drinking day (heavier, episodic drinking) than does the U.S. reference population[76,77]. Specifically, AI/AN women have been found to drink more alcohol pre-pregnancy than women of other racial/ethnic groups[87-91]. Possible explanations for the high prevalence of alcohol consumption among AI/AN include genetics, psychiatric risk, demographic factors, community context, limited health services, and history of cultural as well as individual trauma[74].

Prenatal care

Prenatal care is one of the most commonly utilized preventive health care services in the U.S.[92] Due to the preventive benefits associated with prenatal care, early entry into prenatal care (during the first trimester) is associated with better maternal and fetal outcomes, and is thus, recommended by healthcare and public health professionals[95,96].

Women receiving prenatal care during the first trimester are more likely to be married, have received a higher level of education, be earning a higher income, have planned their pregnancy, and be enrolled in WIC[97]. Younger (18-24) women with less education, lower income, living alone, reporting service-related barriers (child care, transportation, long wait times, etc.), and with an unplanned pregnancy are less likely to start prenatal care in the first trimester[24,97,98].

Prenatal care among AI/ANs

Several studies have shown that AI/AN women are generally less likely to initiate early prenatal care than women of other racial/ethnic groups[33,34,105-108]. This pattern could be explained by the AI/AN traditional cultural beliefs surrounding pregnancy and childbirth, skepticism of Western medicine, as well as inadequate access to health services.

Methods

To assess the association between pre-pregnancy alcohol consumption and early entry into prenatal care, we conducted a retrospective cohort study using data from PRAMS. Information about PRAMS sampling methodology is documented elsewhere[129].

Our study included states that participated in Phase 5 (2004-2008) and Phase 6 (2009-2011) of PRAMS and in which over 5% of births were to AI/AN women. The states (and years of data available) were Alaska (2004-2010), Minnesota (2004-2010), Nebraska (2004-2011), New Mexico (2004-2005, 2011), Oklahoma (2004-2011), Oregon (2004-2011), Utah (2004-2011), and Washington (2004-2011)[111]. The overall sample size of AI/AN women in these states was 12,766. After limiting to AI/AN singleton births, the sample size was 12,420. Women who did not provide information on pre-pregnancy alcohol use were excluded from the analysis, resulting in a final sample size of 12,106 (see Appendix A). The study was certified as exempt by Emory University IRB.

The main outcome of interest was early entry into prenatal care, defined as entry during the first trimester (at or before 12 weeks gestation). Timing of entry into prenatal care was assessed by asking, "How many weeks or months pregnant were you when you had your first visit for prenatal care?" Late entry (defined as after first trimester) or no prenatal care were grouped together for analysis purposes.

The main exposure of interest was pre-pregnancy alcohol consumption and binge drinking. Pre-pregnancy alcohol consumption was categorized based on questions about drinking and binge drinking during the 3 months before pregnancy. An initial question asked "Have you had any alcoholic drinks in the past 2 years? (A drink is 1 glass of wine, wine cooler, can or bottle of beer, shot of liquor, or mixed drink.)" For those answering yes, drinking was subsequently assessed using the question, “During the 3 months before you got pregnant, how many alcoholic drinks did you have in an average week?” Pre-pregnancy binge drinking was assessed using slightly different wording in Phases 5 and 6. In Phase 5, binge drinking was assessed by asking, “During the 3 months before you got pregnant, how many times did you drink 5 alcoholic drinks or more in one sitting?” In Phase 6, the question defined binge drinking as “4 alcoholic drinks or more in one sitting.” In both phases, “a sitting” is defined as “a two hour time span.” Since the difference in question wording was minor, no distinction was made between the two phases during analysis.

The final alcohol consumption variable used in analysis was ordinal, categorized as non-drinkers, non-binge drinkers, light binge drinkers, and heavy binge drinkers. Non-drinkers were classified as those who did not drink in the past two years as well as those who drank in the past two years but did not drink or binge drink three months pre-pregnancy. Non-binge drinkers were comprised of those who drank but did not binge pre-pregnancy. Light binge drinkers comprised those who reported binge drinking 1-3 times in the three months before pregnancy. Heavy binge drinkers were classified as those who reported binge drinking 4 or more times in this period. Non-drinkers were used as the reference group.

Variables considered potential confounders included maternal age, maternal education, marital status, above or below 138% of the federal poverty line (FPL), pre-pregnancy insurance coverage, pre-pregnancy smoking, pre-pregnancy abuse, and whether trying to get pregnant at time of conception. Percentage below the federal poverty line (FPL) was determined using an algorithm, which included number of dependents, total household income during the year before the baby was born, and annual federal poverty guidelines published by the Department of Health and Human Services (DHHS)[112]. The algorithm is regularly used by the CDC[113].

Ascertainment of whether the mother was trying to get pregnant at the time of conception involved combining responses from a question about trying as well as feelings about timing of pregnancy. All variables with missing or unknown values were coded as missing.

Analysis

Percentages and 95% confidence intervals of AI/AN women in the sample reporting no pre-pregnancy alcohol consumption, alcohol consumption but no binging, light binge drinking, and heavy binge drinking were determined by all confounding variables, including state of residence. Percentages of AI/AN women in the sample who entered into prenatal care early vs. late/not at all were also determined across all characteristics.

An initial model was tested for collinearity, followed by interaction assessment using a chunk test and subsequent backwards elimination using p-values. Significant interaction terms included alcohol*FPL and alcohol*age. Interaction assessment was conducted again within strata of FPL. At or below 138% FPL, the alcohol*age interaction was no longer significant. Above 138% FPL, however, alcohol*insured, alcohol*trying and alcohol*age were all initially significant. After collapsing age into three categories for simplicity, the first two interactions were no longer significant. Confounders were then assessed by examining whether Beta estimates changed by more than 10% upon covariate removal. All initial confounders were retained. The final models were thus:

A) Among those at or below 138% FPL:

$$Logit\ P(Y) = \beta_0 + \beta_1(alcohol) + \beta_2(age) + \beta_3(education) + \beta_4(marital) + \beta_5(abuse) + \beta_6(smoking) + \beta_7(insurance) + \beta_8(trying)$$

B) Among those above 138% FPL:

$$Logit\ P(Y) = \beta_0 + \beta_1(alcohol) + \beta_2(age\_3) + \beta_3(education) + \beta_4(marital) + \beta_5(abuse) + \beta_6(smoking) + \beta_7(insurance) + \beta_8(trying) + \beta_{12}(alcohol * age\_3)$$

Figure 3. A) Final model used to estimate the association between pre-pregnancy alcohol and early entry into prenatal care among those at or below 138% FPL and **B)** above 138% FPL (age_3 signifies three-category age variable).

Multivariable logistic regression was used to obtain adjusted odds ratios for those at or below 138% FPL and adjusted odds ratios by age (three categories) among those above 138% FPL. These adjusted estimates were determined overall as well as by state (for those at or below 138% FPL) by running eight separate models, each restricted to one state. All analyses were conducted using SAS-callable SUDAAN in SAS 9.3 (Cary, NC) to account for the complex survey design.

Results

Selected characteristics of AI/AN women in the sample by pre-pregnancy alcohol exposure are shown in Table 1. Age distributions are relatively similar across alcohol consumption groups, although there are fewer 30-34 year-olds in the heavy binge drinking category compared to non-drinkers. Among those who binge drank 1-3 times during the 3 months pre-pregnancy, far fewer were 35 or older compared to non-drinkers. Those who drank but did not binge were more likely to be highly educated, well-off (above 138% FPL) and have non-Medicaid health insurance compared to all other groups. Meanwhile, heavy binge drinkers had the lowest prevalence of higher education (beyond 12 years) and were comprised of relatively poorer individuals. Binge drinkers were more likely to be unmarried. As alcohol consumption increased, prevalence of no insurance, pre-pregnancy smoking, pre-pregnancy abuse, and pregnancy “intendedness/wantedness” also increased. Non-drinkers had the highest prevalence of AI/AN women on Medicaid.

Table 1 also shows variation in pre-pregnancy alcohol use by state. Minnesota had the highest prevalence of binge drinking compared to other states (33.1% light binge drinkers and 13.4% heavy binge drinkers). Oregon had the highest percent of non-binge drinking (32.2%). Utah had the greatest percentage of non-drinkers (70.7%).

Selected characteristics of AI/AN women in the sample by timing of entry into prenatal care are shown in Table 2. Compared to those who entered prenatal care late or not at all, those who entered early tended to be significantly older, more highly educated, better-off financially, married, non-smokers, not abused, not trying to get pregnant at conception, and to have non-Medicaid health insurance. Prevalence of early entry into prenatal care ranged from 64.2% in New Mexico and 64.6% in Utah to 73.5% in Oregon and 73.6% in Oklahoma.

Adjusted odds ratios stratified by FPL (all states) are shown in Table 3. Among those at or below 138% FPL, there did not appear to be any statistically significant associations between pre-pregnancy alcohol use and early entry into prenatal care. Heavy and light binge drinkers were slightly less likely to initiate early prenatal care compared to non-drinkers (OR = 0.97, 95% CI = (0.640, 1.47) for heavy binge drinkers, 95% CI = (0.710, 1.30) for light binge drinkers), after adjusting for education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at the time of conception. Non-binge drinkers were slightly more likely to enter prenatal care early compared to drinkers (OR = 1.05, 95% CI = (0.770, 1.42)). None of these results were statistically significant. Results among AI/AN women above 138% FPL were stratified by age (three categories) to account for interaction. Compared to non-drinkers, and among 25-34 year olds, heavy binge drinkers were 3.20 times as likely to enter prenatal care early ($p=0.007$), light binge drinkers were 3.94 times as likely ($p<0.0001$), and non-binge drinkers were 3.55 times as likely ($p=0.001$).

Given that there were no additional interaction terms among those at or below 138% FPL, statewide associations were also examined for this group. There were no significant associations or trends observed from this analysis (Table 4).

Comments

This was the first known study to directly examine the association between pre-pregnancy alcohol use and early entry into prenatal care among AI/AN women across eight states from 2004-2011. Findings suggest that AI/AN women between 25-34 years old who are above 138% FPL and consume any alcohol during the three months before pregnancy are significantly more likely to enter prenatal care early compared to non-drinkers, after controlling for age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at the time of conception. Specifically, heavy binge drinkers in this category are 3.20 times more likely than non-drinkers, light binge drinkers are nearly four times as likely, and non-binge drinkers are nearly 3.5 times more likely to enter prenatal care early compared to their non-drinking counterparts.

It is important to note that early entry into prenatal care does not imply anything about and should not be used as a proxy for quality or duration of prenatal care. Although each of the elements listed (or a combination of all) could be used as proxies for prenatal care, we chose timing of prenatal care entry as a focus due to the greater associated potential for early risk detection and early health promotion/intervention[95]. Furthermore, early prenatal care entry has been shown to be associated with better health outcomes[116,117].

These findings are surprising, given that among AI/AN, drinkers were hypothesized to have significantly lower odds of early prenatal care compared to non-drinkers. Although this particular stratified association has not been previously researched, findings from other research on pre-pregnancy alcohol and prenatal care utilization among this age group may begin to help explain the results. The literature supports that women who are more socioeconomically stable (e.g. above the FPL, in this case) are more likely to initiate early prenatal care[25,97,98].

Some research suggests that 25-34-year-old women have among the highest rates of pre-pregnancy alcohol consumption as well as early prenatal care initiation. Data from the Canadian Community Health Survey found that between 2003 and 2010, “women aged 25-34 experienced the fastest increase in risky drinking of any age group for both males and females” and that these women accounted for over 62% of births in Canada[118]. An analysis of Oregon PRAMS data in 2004 revealed that compared to other age categories, 25-34 year olds had the highest percentage of live births to women who consumed any alcohol before pregnancy (55.1%)[90]. The same analysis report showed that in 2004, first trimester prenatal care initiation was 44.9% higher among women 25 years or older compared to women less than 18 years old[119]. An analysis of Hawaii PRAMS data for Kauai county from 2000-2008 revealed that mothers between 25-34 years of age had the highest estimate of first trimester prenatal care use compared to those under 25 and those above 35[120]. The same report found that mothers under 25 and those 25-34 had similar and higher estimates of binge drinking during the three months pre-pregnancy compared to those above 35[120]. A study conducted in 30 prenatal clinics in Sweden between 2009-2010 revealed that (moderate and hazardous) alcohol use prior to pregnancy was greatest among women aged 25-34 years compared to other age groups[121]. An Oklahoma PRAMS report from 2010 found that women above 24 years of age were more likely to receive pre-conception counseling, which was found to be significantly associated with first trimester initiation of prenatal care[122]. Similarly, data from 2006-

2008 North Carolina PRAMS analysis revealed that women 25 and older were significantly more likely to enter prenatal care compared to those below 25[123]. A 2008 Kentucky PRAMS report showed that 25-34 year-olds had the highest rates of early entry into prenatal care compared to other age groups[124].

The studies cited suggest that women 25-34 may be a group that consumes more alcohol pre-pregnancy as well as utilizes prenatal care earlier in pregnancy. However, the question of why heavier drinkers may also seek out protective health behaviors still remains. A study by Haines et al. surrounding alcohol use and protective behaviors among college students showed that among those who drink, 73% "usually" or "always" used at least one protective behavior (such as assigning a designated driver), and 47% used at least two protective behaviors[125]. Several studies have also shown that female drinkers are more likely to use protective strategies than male drinkers[126-128]. No known studies of a similar nature have been conducted among AI/AN populations, or pre-pregnant women 25-34 years old. Although the cited associations between drinking and protective health behaviors are among college student populations, it is possible that AI/AN women in the study sample experience a similar causal behavioral mechanism in which the protective health behavior associated with pre-pregnancy alcohol use is early prenatal care. Cultural influences on social networks might also help explain the relationship. Tribes with lower social integration, such as the Southwestern Plains Indians, have been shown to have high risk drinking patterns associated with FAS, while high-integration tribes, such as the Pueblos, generally have lower FAS rates (except if ostracism is at play, in which case there is a danger of riskier drinking even among high-integration groups)[86]. Based on this theory, perhaps 25-34 year-old AI/AN women above

138% FPL are members of low-integration tribes, resulting in high-risk drinking, and because of the lower social cohesion, the same women may be more likely to reject traditional prenatal care practices and follow Western prenatal care recommendations. Another possibility is that there is a generational effect, whereby the 25-34 year-olds have may have a preference for Western prenatal care and a particularly keen inclination toward healthy behaviors once pregnant. Further research is required to clarify the association between pre-pregnancy alcohol use and early prenatal care, and the exact mechanism through which it may operate among 25-34 year-old AI/AN women above the FPL.

Limitations and future directions

There were several limitations to the study. Measurement error may have been introduced by ambiguous wording of the alcohol consumption questions on the PRAMS surveys. Including birth certificate maternal race in the classification of AI/AN may have introduced some error due to misclassification. All measures were self-reported, and thus, may have been biased, especially due to the relative benefits of prenatal care use and stigma associated with the concept of alcohol use surrounding pregnancy.

For those at or below 138% FPL, estimates cannot be compared across states due to the inherently different AI/AN populations in each state that were not accounted for within regression models. Furthermore, statewide estimates cannot be used to make generalizations about tribes within states, since there are several prominent tribes within each state. In calculating crude ORs between exposure and covariates, as well as throughout the study, the alcohol categorization used (non-drinkers, non-binge drinkers, light binge drinkers (1-3 times), and heavy binge drinkers (4+ times)) was treated as ordinal, even though it may not truly be ordinal in nature. Regarding variable creation, the classification of “light” versus “heavy” binge drinkers was made to suggest, on average, binge drinking once a month or less before pregnancy (1-3 times) versus more than once a month (4+ times). However, this division was somewhat arbitrary.

Due to limitations on the variables available from PRAMS, the influence of religion, urban/rural residence, or social norms/attitudes on alcohol or prenatal care use could not be examined in this study, despite their likely importance. This warrants further research, perhaps using mixed methods or qualitative focus groups to help elucidate alternate pathways between pre-pregnancy alcohol use and early prenatal care. Future research should also examine how the association of interest compares between AI/AN and other races in these states.

Despite the limitations of the study, there are also several strengths to note. First and foremost, this is the first known study to be conducted about AI/AN women across eight states examining pre-pregnancy alcohol use and timing of prenatal care entry using PRAMS. There were also numerous variables available in PRAMS for this analysis, which hopefully helped account for some of the potential confounding issues. Additionally, the data in this study spanned eight years. The results of this study contribute to a growing interest in improving maternal and child health outcomes among AI/AN populations in the U.S.

Table 1. Descriptive statistics of AI/AN women in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington by pre-pregnancy alcohol use, PRAMS 2004-2011

	Women who drank no alcohol during the 3 months pre-pregnancy (n=5,293)			**Women who drank any alcohol (but did not binge) during the 3 months pre-pregnancy (n=2,987)**			**Women who binge drank during the 3 months pre-pregnancy: 1-3 times (n=2,715)**			**Women who binge drank during the 3 months pre-pregnancy: 4+ times (n=1,111)**		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Overall (N=12,106)	5,293	45.2	(43.4, 47.0)	2,987	25.0	(23.4, 26.7)	2,715	21.5	(20.0, 23.1)	1,111	8.26	(7.32, 9.32)
Maternal age (years)	5,292			2,986			2,715			1,111		
<20	1,111	50.1	(45.5, 54.8)	334	19.9	(16.1, 24.3)	378	21.2	(17.5, 25.6)	176	8.75	(6.37, 11.9)
20-24	1,658	43.0	(39.9, 46.2)	1,015	24.2	(21.6, 27.2)	1,015	23.0	(20.5, 25.8)	426	9.75	(7.99, 11.8)
25-29	1,256	41.9	(38.5, 45.4)	842	28.5	(25.3, 32.0)	763	21.6	(18.9, 24.5)	292	7.98	(6.36, 9.97)
30-34	784	46.8	(42.2, 51.4)	525	26.7	(22.9, 30.9)	385	21.5	(17.7, 25.8)	133	5.03	(3.75, 6.73)
35+	483	53.1	(46.8, 59.3)	270	24.9	(19.8, 30.8)	174	14.3	(10.8, 18.7)	84	7.70	(4.78, 12.2)
Education (years)	5,220			2,958			2,672			1,094		
< 12	1,625	53.0	(49.5, 56.5)	545	17.1	(14.6, 19.9)	594	20.5	(17.7, 23.6)	283	9.44	(7.53, 11.8)
12	2,166	43.6	(40.7, 46.5)	1,106	24.8	(22.2, 27.5)	1,148	22.5	(20.1, 25.0)	472	9.24	(7.64, 11.1)
13-15	1,120	41.5	(37.9, 45.3)	904	29.4	(26.1, 33.0)	717	22.3	(19.4, 25.6)	276	6.74	(5.25, 8.62)
16+	309	39.7	(33.6, 46.2)	403	38.5	(32.5, 44.9)	213	17.3	(13.3, 22.1)	63	4.48	(2.76, 7.20)
Federal poverty line	4,638			2,783			2,501			1,026		
<= 138%	3,551	46.4	(44.1, 48.7)	1,677	22.0	(20.1, 24.1)	1,770	22.5	(20.6, 24.5)	767	9.11	(7.86, 10.5)
> 138%	1,087	39.6	(36.1, 43.2)	1,106	34.1	(30.8, 37.6)	731	19.9	(17.3, 22.8)	259	6.38	(5.01, 8.10)
Marital status	5,292			2,981			2,712			1,111		
Married	2,059	47.3	(44.3, 50.4)	1,375	29.8	(27.1, 32.7)	880	17.8	(15.5, 20.2)	247	5.11	(3.89, 6.68)
Other	3,233	43.9	(41.6, 46.2)	1,606	22	(20.1, 24.1)	1,832	23.8	(21.9, 25.9)	864	10.2	(8.94, 11.7)
Pre-pregnancy insurance	4,968			2,819			2,477			1,011		
No insurance	1,734	43.2	(40.1, 46.4)	979	24.9	(22.1, 27.8)	934	21.5	(19.0, 24.3)	472	10.5	(8.60, 12.6)
Insured, non-Medicaid	1,330	42.1	(38.6, 45.5)	1,195	30.3	(27.3, 33.6)	863	21.6	(18.9, 24.5)	276	6.03	(4.71, 7.68)
Insured, Medicaid	1,904	53.1	(49.8, 56.3)	645	20.0	(17.4, 23.0)	680	19.7	(17.1, 22.4)	263	7.22	(5.75, 9.04)

Table 1. continued

	Women who drank no alcohol during the 3 months pre-pregnancy (n=5,293)			Women who drank any alcohol (but did not binge) during the 3 months pre-pregnancy (n=2,987)			Women who binge drank during the 3 months pre-pregnancy: 1-3 times (n=2,715)			4+ times (n=1,111)		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Smoked during the 3 months before pregnancy	5,231			2,963			2,674			1,096		
No	3,512	57.3	(54.9, 59.7)	1,608	24.2	(22.1, 26.4)	1,022	14.4	(12.8, 16.2)	303	4.16	(3.26, 5.28)
Yes	1,719	29.9	(27.4, 32.5)	1,355	26.3	(23.8, 29.0)	1,652	30.4	(27.8, 33.1)	793	13.4	(11.7, 15.4)
Abused before pregnancy	5,110			2,908			2,633			1,068		
No	4,724	46.6	(44.6, 48.6)	2,640	25.4	(23.7, 27.2)	2,280	20.6	(19.1, 22.3)	860	7.4	(6.44, 8.49)
Yes	386	31.7	(26.8, 37.1)	268	22.2	(17.8, 27.4)	353	29.9	(25.0, 35.3)	208	16.2	(12.5, 20.8)
Trying to get pregnant when conceived	5,275			2,977			2,707			1,109		
No	2,133	49.3	(46.3, 52.3)	1,235	25.3	(22.8, 28.0)	927	19.7	(17.4, 22.3)	320	5.71	(4.58, 7.11)
Yes	3,142	42.7	(40.5, 45.0)	1,742	25	(22.9, 27.2)	1,780	22.6	(20.7, 24.6)	789	9.76	(8.45, 11.3)
State	5,293			2,987			2,715			1,111		
Alaska	1,553	47.4	(45.8, 49.1)	611	19.7	(18.3, 21.1)	764	23.2	(21.8, 24.6)	311	9.74	(8.78, 10.8)
Minnesota	434	34.5	(30.1, 39.1)	272	19.0	(15.7, 22.9)	357	33.1	(28.0, 38.7)	178	13.4	(11.1, 16.1)
Nebraska	544	40.1	(37.5, 42.8)	313	23.6	(21.4, 26.0)	325	26.4	(24.0, 28.8)	129	9.89	(8.33, 11.7)
New Mexico	287	61.8	(57.4, 66.0)	92	18.9	(15.7, 22.6)	74	15.3	(12.4, 18.7)	19	4.03	(2.58, 6.23)
Oklahoma	796	45.4	(41.5, 49.3)	465	28.1	(24.7, 31.8)	302	19.0	(16.0, 22.3)	129	7.57	(5.68, 10.0)
Oregon	859	37.8	(35.7, 39.8)	741	32.2	(30.3, 34.3)	482	21.8	(20.0, 23.6)	194	8.24	(7.31, 9.28)
Utah	114	70.7	(62.8, 77.6)	25	12.7	(8.04, 19.4)	25	12.2	(7.89, 18.4)	11	4.40	(2.29, 8.29)
Washington	706	38.5	(34.4, 42.7)	468	28.4	(24.3, 32.8)	386	24.6	(20.7, 28.8)	140	8.61	(6.33, 11.6)

Table 2. Descriptive statistics of AI/AN women in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington by timing of entry into prenatal care, PRAMS 2004-2011

	Early entry into prenatal care* (n=8,587)			**Late/no entry into prenatal care (n=3,313)**		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Overall (N=11,900)	8,587	71.0	72.7)	3,313	29.0	30.7)
Maternal age (years)	8,587			3,311		
<20	1,179	60.7	65.2)	756	39.3	(34.8, 43.9)
20-24	2,840	69.8	72.6)	1,190	30.2	(27.4, 33.3)
25-29	2,387	74.8	77.8)	723	25.2	(22.2, 28.5)
30-34	1,433	76.8	80.7)	382	23.2	(19.4, 27.5)
35+	748	75.6	80.4)	260	24.4	(19.6, 29.8)
Education (years)	8,495			3,252		
< 12	1,828	59.3	62.8)	1,111	40.7	(37.2, 44.3)
12	3,407	71.1	73.8)	1,384	28.9	(26.3, 31.7)
13-15	2,365	77.1	80.2)	656	22.9	(19.8, 26.2)
16+	895	87.7	91.4)	101	12.3	(8.60, 17.1)
Federal poverty line	7,924			2,866		
<= 138%	5,230	66.8	69.0)	2,384	33.2	(31.0, 35.4)
> 138%	2,694	84.4	86.8)	482	15.6	(13.2, 18.3)
Marital status	8,581			3,309		
Married	3,683	80.7	(78.2, 83.0)	838	19.3	(17.0, 21.8)
Other	4,898	64.8	67.1)	2,471	35.2	(32.9, 37.4)
Pre-pregnancy insurance	8,012			3,082		
No insurance	2,648	65.0	(61.9, 68.1)	1,382	35.0	(32.0, 38.1)
Insured, non-Medicaid	3,050	81.7	(78.7, 84.3)	604	18.3	(15.7, 21.3)
Insured, Medicaid	2,314	66.3	(63.1, 69.3)	1,096	33.7	(30.7, 36.9)

*entry during 1st trimester of pregnancy

Table 2. continued

	Early entry into prenatal care* (n=8,587)			Late/no entry into prenatal care (n=3,313)		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Smoked during the 3 months before pregnancy	8,423			3,231		
No	4,644	74.1	(71.9, 76.2)	1,620	25.9	(23.8, 28.1)
Yes	3,779	67.1	(64.3, 69.8)	1,611	32.9	(30.2, 35.7)
Abused before pregnancy	8,303			3,144		
No	7,550	72.5	(70.7, 74.3)	2,703	27.5	(25.7, 29.3)
Yes	753	57.7	(51.9, 63.3)	441	42.3	(36.7, 48.1)
Trying to get pregnant when conceived	8,571			3,306		
No	3,654	81.3	(78.9, 83.5)	875	18.7	(16.6, 21.1)
Yes	4,917	65.0	(62.7, 67.2)	2,431	35.0	(32.8, 37.3)
State	8,587			3,313		
Alaska	2,125	69.4	(67.8, 71.0)	954	30.6	(29.0, 32.2)
Minnesota	882	66.2	(61.0, 71.1)	361	33.8	(28.9, 39.0)
Nebraska	964	72.3	(69.9, 74.7)	340	27.7	(25.4, 30.2)
New Mexico	304	64.2	(59.7, 68.5)	159	35.8	(31.5, 40.3)
Oklahoma	1,296	73.6	(69.9, 77.1)	380	26.4	(22.9, 30.1)
Oregon	1,680	73.5	(71.6, 75.4)	586	26.5	(24.6, 28.4)
Utah	104	64.6	(56.5, 72.1)	70	35.4	(27.9, 43.5)
Washington	1,232	71.5	(67.5, 75.2)	463	28.5	(24.8, 32.5)

*entry during 1st trimester of pregnancy

Table 3. Adjusted odds ratios for association of pre-pregnancy alcohol consumption with early entry into prenatal care among AI/AN women stratified by federal poverty level (FPL) (all states)

Among those at or below 138% FPL* (Unweighted N= 6,235)

	OR	LL	UL	CI width	p-value
Heavy bingers vs. non-drinkers	0.970	0.640	1.47	2.2969	0.880
Light bingers vs. non-drinkers	0.970	0.710	1.30	1.831	0.819
Non-bingers vs. non-drinkers	1.05	0.770	1.42	1.8442	0.775

*adjusted for age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at conception

Among those above 138% FPL* (Unweighted N = 2,879)

	Among < 25 year-olds					**Among 25-34 year-olds**					**Among 35+ year-olds**				
	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value
Heavy-bingers vs. non-drinkers	0.570	0.190	1.7	8.9474	0.317	3.20**	1.38	7.39	5.355	0.007	0.170	0.020	1.34	67.0	0.093
Light bingers vs. non-drinkers	1.35	0.500	3.64	7.28	0.548	3.94**	2.10	7.41	3.529	<0.0001	0.670	0.250	1.80	7.20	0.425
Non-bingers vs. non-drinkers	1.11	0.450	2.69	5.9778	0.824	3.55**	1.69	7.44	4.402	0.001	1.13	0.430	2.93	6.814	0.807

*adjusted for (3-category) age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at conception

**significant at α=0.05

Table 4. Adjusted odds ratios by state for association of pre-pregnancy alcohol consumption with early entry into prenatal care among AI/AN women at or below 138% federal poverty level*

	Heavy bingers vs. non-drinkers					Light bingers vs. non-drinkers					Non-bingers vs. non-drinkers				
	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value
Alaska (N=1,678)	1.39	0.95	2.04	2.147	0.090	1.14	0.87	1.48	1.7011	0.347	1.20	0.89	1.61	1.809	0.237
Minnesota (N=774)	0.75	0.41	1.40	3.415	0.368	0.86	0.46	1.61	3.50	0.628	1.16	0.53	2.57	4.849	0.708
Nebraska (N=847)	1.18	0.66	2.12	3.212	0.574	0.71	0.48	1.04	2.1667	0.080	1.16	0.78	1.73	2.218	0.476
New Mexico (N=294)	1.06	0.34	3.29	9.676	0.915	0.72	0.33	1.54	4.6667	0.391	0.75	0.38	1.50	3.947	0.420
Oklahoma (N=876)	1.16	0.46	2.95	6.413	0.747	1.22	0.60	2.49	4.15	0.589	1.13	0.58	2.21	3.81	0.719
Oregon (N=1,019)	0.81	0.53	1.22	2.302	0.306	1.20	0.85	1.71	2.0118	0.297	1.24	0.89	1.73	1.944	0.200
Utah (N=116)	1.22	0.14	10.5	75.0	0.853	1.36	0.27	6.91	25.593	0.708	1.12	0.31	4.07	13.13	0.860
Washington (N=928)	0.89	0.32	2.48	7.75	0.818	0.77	0.44	1.37	3.1136	0.377	0.80	0.45	1.42	3.156	0.446

*adjusted for age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at conception

Methods

To assess the association between pre-pregnancy alcohol consumption and timing of early prenatal care entry, we conducted a retrospective cohort study using data from PRAMS. PRAMS is a population-based mail and telephone survey conducted annually by CDC to gather information from women in the U.S. who have recently delivered an infant. Eligible women randomly selected from birth certificate records in participating states are contacted two to six months after delivery. Respondents are asked questions about various practices, experiences and feelings before and during pregnancy, as well as after delivery. The questions asked include demographic information, alcohol consumption and binge drinking before and during pregnancy, and timing of entry into prenatal care. Women in hard-to-reach or typically underrepresented groups, such as AI/ANs, are oversampled in order to provide more reliable estimates[109]. Responses are gathered during a calendar year, combined with birth certificate data, and weighted to be representative of all mothers who had a live birth in each state[110].

We were interested in including states with high percentages of AI/AN. Arizona and North Dakota do not participate in PRAMS. South Dakota Tribal was initially considered but not included because consent from all tribes would have been necessary and data were only available for 2007. Ultimately, we restricted our study to states that participated in Phase 5 (2004-2008) and Phase 6 (2009-2011) of PRAMS and in which over 5% of births were to AI/AN women. The states included in the analysis (and years of data available) were Alaska (2004-2010), Minnesota (2004-2010), Nebraska (2004-2011), New Mexico (2004-2005, 2011), Oklahoma (2004-2011), Oregon (2004-2011), Utah (2004-2011), and Washington (2004-2011)[111]. The overall sample size of AI/AN women in these states was 12,766. After limiting to AI/AN singleton births, the sample size was 12,420. Women who did not provide information on pre-pregnancy alcohol use were excluded from the analysis, yielding a final sample size of 12,106 (see Appendix A). The study was certified as exempt by Emory University IRB.

Variable definitions

Survey respondents were considered AI/AN if they self-reported race on PRAMS as American Indian or Alaska Native or if maternal race on the birth certificate was American Indian/Alaska Native. The main outcome of interest was early entry into prenatal care, defined as entry during the first trimester (at or before 12 weeks gestation). Timing of entry into prenatal care was assessed by asking, “How many weeks or months pregnant were you when you had your first visit for prenatal care?” Late entry (defined as after first trimester) or no prenatal care were grouped together for analysis purposes.

The main exposure of interest was pre-pregnancy alcohol consumption and binge drinking. Pre-pregnancy alcohol consumption was categorized based on questions about drinking and binge drinking during the 3 months before pregnancy. An initial question asked “Have you had any alcoholic drinks in the past 2 years? (A drink is 1 glass of wine, wine cooler, can or bottle of beer, shot of liquor, or mixed drink.)” For those answering yes, drinking was subsequently assessed using the question, “During the 3 months before you got pregnant, how many alcoholic drinks did you have in an average week?” Respondents selected from “14 drinks or more a week,” “7 to 13 drinks a week,” “4 to 6 drinks a week,” “1 to 3 drinks a week,” “Less than 1 drink a week,” and “I didn’t drink then.” Pre-pregnancy binge drinking was assessed using slightly different wording in

Phases 5 and 6. In Phase 5, binge drinking was assessed by asking, “During the 3 months before you got pregnant, how many times did you drink 5 alcoholic drinks or more in one sitting?” In Phase 6, the question defined binge drinking as “4 alcoholic drinks or more in one sitting.” In both phases, “a sitting” is defined as “a two hour time span.” The response options were “6 or more times,” “4 to 5 times,” “2 to 3 times,” “1 time,” and “I didn’t have 4 drinks or more in 1 sitting.” Since the difference in question wording was minor, no distinction was made between the two phases during analysis.

The final alcohol consumption variable used in analysis was ordinal, categorized as non-drinkers, non-binge drinkers, light binge drinkers, and heavy binge drinkers. Non-drinkers were classified as those who did not drink in the past two years as well as those who drank in the past two years but did not drink or binge drink pre-pregnancy. Non-binge drinkers were comprised of those who drank but did not binge pre-pregnancy. Light binge drinkers comprised those who reported binge drinking 1-3 times during the three months before pregnancy. Heavy binge drinkers were classified as those who reported binge drinking 4 or more times. Non-drinkers were used as the reference group.

Other variables were assessed as potential confounders in the analysis and were identified from the literature as well as through causal diagrams. These variables include: maternal age, maternal education, percent below federal poverty line, pre-pregnancy insurance coverage, pre-pregnancy smoking, marital status, history of previous live births, experience of abuse before pregnancy, and whether trying to get pregnant at time of conception. Maternal age (in years) was categorized into “under 20,” “20-24,” “25-29,” “30-34,” and “35 or older.” Years of education completed were categorized into “less than 12,” “12,” “13-15,” and “16 or more.” Percentage below the federal poverty line (FPL) was determined using an algorithm, which included number of dependents, total household income during the year before the baby was born, and annual federal poverty guidelines published by the Department of Health and Human Services (DHHS)[112]. The algorithm is regularly used by the CDC[113]. In order to calculate the percentage above/below FPL, first, a variable designating the midpoint for each state's income categories was created. Family size was determined by adding 1 to the number of reported dependents, in order to account for the newborn. Poverty cutoffs were determined by dividing the income midpoint by the DHHS poverty guideline corresponding to the appropriate family size (ranging from 1 to over 13 members). For each year, the previous year's poverty guidelines from DHHS were used. While separate poverty guidelines were used for Alaska (also published by DHHS), the remaining seven states used consistent federal poverty guidelines. This process was conducted for each year from 2004 to 2011. Finally, a variable for percent of FPL was created by multiplying the poverty cutoff by 100. For analysis purposes, the FPL was categorized into "at or below 138%" or "above 138%," in accordance with federal Medicaid eligibility guidelines.

Pre-pregnancy insurance coverage was assessed by asking, "Just before you got pregnant, did you have health insurance?" and "Just before you got pregnant, were you on Medicaid?" For analysis purposes, insurance was grouped into "no insurance," "insured, non-Medicaid" and "insured, Medicaid." Pre-pregnancy smoking was determined from the question, "In the 3 months before you got pregnant, how many cigarettes did you smoke on an average day? (A pack has 20 cigarettes)." The response choices were "41 cigarettes or more," "21 to 40 cigarettes," "11 to 20 cigarettes," "6 to

10 cigarettes," "1 to 5 cigarettes," "less than 1 cigarette," and "I didn't smoke then." For analysis purposes, pre-pregnancy smoking was classified as "yes/no."

Previous live births were determined by the PRAMS question, "Before you got pregnant with your new baby, did you ever have any other babies who were born alive?" The birth certificate recorded number of previous live births. For analysis purposes, the birth certificate information was deemed more reliable and was grouped into a binary "yes/no." In PRAMS, mothers were asked if the previous baby was born preterm. The birth certificate, however, asked if mothers had *ever* had a previous preterm birth. A "yes" on either document was used to capture history of previous preterm births, categorized as "yes/no." For analysis, live and preterm births were jointly categorized into "no previous live births," "previous preterm births" or "previous non-preterm live births."

Experience of abuse before pregnancy was assessed by asking, "During the 12 months before you got pregnant with your new baby, did your husband [or ex-husband] or partner [or ex-partner] push, hit, slap, kick, choke, or physically hurt you in any other way?"

Ascertainment of whether the mother was trying to get pregnant at the time of conception involved use of two questions. The first was, "When you got pregnant with your new baby, were you trying to get pregnant?" where a "yes" counted as "trying" and "no" as "not trying." The second question was "Thinking back to just before you got pregnant with your new baby, how did you feel about becoming pregnant?" If the first question was left blank and the second was answered with either "I wanted to be pregnant sooner" or "I wanted to be pregnant then," the response was classified as "trying." If the first question was left blank and the second was answered with “I wanted to be pregnant later” or “I didn’t want to be pregnant then or at any time in the future,” the response was categorized as “not trying.”

Mental health before pregnancy was only queried in Phase 6, and was therefore, not included in the overall analysis. Questions regarding specific barriers to prenatal care use (e.g. transportation, cost, etc.) could not be analyzed due to large quantities of missing data. All variables with missing or unknown values were coded as missing.

Descriptive statistics and preliminary analysis

Percentages and 95% confidence intervals of AI/AN women in the sample reporting no pre-pregnancy alcohol consumption, alcohol consumption but no binging, light binge drinking, and heavy binge drinking were determined by all confounding variables, including state of residence. Percentages of AI/AN women in the sample who entered prenatal care early vs. late/not at all were also determined across all characteristics. All potential confounders and the exposure were tested for independent (crude) associations with early entry into prenatal care using logistic regression (proc rlogist in SUDAAN). Crude associations between potential confounders and pre-pregnancy alcohol were also determined using ordinal logistic regression (proc multilog in SUDAAN). Potential confounders were only considered for inclusion in the model selection process if they yielded a significant association ($p<0.05$) with both exposure and outcome. History of previous live births was not significantly associated with early entry into prenatal care, and as such, was excluded from further analysis. All other potential confounders were significantly associated with exposure and outcome.

A directed acyclic graph (DAG) was also drawn in order to illuminate potentially causal relationships and help determine the final set of possible confounders (see Appendix B). The DAG revealed that pre-pregnancy smoking, pre-pregnancy insurance, FPL, and trying to conceive were not only potential confounders, but also potential colliders. As such, controlling for them could open backdoor paths, introducing bias into the estimates. In order to resolve this issue, the literature was consulted. The literature supported that all of these variables were significantly associated with both pre-pregnancy alcohol consumption and timing of entry into prenatal care. Therefore, all other potential confounders were retained to begin the modeling process.

Model selection and multivariable analysis

First, collinearity was assessed using a full model with all possible terms. A SAS macro was used to generate VDPs and condition indices. Although some condition indices were greater than 30, all VDPs were below 0.5, so there was assumed to be no multicollinearity present.

Next, interaction terms were assessed for significance in the model. All possible interactions of the form exposure*confounder were included in the initial model with all confounders. A likelihood ratio "chunk" test indicated that the group of interaction terms was statistically significant ($p=0.0042$), and thus, at least one term was likely significant. A backwards elimination approach was used to assess significance of interaction terms using p-values. Interaction terms that were least significant ($p >> 0.05$) were dropped from the model one-by-one. The model was re-run after each term was dropped until any remaining interaction terms were significant ($p<0.05$). The interaction terms that remained significant were alcohol*FPL and alcohol*maternal age. This result was also confirmed by assessing significance of interaction terms one at a time starting with a no-interaction model. Through this method, alcohol*FPL was individually significant in the model, and thus retained. Other interaction terms were added one at a time to the model now including alcohol*FPL. Subsequently, alcohol*maternal age was found to be jointly significant, and thus, was retained. No other interaction terms were significant using this approach.

Confounding assessment was conducted next. Although the pre-pregnancy smoking variable was ultimately coded as described above, the primary (or filter) smoking question in PRAMS was initially taken into account as well. The primary question used in Phase 5 was "Have you smoked at least 100 cigarettes in the past 2 years?" In Phase 6, the initial question was changed to "Have you smoked any cigarettes in the past 2 years?" As a result, more "light" smokers were captured in Phase 6 than in Phase 5. A recent PRAMS analysis done by CDC showed that the change in filter question between Phases 5 and 6 had a significant effect on prevalence estimates of pre-pregnancy smoking[114].

The cited analysis used a categorical filter variable in models to control for the effect of change in filter question on smoking estimates over time, where filter is essentially a proxy for phase. However, including a filter variable in models in the present analysis would assume that filter was a confounder. While there may be reason to believe that change in smoking filter question could be associated with a change in prevalence of pre-pregnancy alcohol, there is little reason to believe that it is also associated with early entry into prenatal care (Figure 1).

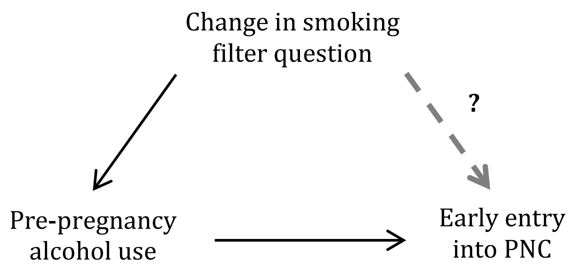


Figure 1. Potential associations between change in smoking filter question, pre-pregnancy alcohol use and early entry into prenatal care (PNC)

Furthermore, pre-pregnancy smoking was not a primary outcome of interest in the present analysis. Therefore a different approach was taken. The binary filter variable and a smoke*filter term were entered into a preliminary model along with year of birth (and all confounders including smoking as well as the two significant interactions), so that the filter variable and interaction would only measure phase, not a time effect. Estimates from this analysis were then compared to those from a model with filter and smoke*filter removed and only year of birth retained (along with all potential confounders including smoking as well as the two significant interactions). Estimates for the variables of interest (namely, exposure, outcome and interactions) changed by less than 10% from the first model. Thus, there was deemed to be no significant impact of the change in filter question on the main association of interest, and the filter, smoke*filter, and year of birth variables were dropped from the model. Interaction assessment was conducted again without the filter and smoke*filter terms, and yielded the same result (chunk test for interaction terms p-value =0.0017).

Confounding was assessed for the remaining variables using two approaches as well. The “gold standard” model after interaction assessment was considered to be:

$$Logit\ P(Y) = \beta_0 + \beta_1(alcohol) + \beta_2(age) + \beta_3(FPL) + \beta_4(education) + \beta_5(marital) + \beta_6(abuse) + \beta_7(smoking) + \beta_8(insurance) + \beta_9(trying) + \beta_{12}(alcohol * age) + \beta_{13}(alcohol * FPL)$$

Figure 2. "Gold standard" model for association between pre-pregnancy alcohol use and early entry into prenatal care.

The first approach was to examine change in odds ratio estimates after dropping confounders from the "gold standard" model one by one. Due to the presence of interaction, tables of estimates were stratified by age and FPL. After dropping a confounder, if the odds ratios were all within 10% of the "gold standard" odds ratios, the variable was a potential candidate for exclusion from the final model. Using the odds ratio change-in-estimate approach, only two confounders seemed to be fully necessary (estimates changed by over 10% when dropped from model): pre-pregnancy insurance and whether trying to get pregnant at time of conception. However, despite checking precision of odds ratio estimates, it was unclear if any of the other confounders (education, marital status, abuse, and smoking) could confidently be dropped from the model.

The second approach assessed change in $\hat{\beta}$ estimates after dropping confounders from the "gold standard" model one by one. The estimates of interest were all levels of the following: $\hat{\beta}_1$(alcohol), $\hat{\beta}_2$(age), $\hat{\beta}_3$(FPL), $\hat{\beta}_{12}$(alcohol*age), and $\hat{\beta}_{13}$(alcohol*FPL). The same 10%-change rule was employed. Using this more sensitive approach revealed that no confounders could be dropped from the model without $\hat{\beta}$s changing more than 10% from the "gold standard" estimates. This confirmed that the final model was the "gold standard" model (Figure 2).

In order to report results in a comprehensible way given the presence of two interaction terms, the model was stratified by FPL. As such, FPL and alcohol*FPL were removed from the "gold standard" model and two separate models were run: one restricted to those at or below 138% FPL and the second restricted to those above 138% FPL. Interaction assessment was conducted again for each of these stratified models, to check whether any other interactions were significant. The backwards elimination by p-value approach was used. For those at or below 138% FPL, the chunk test for interaction terms was significant (p=0.0121). Backwards elimination, however, revealed that no interaction terms remained significant at p=0.05. Thus, the model restricted to AI/AN women at or below 138% FPL contained only confounders (Figure 3A). All confounders were retained in the model based on the prior assessment of confounding.

For those above 138% FPL, the chunk test for interaction terms was also significant (p=0.0356). Backwards elimination revealed that the following interaction terms were significant and should be retained in the model: alcohol*age (p=0.0075), alcohol*trying (p=0.0148) and alcohol*insured (p=0.0158). In an attempt to report these results in a simpler format, $\hat{\beta}$ estimates for the five levels of maternal age were examined for significance and levels were collapsed to form three groups: < 25 years old, 25-34 years old (reference) and 35+ years old. The model with all three interaction terms was re-run using the three-category age variable and substituting alcohol*three-category age. Due to the increased robustness of each age group, neither alcohol*trying nor alcohol*insured remained significant in the model. Thus, they were sequentially dropped, leaving alcohol*three-category age as the only significant interaction term in the model for those above 138% FPL (Figure 3B):

A) Among those at or below 138% FPL:

$$Logit\ P(Y) = \beta_0 + \beta_1(alcohol) + \beta_2(age) + \beta_3(education) + \beta_4(marital) + \beta_5(abuse) + \beta_6(smoking) + \beta_7(insurance) + \beta_8(trying)$$

B) Among those above 138% FPL:

$$Logit\ P(Y) = \beta_0 + \beta_1(alcohol) + \beta_2(age\_3) + \beta_3(education) + \beta_4(marital) + \beta_5(abuse) + \beta_6(smoking) + \beta_7(insurance) + \beta_8(trying) + \beta_{12}(alcohol * age\_3)$$

Figure 3. A) Final model used to estimate the association between pre-pregnancy alcohol and early entry into prenatal care among those at or below 138% FPL and **B)** those above 138% FPL (age_3 signifies three-category age variable).

Multivariable logistic regression was used to obtain adjusted odds ratios for those at or below 138% FPL and adjusted odds ratios by age (three categories) among those above 138% FPL. These adjusted estimates were determined overall as well as by state (for those at or below 138% FPL) by running eight separate models, each restricted to one state. All analyses were conducted using SAS-callable SUDAAN in SAS 9.3 (Cary, NC) to account for the complex survey design.

Results

Selected characteristics of AI/AN women in the sample by pre-pregnancy alcohol exposure are shown in Table 1. Odds ratios are shown in Table 2. The overall prevalence of pre-pregnancy alcohol use in the study sample was 45.2% non-drinkers, 25% non-binge drinkers, 21.5% light binge drinkers, and 8.26% heavy binge drinkers. 20-24 year-old AI/AN women are slightly more likely to binge drink compared to other age groups (23% light bingers and 9.75% heavy bingers). Women 35+ had the lowest prevalence of light binge drinking, while 30-34 year-olds had the lowest prevalence of heavy binge drinking. The youngest and oldest age groups had the highest prevalence of non-drinkers (over 50%). Women with the highest education were more likely to drink but not binge, whereas those with the least education (high school or less) had not only the most non-drinkers (53%), but also comparatively higher prevalence of heavy binge drinkers (over 9%). Similarly, those above 138% FPL were more likely to drink but not binge, while those at or below 138% FPL had a majority of non-drinkers, as well as a comparatively higher prevalence of heavy binge drinkers. Married women were less likely to binge drink compared to non-married women. Those without insurance had comparatively higher prevalence of heavy binge drinking (10.5%). Those with Medicaid insurance were mostly non-drinkers (53.1%). Those who smoked or were abused before pregnancy were also more likely to both drink and binge. Women who were trying to get pregnant at the time of conception had a higher prevalence of binge drinkers compared to those who were not trying to get pregnant. New Mexico and Utah had the highest prevalence of non-drinkers (61.8% and 70.7%) and lowest prevalence of drinking or binging. Minnesota reported the highest percentage of binge drinking (33.1% light bingers, 13.4% heavy bingers). Oregon, Oklahoma and Washington had the highest prevalence of drinking but not binging (32.2%, 28.1% and 28.4%, respectively).

Selected characteristics of AI/AN women in the sample by timing of entry into prenatal care are shown in Table 3. Odds ratios are shown in Table 4. Overall, 71% of AI/AN women in the sample entered prenatal care early and 29% entered late or not at all. Those who entered prenatal care early tended to be significantly older, more highly educated, above the FPL, married, non-smokers, not abused, not trying to get pregnant at conception, and have non-Medicaid health insurance compared to those who entered late or not at all. Early prenatal care entry by state ranged from 64.2% to 73.6%. The states with greatest early prenatal care entry were Oklahoma (73.6%) and Oregon (73.5%), while the states with lowest early prenatal care entry were New Mexico (64.2%) and Utah (64.6%).

Crude associations between pre-pregnancy alcohol and early entry into prenatal care are shown in Table 4. Non-binge drinkers were significantly more likely to enter prenatal care early compared to non-drinkers (OR = 1.36, 95% CI = (1.09, 1.70)), while binge drinkers were generally less likely.

Adjusted odds ratios stratified by FPL (all states) are shown in Table 5. Among those at or below 138% FPL, there did not appear to be any statistically significant associations between pre-pregnancy alcohol use and early entry into prenatal care. Heavy and light binge drinkers were slightly less likely to initiate early prenatal care compared to non-drinkers (OR = 0.97, 95% CI = (0.640, 1.47) for heavy binge drinkers, 95% CI = (0.710, 1.30) for light binge drinkers), after adjusting for education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at the time of conception. Non-binge drinkers were slightly more likely to enter prenatal care early compared to drinkers (OR = 1.05, 95% CI = (0.770, 1.42)). None of these results were statistically significant.

Results among AI/AN women above 138% FPL were stratified by age (three categories) to account for interaction. Compared to non-drinkers, and among 25-34 year olds, heavy binge drinkers were 3.20 times as likely to enter prenatal care early (95% CI = (1.38, 7.39)), light binge drinkers were 3.94 times as likely (95% CI = (2.10, 7.41)), and non-binge drinkers were 3.55 times as likely (95% CI = (1.69, 7.44)).

Given that there were no additional interaction terms among those at or below 138% FPL, statewide associations were also examined for this category. There were no significant associations or trends observed from this analysis (Table 6). Statewide associations could not be produced for those above 138% FPL due to small sample sizes post-stratification.

Discussion

This was the first known study to directly examine the association between pre-pregnancy alcohol use and early entry into prenatal care among AI/AN women across eight states from 2004-2011. Findings from the descriptive statistics suggest that 71% of AI/AN women in the eight states of interest entered prenatal care early between 2004 and 2011 (compared to the 1998 estimate of 69%). Furthermore, it is encouraging to note that nearly half of AI/AN women in the sample (45.2%) reported not drinking alcohol and 70.2% overall reported not binge drinking during the three months before pregnancy. The age-related patterns seen for alcohol use in Table 1 change substantially after examining the association with interaction. It is interesting to note that AI/AN women who had either a high school education or lower or were at or below 138% FPL were mostly non-drinkers, but also had higher comparative prevalence of heavy binge drinkers. This suggests that while a majority of poor and less educated AI/AN women do not drink, a small subset of them binge drink more heavily than their more well off and higher educated peers. The former could be a result of frugality due to limited resources, but could also be influenced by drinking behaviors of the women's partners, which are unknown. The findings that married women are less likely to binge drink than unmarried women, and that women who smoked or were abused pre-pregnancy were more likely to drink or binge are also supported by the literature[13,20-22]. The literature also confirms that the uninsured are more likely to (heavily) binge drink, while those relying on public assistance such as Medicaid, are less likely to drink[21]. The finding that those who were trying to get pregnant at the time of conception were significantly more likely to not only binge drink, but also enter prenatal care late compared to women who were not trying to get pregnant is unusual. The latter might be a result of a preference for more traditional non-Western care among those who are trying to become pregnant. Aside from the anomaly about women trying to get pregnant, AI/AN women in our study appeared to have characteristics similar to those of other women entering prenatal care early[24,97,98].

Regarding alcohol use and prenatal care timing across states, New Mexico and Utah may have more AI/AN non-drinkers and late prenatal care initiators as a result of the influence of dominant religious and political beliefs in these states. In support of our findings, a 2010 CDC analysis ranked Minnesota among states with the highest prevalence of binge drinking, while Utah and New Mexico ranked among the lowest[115]. This could be explained by a more liberal political climate in Minnesota. The statewide prevalence estimates are consistent with research showing that Northern Plains Indians (e.g. Chippewa in Minnesota) have a higher prevalence of alcohol use compared to Southwest Indians (e.g. Navajo in Utah and New Mexico)[76-80].

Findings from the models suggest that AI/AN women between 25-34 years old who are above 138% FPL and consume any alcohol during the three months before pregnancy are significantly more likely to enter prenatal care early compared to non-drinkers, after controlling for age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at the time of conception. Specifically, heavy binge drinkers in this category are 3.20 times as likely as non-drinkers, light binge drinkers are nearly four times as likely, and non-binge drinkers are nearly 3.5 times more likely to enter prenatal care early compared to their non-drinking counterparts.

It is important to note that early entry into prenatal care does not imply anything about and should not be used as a proxy for quality or duration of prenatal care. Although each of the elements listed (or a combination of all) could be used as proxies for prenatal care, timing of prenatal care entry has been chosen as a focus due to the greater associated potential for early risk detection and early health promotion/intervention[95]. Furthermore, early prenatal care entry has been shown to be associated with better health outcomes[116,117].

These findings are surprising, given that among AI/AN, drinkers are hypothesized to have significantly lower odds of early prenatal care compared to non-drinkers. Although this particular stratified association with age has not been previously researched, findings from other research on pre-pregnancy alcohol and prenatal care utilization among this age group may begin to help explain the results. The literature supports that women who are more socioeconomically stable (e.g. above the FPL, in this case) are more likely to initiate early prenatal care[25,97,98].

Some research suggests that 25-34-year-old women have among the highest rates of pre-pregnancy alcohol consumption as well as early prenatal care initiation. Data from the Canadian Community Health Survey found that between 2003 and 2010, "women aged 25-34 experienced the fastest increase in risky drinking of any age group for both males and females" and that these women accounted for over 62% of births in Canada[118]. An analysis of Oregon PRAMS data in 2004 revealed that compared to other age categories, 25-34 year-olds had the highest percentage of live births to women who consumed any alcohol before pregnancy (55.1%)[90]. The same analysis report showed that in 2004, first trimester prenatal care initiation was 44.9% higher among women 25 years or older compared to women less than 18 years old[119]. An analysis of Hawaii PRAMS data for Kauai county from 2000-2008 revealed that mothers between 25-34 years of age had the highest estimate of first trimester prenatal care use compared to those under 25 and those above 35[120]. The same report found that mothers under 25 and those 25-34 had similar and higher estimates of binge drinking during the three months pre-pregnancy compared to those above 35[120]. A study conducted in 30 prenatal clinics in Sweden between 2009-2010 revealed that (moderate and hazardous) alcohol use prior to pregnancy was greatest among women aged 25-34 years compared to other age groups[121]. An Oklahoma PRAMS report from 2010 found that women above 24 years of age were more likely to receive pre-conception counseling, which was found to be significantly associated with first trimester initiation of prenatal care[122]. Similarly, data from a 2006-2008 North Carolina PRAMS analysis revealed that women 25 and older were significantly more likely to enter prenatal care early compared to those below 25[123]. A 2008 Kentucky PRAMS report showed that 25-34 year-olds had the highest rates of early entry into prenatal care compared to other age groups[124].

The studies cited suggest that women 25-34 may be a group that consumes more alcohol pre-pregnancy as well as utilizes prenatal care earlier in pregnancy. However, the question of why heavier drinkers may also seek out protective health behaviors still remains. A study by Haines et al. surrounding alcohol use and protective behaviors among college students showed that among those who drink, 73% “usually” or “always” used at least one protective behavior (such as assigning a designated driver), and 47% used at least two protective behaviors[125]. Several studies have also shown that female drinkers are more likely to use protective strategies than male drinkers[126-128]. No known studies of a similar nature have been conducted among AI/AN populations, or pre-pregnant women 25-34 years old. Although the cited associations between drinking and protective health behaviors are among college student populations, it is possible that AI/AN women in the study sample experience a similar causal behavioral mechanism in which the protective health behavior associated with pre-pregnancy alcohol use is early prenatal care. Cultural influences on social networks might also help explain the relationship. Social integration is a process that merges individuals into a larger group, and also refers to how individuals are attached symbolically and structurally to the larger group[86]. In low-integration societies, there are fewer norms and individuals tend to have more freedom in behavior[86]. In high-integration societies, individuals are expected to conform to group standards[86]. Based on a 1982 study of alcohol use among American Indians in the Southwest U.S., May concluded that low-integration tribes, such as the Southwestern Plains Indians, have high risk drinking patterns associated with FAS, while high-integration tribes, such as the Pueblos, generally have lower FAS rates (except if ostracism is at play, in which case there is a danger of riskier drinking even among high-integration groups)[86]. Based on this theory, perhaps 25-34 year-old AI/AN women above 138% FPL are members of low-integration tribes, resulting in high-risk drinking, and because of the lower social cohesion, the same women may be more likely to reject traditional prenatal care practices and follow Western prenatal care recommendations. Another possibility is that there is a generational effect, whereby the 25-34 year-olds have may have a preference for Western prenatal care and a particularly keen inclination toward healthy behaviors once pregnant. Further research is required to clarify the association between pre-pregnancy alcohol use and early prenatal care, and the exact mechanism through which it may operate among 25-34 year-old AI/AN women above the FPL.

Limitations

There were several limitations to the study. Measurement error may have been introduced by the wording of questions on the PRAMS surveys. The questions about pre-pregnancy alcohol use defined an alcoholic drink as including “1 glass of wine, wine cooler, can or bottle of beer, shot of liquor, or mixed drink.” One glass of wine could be gauged differently, neither proofs nor can/bottle sizes are specified, and the time period “in an average week,” is vague. All of these could be interpreted differently by different respondents. Also, the change in definition of binge drinking from Phase 5 to Phase 6 was deemed minor, but may have had some impact on results. Similarly, the change in filter question for smoking was handled as seen fit, but since there is no standard precedent, this was ultimately a flaw in the instrument, which may have still introduced some residual confounding. Including birth certificate maternal race in the classification of AI/AN may have introduced some error due to misclassification.

All measures of interest in the study were categorical, resulting in a large number of degrees of freedom, and subsequent reduction in statistical robustness. All measures were self-reported, and thus, may have been biased, especially due to the relative benefits of prenatal care use and stigma associated with the concept of alcohol use surrounding pregnancy.

Unfortunately, statewide estimates were not obtainable among those above 138% FPL, due to small sample size. For those at or below 138% FPL, estimates cannot be compared across states due to the inherently different AI/AN populations in each state that were not accounted for within regression models. Furthermore, statewide estimates cannot be used to make generalizations about tribes within states, since there are several prominent tribes within each state. Additionally, New Mexico contributed sparse data, since the only years available were 2004-2005 and 2011.

Regarding modeling, not all covariate*covariate terms were tested as potential confounders. Furthermore, in calculating crude ORs between exposure and covariates, as well as throughout the study, the alcohol categorization used (non-drinkers, non-binge drinkers, light binge drinkers (1-3 times), and heavy binge drinkers (4+ times)) was treated as ordinal, even though it may not truly be ordinal in nature.

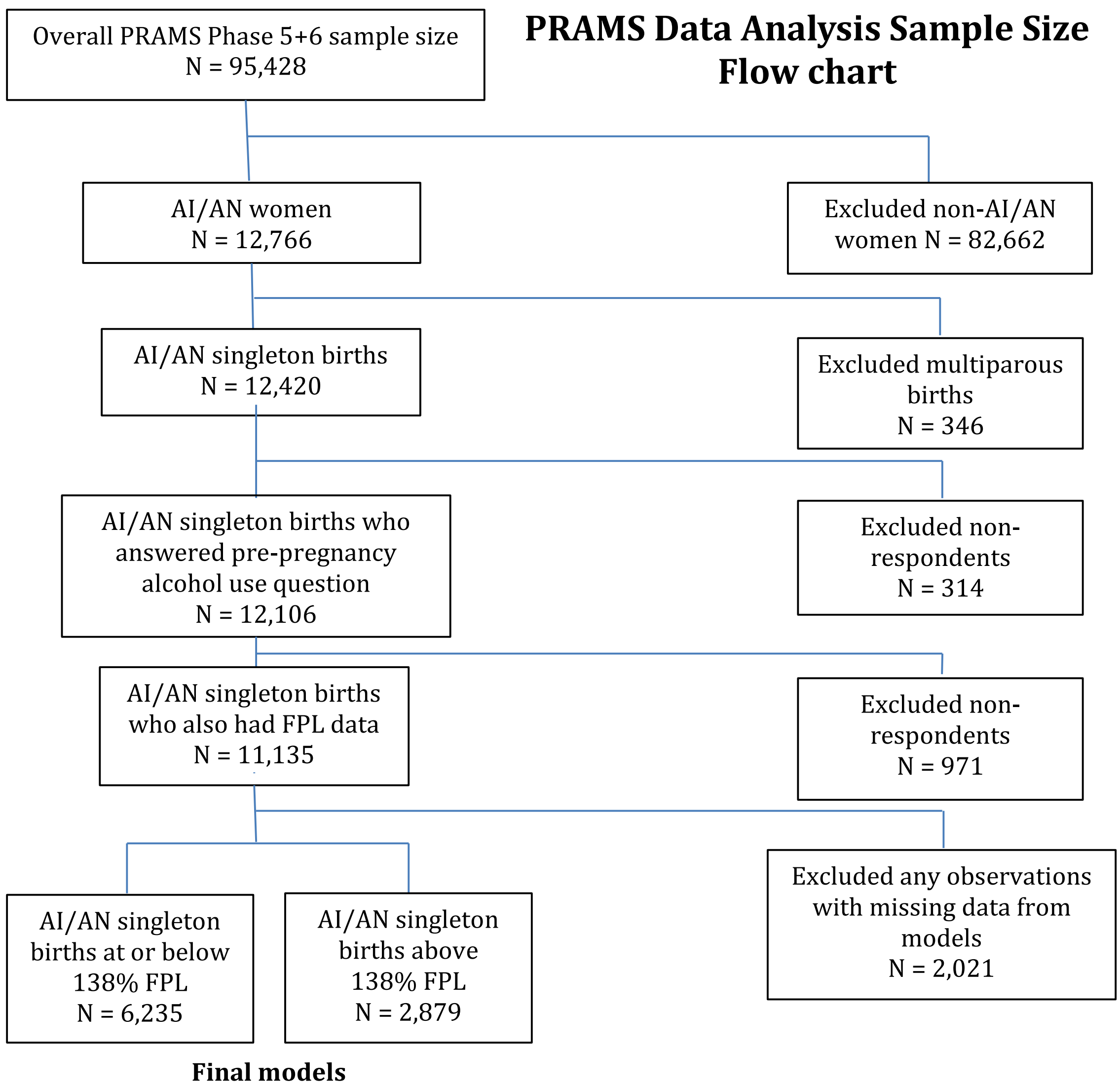
Regarding variable creation, the classification of “light” versus “heavy” binge drinkers was made to suggest, on average, binge drinking once a month or less before pregnancy (1-3 times) versus more than once a month (4+ times). However, this division was somewhat arbitrary. Similarly, using different cutoffs for FPL (e.g. 150%, 200% FPL) may modify the results slightly. Since IHS insurance was only specifically asked about in the Phase 6 questionnaire, it was not included as an insurance category for consistency. Pre-pregnancy mental health was also only asked about in Phase 6, and thus, could not be used as a potential confounder in analysis. Future research using Phase 6 and beyond could account for the potential confounding effect of mental health issues in this association.

A DAG was created and considered to help decide on potential confounders. Although the DAG suggested that some potential confounders may have also been colliders, which could have introduced bias if controlled for, the directions of the causal relationships illustrated were not absolutely certain. Therefore, the final decision on which confounders to include was supported by findings from previous literature as well as crude associations.

Due to limitations on the variables available from PRAMS, the influence of religion, urban/rural residence, or social norms/attitudes on alcohol or prenatal care use could not be examined in this study, despite their likely importance. This warrants further research, perhaps using mixed methods or qualitative focus groups to help elucidate alternate pathways between pre-pregnancy alcohol use and early prenatal care. Future research should also examine how the association of interest compares between AI/AN and other races in these states.

Despite the limitations of the study, there are also several strengths to note. First and foremost, this is the first known study to be conducted about AI/AN women across eight states examining pre-pregnancy alcohol use and timing of prenatal care entry using PRAMS. There were also numerous variables available in PRAMS for this analysis, which hopefully helped account for some of the potential confounding issues. Additionally, the data in this study spanned eight years. The results of this study contribute to a growing interest in improving maternal and child health outcomes among AI/AN populations in the U.S.

Appendix A


PRAMS Data Analysis Sample Size Flow chart
Overall PRAMS Phase 5+6 sample size N = 95,428
AI/AN women N = 12,766
Excluded non-AI/AN women N = 82,662
AI/AN singleton births N = 12,420
Excluded multiparous births N = 346
AI/AN singleton births who answered pre-pregnancy alcohol use question N = 12,106
Excluded non-respondents N = 314
AI/AN singleton births who also had FPL data N = 11,135
Excluded non-respondents N = 971
Excluded any observations with missing data from models N = 2,021
AI/AN singleton births at or below 138% FPL N = 6,235
AI/AN singleton births above 138% FPL N = 2,879
Final models

Appendix B

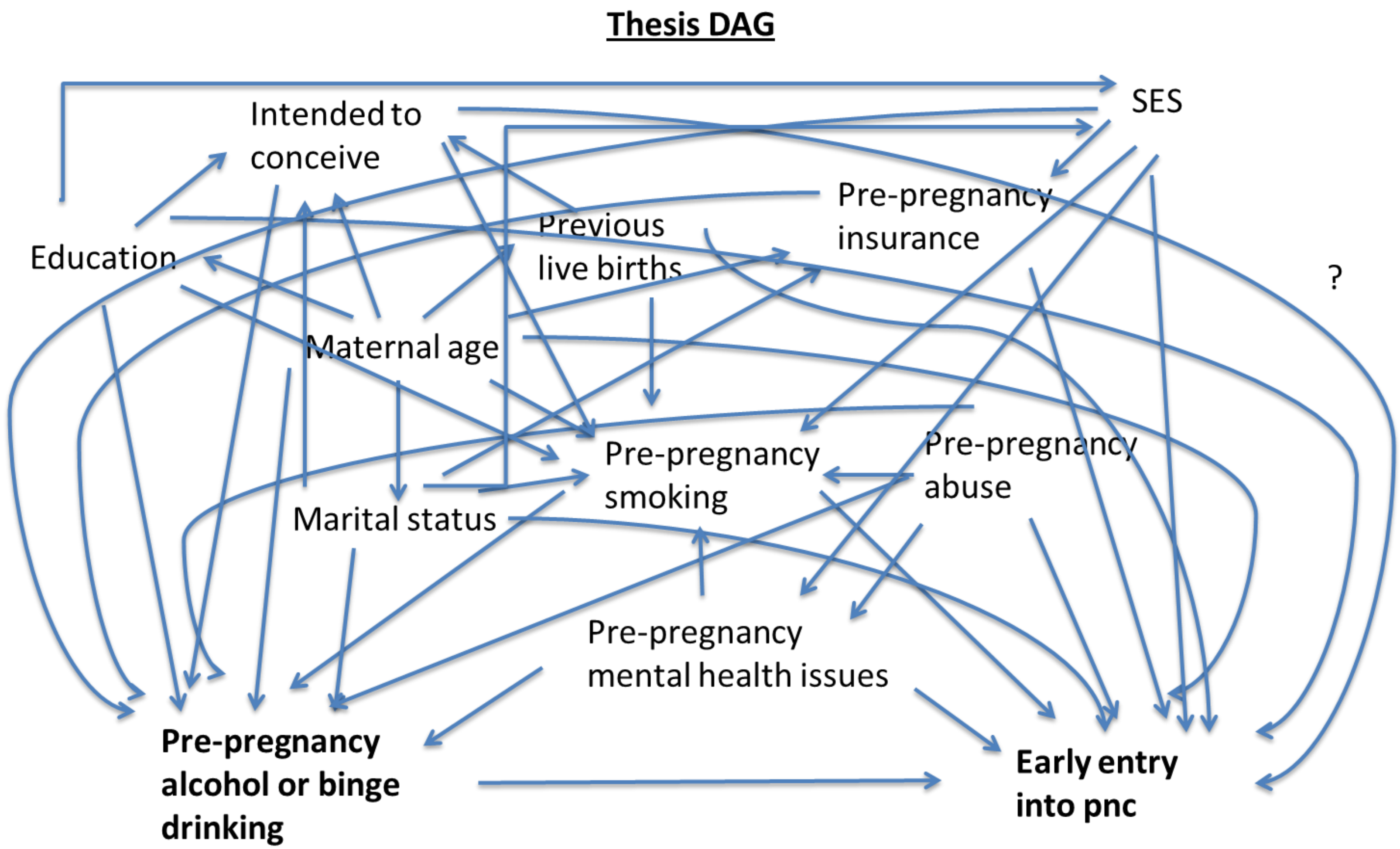

Thesis DAG
SES
Intended to conceive
Pre-pregnancy insurance
Previous live births
Education
?
Maternal age
Pre-pregnancy smoking
Pre-pregnancy abuse
Marital status
Pre-pregnancy mental health issues
Pre-pregnancy alcohol or binge drinking
Early entry into pnc

Table 1. Descriptive statistics of AI/AN women in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington by pre-pregnancy alcohol use, PRAMS 2004-2011

	Women who drank no alcohol during the 3 months pre-pregnancy (n=5,293)			**Women who drank any alcohol (but did not binge) during the 3 months pre-pregnancy (n=2,987)**			**Women who binge drank during the 3 months pre-pregnancy: 1-3 times (n=2,715)**			**Women who binge drank during the 3 months pre-pregnancy: 4+ times (n=1,111)**		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Overall (N=12,106)	5,293	45.2	(43.4, 47.0)	2,987	25.0	(23.4, 26.7)	2,715	21.5	(20.0, 23.1)	1,111	8.26	(7.32, 9.32)
Maternal age (years)	5,292			2,986			2,715			1,111		
<20	1,111	50.1	(45.5, 54.8)	334	19.9	(16.1, 24.3)	378	21.2	(17.5, 25.6)	176	8.75	(6.37, 11.9)
20-24	1,658	43.0	(39.9, 46.2)	1,015	24.2	(21.6, 27.2)	1,015	23.0	(20.5, 25.8)	426	9.75	(7.99, 11.8)
25-29	1,256	41.9	(38.5, 45.4)	842	28.5	(25.3, 32.0)	763	21.6	(18.9, 24.5)	292	7.98	(6.36, 9.97)
30-34	784	46.8	(42.2, 51.4)	525	26.7	(22.9, 30.9)	385	21.5	(17.7, 25.8)	133	5.03	(3.75, 6.73)
35+	483	53.1	(46.8, 59.3)	270	24.9	(19.8, 30.8)	174	14.3	(10.8, 18.7)	84	7.70	(4.78, 12.2)
Education (years)	5,220			2,958			2,672			1,094		
< 12	1,625	53.0	(49.5, 56.5)	545	17.1	(14.6, 19.9)	594	20.5	(17.7, 23.6)	283	9.44	(7.53, 11.8)
12	2,166	43.6	(40.7, 46.5)	1,106	24.8	(22.2, 27.5)	1,148	22.5	(20.1, 25.0)	472	9.24	(7.64, 11.1)
13-15	1,120	41.5	(37.9, 45.3)	904	29.4	(26.1, 33.0)	717	22.3	(19.4, 25.6)	276	6.74	(5.25, 8.62)
16+	309	39.7	(33.6, 46.2)	403	38.5	(32.5, 44.9)	213	17.3	(13.3, 22.1)	63	4.48	(2.76, 7.20)
Federal poverty line	4,638			2,783			2,501			1,026		
<= 138%	3,551	46.4	(44.1, 48.7)	1,677	22.0	(20.1, 24.1)	1,770	22.5	(20.6, 24.5)	767	9.11	(7.86, 10.5)
> 138%	1,087	39.6	(36.1, 43.2)	1,106	34.1	(30.8, 37.6)	731	19.9	(17.3, 22.8)	259	6.38	(5.01, 8.10)
Marital status	5,292			2,981			2,712			1,111		
Married	2,059	47.3	(44.3, 50.4)	1,375	29.8	(27.1, 32.7)	880	17.8	(15.5, 20.2)	247	5.11	(3.89, 6.68)
Other	3,233	43.9	(41.6, 46.2)	1,606	22	(20.1, 24.1)	1,832	23.8	(21.9, 25.9)	864	10.2	(8.94, 11.7)
Pre-pregnancy insurance	4,968			2,819			2,477			1,011		
No insurance	1,734	43.2	(40.1, 46.4)	979	24.9	(22.1, 27.8)	934	21.5	(19.0, 24.3)	472	10.5	(8.60, 12.6)
Insured, non-Medicaid	1,330	42.1	(38.6, 45.5)	1,195	30.3	(27.3, 33.6)	863	21.6	(18.9, 24.5)	276	6.03	(4.71, 7.68)
Insured, Medicaid	1,904	53.1	(49.8, 56.3)	645	20.0	(17.4, 23.0)	680	19.7	(17.1, 22.4)	263	7.22	(5.75, 9.04)

Table 1. continued

	Women who drank no alcohol during the 3 months pre-pregnancy (n=5,293)			Women who drank any alcohol (but did not binge) during the 3 months pre-pregnancy (n=2,987)			Women who binge drank during the 3 months pre-pregnancy: 1-3 times (n=2,715)			Women who binge drank during the 3 months pre-pregnancy: 4+ times (n=1,111)		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Smoked during the 3 months before pregnancy	5,231			2,963			2,674			1,096		
No	3,512	57.3	(54.9, 59.7)	1,608	24.2	(22.1, 26.4)	1,022	14.4	(12.8, 16.2)	303	4.16	(3.26, 5.28)
Yes	1,719	29.9	(27.4, 32.5)	1,355	26.3	(23.8, 29.0)	1,652	30.4	(27.8, 33.1)	793	13.4	(11.7, 15.4)
Abused before pregnancy	5,110			2,908			2,633			1,068		
No	4,724	46.6	(44.6, 48.6)	2,640	25.4	(23.7, 27.2)	2,280	20.6	(19.1, 22.3)	860	7.4	(6.44, 8.49)
Yes	386	31.7	(26.8, 37.1)	268	22.2	(17.8, 27.4)	353	29.9	(25.0, 35.3)	208	16.2	(12.5, 20.8)
Trying to get pregnant when conceived	5,275			2,977			2,707			1,109		
No	2,133	49.3	(46.3, 52.3)	1,235	25.3	(22.8, 28.0)	927	19.7	(17.4, 22.3)	320	5.71	(4.58, 7.11)
Yes	3,142	42.7	(40.5, 45.0)	1,742	25	(22.9, 27.2)	1,780	22.6	(20.7, 24.6)	789	9.76	(8.45, 11.3)
State	5,293			2,987			2,715			1,111		
Alaska	1,553	47.4	(45.8, 49.1)	611	19.7	(18.3, 21.1)	764	23.2	(21.8, 24.6)	311	9.74	(8.78, 10.8)
Minnesota	434	34.5	(30.1, 39.1)	272	19.0	(15.7, 22.9)	357	33.1	(28.0, 38.7)	178	13.4	(11.1, 16.1)
Nebraska	544	40.1	(37.5, 42.8)	313	23.6	(21.4, 26.0)	325	26.4	(24.0, 28.8)	129	9.89	(8.33, 11.7)
New Mexico	287	61.8	(57.4, 66.0)	92	18.9	(15.7, 22.6)	74	15.3	(12.4, 18.7)	19	4.03	(2.58, 6.23)
Oklahoma	796	45.4	(41.5, 49.3)	465	28.1	(24.7, 31.8)	302	19.0	(16.0, 22.3)	129	7.57	(5.68, 10.0)
Oregon	859	37.8	(35.7, 39.8)	741	32.2	(30.3, 34.3)	482	21.8	(20.0, 23.6)	194	8.24	(7.31, 9.28)
Utah	114	70.7	(62.8, 77.6)	25	12.7	(8.04, 19.4)	25	12.2	(7.89, 18.4)	11	4.40	(2.29, 8.29)
Washington	706	38.5	(34.4, 42.7)	468	28.4	(24.3, 32.8)	386	24.6	(20.7, 28.8)	140	8.61	(6.33, 11.6)

Table 2. Crude covariate associations with pre-pregnancy drinking status among AI/AN women in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington, PRAMS 2004-2011

	OR comparing non-binge drinkers to non-drinkers	**95% CI**	**OR comparing light binge-drinkers to non-drinkers**	**95% CI**	**OR comparing heavy binge drinkers to non-drinkers**	**95% CI**	**p-value**
Maternal age (years)							0.0001
<20	0.58	(0.42, 0.80)	0.82	(0.61, 1.12)	0.92	(0.59, 1.41)	
20-24	0.83	(0.65, 1.06)	1.04	(0.82, 1.33)	1.19	(0.84, 1.68)	
25-29 (reference)	1	--	1	--	1	--	
30-34	0.84	(0.63, 1.11)	0.89	(0.65, 1.22)	0.57	(0.37, 0.85)	
35+	0.69	(0.48, 0.99)	0.52	(0.36, 0.77)	0.76	(0.43, 1.36)	
Education (years)							<0.0001
< 12	0.57	(0.44, 0.73)	0.75	(0.59, 0.96)	0.84	(0.60, 1.17)	
12 (reference)	1	--	1	--	1	--	
13-15	1.25	(0.98, 1.58)	1.04	(0.81, 1.34)	0.76	(0.54, 1.09)	
16+	1.71	(1.22, 2.38)	0.84	(0.58, 1.23)	0.53	(0.30, 0.94)	
Federal poverty line							
<= 138% (reference)	1	--	1	--	1	--	<0.0001
> 138%	1.81	(1.47, 2.23)	1.04	(0.83, 1.30)	0.82	(0.60, 1.13)	
Marital status							<0.0001
Married	1.25	(1.04, 1.52)	0.69	(0.56, 0.85)	0.46	(0.33, 0.64)	
Other (reference)	1	--	1	--	1	--	

Table 2. continued

	OR comparing non-binge drinkers to non-drinkers	95% CI	OR comparing light binge-drinkers to non-drinkers	95% CI	OR comparing heavy binge drinkers to non-drinkers	95% CI	p-value
State							<0.0001
Alaska	2.32	(1.37, 3.91)	2.83	(1.72, 4.67)	3.3	(1.65, 6.60)	
Minnesota	3.09	(1.74, 5.48)	5.58	(3.19, 9.78)	6.24	(3.03, 12.86)	
Nebraska	3.29	(1.93, 5.61)	3.81	(2.28, 6.35)	3.96	(1.94, 8.06)	
New Mexico	1.71	(0.97, 3.01)	1.44	(0.82, 2.50)	1.05	(0.46, 2.39)	
Oklahoma	3.46	(2.00, 5.99)	2.42	(1.41, 4.15)	2.68	(1.26, 5.70)	
Oregon	4.77	(2.82, 8.07)	3.34	(2.01, 5.55)	3.51	(1.75, 7.04)	
Utah (reference)	1	--	1	--	1	--	
Washington	4.12	(2.35, 7.22)	3.7	(2.15, 6.38)	3.6	(1.67, 7.72)	
Pre-pregnancy insurance							<0.0001
No insurance (reference)	1	--	1	--	1	--	
Insured, non-Medicaid	1.25	(0.99, 1.58)	1.03	(0.80, 1.32)	0.59	(0.42, 0.84)	
Insured, Medicaid	0.66	(0.51, 0.84)	0.74	(0.58, 0.95)	0.56	(0.40, 0.79)	
Smoked during the 3 months before pregnancy							<0.0001
No (reference)	1	--	1	--	1	--	
Yes	2.09	(1.72, 2.54)	4.06	(3.31, 4.97)	6.19	(4.53, 8.45)	
Abused before pregnancy							<0.0001
No (reference)	1	--	1	--	1	--	
Yes	1.28	(0.92, 1.78)	2.13	(1.57, 2.88)	3.21	(2.21, 4.66)	
Trying to get pregnant when conceived							<0.0001
No (reference)	1	--	1	--	1	--	
Yes	1.14	(0.94, 1.38)	1.32	(1.07, 1.62)	1.97	(1.47, 2.64)	

Table 3. Descriptive statistics of AI/AN women in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington by timing of entry into prenatal care, PRAMS 2004-2011

	Early entry into prenatal care* (n=8,587)			**Late/no entry into prenatal care (n=3,313)**		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Overall (N=11,900)	8,587	71.0	(69.3, 72.7)	3,313	29.0	(27.3, 30.7)
Maternal age (years)	8,587			3,311		
<20	1,179	60.7	(56.1, 65.2)	756	39.3	(34.8, 43.9)
20-24	2,840	69.8	(66.7, 72.6)	1,190	30.2	(27.4, 33.3)
25-29	2,387	74.8	(71.6, 77.8)	723	25.2	(22.2, 28.5)
30-34	1,433	76.8	(72.5, 80.7)	382	23.2	(19.4, 27.5)
35+	748	75.6	(70.2, 80.4)	260	24.4	(19.6, 29.8)
Education (years)	8,495			3,252		
< 12	1,828	59.3	(55.7, 62.8)	1,111	40.7	(37.2, 44.3)
12	3,407	71.1	(68.3, 73.8)	1,384	28.9	(26.3, 31.7)
13-15	2,365	77.1	(73.8, 80.2)	656	22.9	(19.8, 26.2)
16+	895	87.7	(82.9, 91.4)	101	12.3	(8.60, 17.1)
Federal poverty line	7,924			2,866		
<= 138%	5,230	66.8	(64.6, 69.0)	2,384	33.2	(31.0, 35.4)
> 138%	2,694	84.4	(81.7, 86.8)	482	15.6	(13.2, 18.3)
Marital status	8,581			3,309		
Married	3,683	80.7	(78.2, 83.0)	838	19.3	(17.0, 21.8)
Other	4,898	64.8	(62.6, 67.1)	2,471	35.2	(32.9, 37.4)
Pre-pregnancy insurance	8,012			3,082		
No insurance	2,648	65.0	(61.9, 68.1)	1,382	35.0	(32.0, 38.1)
Insured, non-Medicaid	3,050	81.7	(78.7, 84.3)	604	18.3	(15.7, 21.3)
Insured, Medicaid	2,314	66.3	(63.1, 69.3)	1,096	33.7	(30.7, 36.9)

*entry during 1st trimester of pregnancy

Table 3. continued

	Early entry into prenatal care* (n=8,587)			Late/no entry into prenatal care (n=3,313)		
	Unweighted N	Weighted Percent	95% CI	Unweighted N	Weighted Percent	95% CI
Smoked during the 3 months before pregnancy	8,423			3,231		
No	4,644	74.1	(71.9, 76.2)	1,620	25.9	(23.8, 28.1)
Yes	3,779	67.1	(64.3, 69.8)	1,611	32.9	(30.2, 35.7)
Abused before pregnancy	8,303			3,144		
No	7,550	72.5	(70.7, 74.3)	2,703	27.5	(25.7, 29.3)
Yes	753	57.7	(51.9, 63.3)	441	42.3	(36.7, 48.1)
Trying to get pregnant when conceived	8,571			3,306		
No	3,654	81.3	(78.9, 83.5)	875	18.7	(16.6, 21.1)
Yes	4,917	65.0	(62.7, 67.2)	2,431	35.0	(32.8, 37.3)
State	8,587			3,313		
Alaska	2,125	69.4	(67.8, 71.0)	954	30.6	(29.0, 32.2)
Minnesota	882	66.2	(61.0, 71.1)	361	33.8	(28.9, 39.0)
Nebraska	964	72.3	(69.9, 74.7)	340	27.7	(25.4, 30.2)
New Mexico	304	64.2	(59.7, 68.5)	159	35.8	(31.5, 40.3)
Oklahoma	1,296	73.6	(69.9, 77.1)	380	26.4	(22.9, 30.1)
Oregon	1,680	73.5	(71.6, 75.4)	586	26.5	(24.6, 28.4)
Utah	104	64.6	(56.5, 72.1)	70	35.4	(27.9, 43.5)
Washington	1,232	71.5	(67.5, 75.2)	463	28.5	(24.8, 32.5)

*entry during 1st trimester of pregnancy

Table 4. Crude covariate associations with early entry into prenatal care among AI/AN women in Alaska, Minnesota, Nebraska, New Mexico, Oklahoma, Oregon, Utah, and Washington, PRAMS 2004-2011

	Crude association with early entry into prenatal care (OR)	**95% CI**	**Chi-square p-value**
Pre-pregnancy alcohol use			0.0071
Heavy binge drinkers	0.81	(0.60, 1.09)	
Light binge drinkers (1-	0.98	(0.79, 1.22)	
Non-binge drinkers	1.36	(1.09, 1.70)	
Non-drinkers (reference)	1		
Maternal age (years)			<0.0001
<20	0.52	(0.40, 0.67)	
20-24	0.78	(0.62, 0.97)	
25-29 (reference)	1	--	
30-34	1.12	(0.84, 1.48)	
35+	1.05	(0.76, 1.44)	
Education (years)			<0.0001
< 12	0.59	(0.49, 0.72)	
12 (reference)	1	--	
13-15	1.37	(1.09, 1.71)	
16+	2.91	(1.92, 4.41)	
Federal poverty line			<0.0001
<= 138% (reference)	1	--	
> 138%	2.68	(2.16, 3.34)	
Marital status			<0.0001
Married	2.27	(1.89, 2.73)	
Other (reference)	1	--	

*entry during 1st trimester of pregnancy

Table 4. continued

	Crude association with early entry into prenatal care (OR)	95% CI	Chi-square p-value
State			0.0001
Alaska	1.24	(0.87, 1.76)	
Minnesota	1.07	(0.71, 1.62)	
Nebraska	1.43	(0.99, 2.06)	
New Mexico	0.98	(0.66, 1.45)	
Oklahoma	1.53	(1.03, 2.26)	
Oregon	1.52	(1.06, 2.17)	
Utah (reference)	1	--	
Washington	1.37	(0.93, 2.03)	
Pre-pregnancy insurance			<0.0001
No insurance (reference)	1	--	
Insured, non-Medicaid	2.4	(1.90, 3.02)	
Insured, Medicaid	1.06	(0.87, 1.28)	
Smoked during the 3 months before pregnancy			0.0001
No (reference)	1	--	
Yes	0.71	(0.60, 0.84)	
Abused before pregnancy			<0.0001
No (reference)	1	--	
Yes	0.52	(0.40, 0.67)	
Trying to get pregnant when conceived			<0.0001
No (reference)	1	--	
Yes	0.43	(0.36, 0.51)	

*entry during 1st trimester of pregnancy

Table 5. Adjusted odds ratios for association of pre-pregnancy alcohol consumption with early entry into prenatal care among AI/AN women stratified by federal poverty level (FPL) (all states)

Among those at or below 138% FPL* (Unweighted N= 6,235)

	OR	LL	UL	CI width	p-value
Heavy bingers vs. non-drinkers	0.970	0.640	1.47	2.2969	0.880
Light bingers vs. non-drinkers	0.970	0.710	1.30	1.831	0.819
Non-bingers vs. non-drinkers	1.05	0.770	1.42	1.8442	0.775

*adjusted for age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at conception

Among those above 138% FPL* (Unweighted N = 2,879)

	Among < 25 year-olds					**Among 25-34 year-olds**					**Among 35+ year-olds**				
	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value
Heavy-bingers vs. non-drinkers	0.570	0.190	1.7	8.9474	0.317	3.20**	1.38	7.39	5.355	0.007	0.170	0.020	1.34	67.0	0.093
Light bingers vs. non-drinkers	1.35	0.500	3.64	7.28	0.548	3.94**	2.10	7.41	3.529	<0.0001	0.670	0.250	1.80	7.20	0.425
Non-bingers vs. non-drinkers	1.11	0.450	2.69	5.9778	0.824	3.55**	1.69	7.44	4.402	0.001	1.13	0.430	2.93	6.814	0.807

*adjusted for (3-category) age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at conception

**significant at α=0.05

Table 6. Adjusted odds ratios by state for association of pre-pregnancy alcohol consumption with early entry into prenatal care among AI/AN women at or below 138% federal poverty level*

	Heavy bingers vs. non-drinkers					**Light bingers vs. non-drinkers**					**Non-bingers vs. non-drinkers**				
	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value	OR	LL	UL	CI width	p-value
Alaska (N=1,678)	1.39	0.95	2.04	2.147	0.090	1.14	0.87	1.48	1.7011	0.347	1.20	0.89	1.61	1.809	0.237
Minnesota (N=774)	0.75	0.41	1.40	3.415	0.368	0.86	0.46	1.61	3.50	0.628	1.16	0.53	2.57	4.849	0.708
Nebraska (N=847)	1.18	0.66	2.12	3.212	0.574	0.71	0.48	1.04	2.1667	0.080	1.16	0.78	1.73	2.218	0.476
New Mexico (N=294)	1.06	0.34	3.29	9.676	0.915	0.72	0.33	1.54	4.6667	0.391	0.75	0.38	1.50	3.947	0.420
Oklahoma (N=876)	1.16	0.46	2.95	6.413	0.747	1.22	0.60	2.49	4.15	0.589	1.13	0.58	2.21	3.81	0.719
Oregon (N=1,019)	0.81	0.53	1.22	2.302	0.306	1.20	0.85	1.71	2.0118	0.297	1.24	0.89	1.73	1.944	0.200
Utah (N=116)	1.22	0.14	10.5	75.0	0.853	1.36	0.27	6.91	25.593	0.708	1.12	0.31	4.07	13.13	0.860
Washington (N=928)	0.89	0.32	2.48	7.75	0.818	0.77	0.44	1.37	3.1136	0.377	0.80	0.45	1.42	3.156	0.446

*adjusted for age, education, marital status, pre-pregnancy abuse, pre-pregnancy smoking, pre-pregnancy insurance, and whether trying to get pregnant at conception

References

1. Centers for Disease Control and Prevention. Preconception Health and Health Care: Overview. 2012; http://www.cdc.gov/preconception/overview.html.
2. Moos MK. Preconception health: where to from here? *Womens Health Issues.* Jul-Aug 2006;16(4):156-158.
3. Dunlop AL, Jack B, Frey K. National recommendations for preconception care: the essential role of the family physician. *J. Am. Board Fam. Med.* Jan-Feb 2007;20(1):81-84.
4. ACOG Committee Opinion number 313, September 2005. The importance of preconception care in the continuum of women's health care. *Obstet. Gynecol.* Sep 2005;106(3):665-666.
5. Centers for Disease Control and Prevention. Preconception Health and Health Care. *Information for Health Professionals.* 2013.
6. American Pregnancy Association. Miscarriage. 2011; http://americanpregnancy.org/pregnancycomplications/miscarriage.html.
7. Sokol RJ, Delaney-Black V, Nordstrom B. Fetal alcohol spectrum disorder. *JAMA.* Dec 10 2003;290(22):2996-2999.
8. Stratton K HC, Battaglia F (Eds.). Fetal alcohol syndrome: Diagnosis, epidemiology, prevention, and treatment. In: Division of biobehavioral sciences and mental disorders Ctsfas, ed. Washington DC: National Academy Press; 1996.
9. US Department of Health and Human Services. US Surgeon General releases advisory on alcohol use in pregnancy. Washington DC: US Department of Health and Human Services; 2005.
10. Jacobson JJ, SW. Prenatal alcohol exposure and neurobehavioral development: Where is the threshold? *Alcohol Health Res. World.* 1994;18(1):30-36.
11. Coles C. Critical periods for prenatal alcohol exposure: Evidence from animal and human studies. *Alcohol Health Res. World.* 1994;18(1):22-29.
12. Windham GC, Von Behren J, Fenster L, Schaefer C, Swan SH. Moderate maternal alcohol consumption and risk of spontaneous abortion. *Epidemiology.* Sep 1997;8(5):509-514.
13. Floyd RL, Decoufle P, Hungerford DW. Alcohol use prior to pregnancy recognition. *Am. J. Prev. Med.* Aug 1999;17(2):101-107.
14. Del Boca FK, Darkes J. The validity of self-reports of alcohol consumption: state of the science and challenges for research. *Addiction.* Dec 2003;98 Suppl 2:1-12.
15. National Institute on Alcohol Abuse and Alcoholism. What is a standard drink?
16. Kaskutas LA, Graves K. Pre-pregnancy drinking: how drink size affects risk assessment. *Addiction.* Aug 2001;96(8):1199-1209.
17. da Costa Pereira A, Olsen J, Ogston S. Variability of self reported measures of alcohol consumption: implications for the association between drinking in

pregnancy and birth weight. *J. Epidemiol. Community Health.* Aug 1993;47(4):326-330.
18. D'Angelo D, Williams L, Morrow B, et al. Preconception and interconception health status of women who recently gave birth to a live-born infant--Pregnancy Risk Assessment Monitoring System (PRAMS), United States, 26 reporting areas, 2004. *MMWR Surveill. Summ.* Dec 14 2007;56(10):1-35.
19. Ethen MK, Ramadhani TA, Scheuerle AE, et al. Alcohol consumption by women before and during pregnancy. *Maternal and child health journal.* Mar 2009;13(2):274-285.
20. Naimi TS, Lipscomb LE, Brewer RD, Gilbert BC. Binge drinking in the preconception period and the risk of unintended pregnancy: implications for women and their children. *Pediatrics.* May 2003;111(5 Pt 2):1136-1141.
21. Oklahoma State Department of Health Maternal and Child Health Service. PRAMS Gram: Alcohol consumption and related risk factors. Vol 5: Oklahoma State Department of Health; 1995:1-4.
22. Tough S, Tofflemire K, Clarke M, Newburn-Cook C. Do women change their drinking behaviors while trying to conceive? An opportunity for preconception counseling. *Clin. Med. Res.* Jun 2006;4(2):97-105.
23. Anderson JE, Ebrahim S, Floyd L, Atrash H. Prevalence of risk factors for adverse pregnancy outcomes during pregnancy and the preconception period--United States, 2002-2004. *Maternal and child health journal.* Sep 2006;10(5 Suppl):S101-106.
24. Beeckman K, Louckx F, Putman K. Predisposing, enabling and pregnancy-related determinants of late initiation of prenatal care. *Maternal and child health journal.* Oct 2011;15(7):1067-1075.
25. Brown SS. Drawing women into prenatal care. *Fam. Plann. Perspect.* Mar-Apr 1989;21(2):73-80.
26. Pagnini DL, Reichman NE. Psychosocial factors and the timing of prenatal care among women in New Jersey's HealthStart program. *Fam. Plann. Perspect.* Mar-Apr 2000;32(2):56-64.
27. Norris T VP, Hoeffel EM. The American Indian and Alaska Native Population: 2010. In: US Census Bureau, ed: US Department of Commerce, ; 2012.
28. Jones DS. The persistence of American Indian health disparities. *Am. J. Public Health.* Dec 2006;96(12):2122-2134.
29. US Commission on Civil Rights. A Quiet Crisis: Federal Funding and Unmet Needs in Indian Country. 2004.
30. Sarche M, Spicer P. Poverty and health disparities for American Indian and Alaska Native children: current knowledge and future prospects. *Ann. N. Y. Acad. Sci.* 2008;1136:126-136.
31. U.S. Census Bureau Public Information Office. American Indian and Alaska Native Heritage Month: November 2013. 2013; https://http://www.census.gov/newsroom/releases/archives/facts_for_features_special_editions/cb13-ff26.html.
32. Shalala DE TM, Hartz GJ, D'Angelo AJ. Regional differences in Indian health, 1998-1999. In: US Department of Health and Human Services, ed. Rockville, MD2000.

33. Castor ML, Smyser MS, Taualii MM, Park AN, Lawson SA, Forquera RA. A nationwide population-based study identifying health disparities between American Indians/Alaska Natives and the general populations living in select urban counties. *Am. J. Public Health.* Aug 2006;96(8):1478-1484.
34. Grossman DC, Krieger JW, Sugarman JR, Forquera RA. Health status of urban American Indians and Alaska Natives. A population-based study. *JAMA.* Mar 16 1994;271(11):845-850.
35. U.S. Census Bureau Public Information Office. 2010 Census Shows Nearly Half of American Indians and Alaska Natives Report Multiple Races. 2012; http://www.census.gov/newsroom/releases/archives/2010_census/cb12-cn06.html.
36. National Conference of State Legislatures. Federal and State Recognized Tribes. 2014; http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx - ak.
37. U.S. Census Bureau. American Indian and Alaska Native as a Percentage of County Population: 2010. In: 2010 Census Redistricting Data (Public Law 94-171) Summary File: Table P1, ed: U.S. Census Bureau; 2010.
38. Friends Committee on National Legislation. *Geographic & Demographic Profile of Indian Country.* 2012.
39. Minority Rights Group International. Inuit and Alaska Natives Profile. 2009; http://www.minorityrights.org/2617/united-states-of-america/inuit-and-alaska-natives.html.
40. Alaska Humanities Forum. Alaska's Heritage. 2004; http://www.akhistorycourse.org/articles/article.php?artID=151.
41. JohnActive. Why Subsistence is a Matter of Cultural Survival: A Yup'ik Point of View. 1998; http://www.culturalsurvival.org/ourpublications/csq/article/why-subsistence-a-matter-cultural-survival-a-yupik-point-view.
42. CrystalLinks. Eskimos. http://www.crystalinks.com/eskimos.html.
43. U.S. Census Bureau. American Indian and Alaska Native Alone and Alone or in Combination Population by Tribe for Oklahoma: 2000. 2004.
44. U.S. Census Bureau. American Indian and Alaska Native Alone and Alone or in Combination Population by Tribe for Oregon: 2000. 2004.
45. Cherokee Nation. The Traditional Belief System. 2014; http://www.cherokee.org/AboutTheNation/Culture/General/TheTraditionalBeliefSystem.aspx. Accessed April, 2014.
46. U.S. Census Bureau. Profiles of General Demographic Characteristics: 2000 Census of Population and Housing New Mexico. In: U.S. Department of Commerce, ed. Washington D.C.2001.
47. U.S. Census Bureau. Profiles of General Demographic Characteristics: 2000 Census of Population and Housing Utah. In: U.S. Department of Commerce, ed. Washington D.C.2001.
48. U.S. Census Bureau. American Indian and Alaska Native Alone or in Combination Population by Tribe for New Mexico: 2000. Washington D.C.2004.

49. U.S. Census Bureau. American Indian and Alaska Native Alone and Alone or in Combination Population by Tribe for Utah: 2000. 2004.
50. Navajo People. Navajo Culture. 2011; http://navajopeople.org/navajo-culture.htm.
51. Reid B. Navajo Women: Doorway Between Traditional and Modern Life. 2008; 21:http://www.terrain.org/essays/21/reid.htm.
52. Utah Division of State History. The Navajos. http://www.ilovehistory.utah.gov/people/first_peoples/tribes/navajo.html. Accessed April, 2014.
53. Navajo Tourism: Utah Travel Industry. Navajo People. 2013; http://www.utah.com/tribes/navajo_people.htm.
54. U.S. Census Bureau. American Indian and Alaska Native Alone and Alone or in Combination Population by Tribe for Washington: 2000. 2004.
55. Watson KG. Native Americans of Puget Sound -- A Brief History of the First People and Their Cultures. 1999; http://www.historylink.org/index.cfm?DisplayPage=output.cfm&File_Id=1506. Accessed April, 2014.
56. U.S. Census Bureau. Profiles of General Demographic Characteristics: 2000 Census of Population and Housing Minnesota. In: U.S. Department of Commerce, ed. Washington D.C.2001.
57. U.S. Census Bureau. American Indian and Alaska Native Alone and Alone or in Combination Population by Tribe for Minnesota: 2000. 2004.
58. Indian Affairs Council. Fond du Lac. 2007; http://mn.gov/indianaffairs/tribes_fonddulac.html. Accessed April, 2014.
59. Dodgson J, Struthers R. Traditional breastfeeding practices of the Ojibwe of Northern Minnesota. *Health Care Women Int.* Jan 2003;24(1):49-61.
60. U.S. Census Bureau. Profiles of General Demographic Characteristics: 2000 Census of Population and Housing Nebraska. In: U.S. Department of Commerce, ed. Washington D.C.2001.
61. U.S. Census Bureau. American Indian and Alaska Native Alone and Alone or in Combination Population by Tribe for Nebraska: 2000. 2004.
62. Ketteringham K. Sioux Indian Culture. 2007; http://voices.yahoo.com/sioux-indian-culture-422769.html?cat=37. Accessed April, 2014.
63. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the American Indian or Alaska Native adult population: United States, 2004-2008. *National health statistics reports.* Mar 9 2010(20):1-22.
64. Bureau of Indian Affairs Division of Tribal Government Services. Tribal Directory. 2014.
65. Anderson RN, Smith BL. Deaths: leading causes for 2001. *Natl. Vital Stat. Rep.* Nov 7 2003;52(9):1-85.
66. Alexander GR, Wingate MS, Boulet S. Pregnancy outcomes of American Indians: contrasts among regions and with other ethnic groups. *Maternal and child health journal.* Jul 2008;12 Suppl 1:5-11.
67. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2006 period linked birth/infant death data set. *Natl. Vital Stat. Rep.* Apr 30 2010;58(17):1-31.

68. Indian Health Service. Agency Overview. http://www.ihs.gov/aboutihs/overview/.
69. Centers for Medicare & Medicaid Services. Health care reform: Tracking tribal, federal, and state implementation. In: Centers for Medicare & Medicaid Services, ed. Washington D.C.2011.
70. Office on Women's Health: U.S. Department of Health and Human Services. Minority Women's Health: American Indians/Alaska Natives. 2012; http://www.womenshealth.gov/minority-health/american-indians/index.html.
71. Centers for Disease Control and Prevention. Minority Health: American Indian & Alaska Native Populations. 2013; http://www.cdc.gov/minorityhealth/populations/REMP/aian.html.
72. Denny CH, Floyd RL, Green PP, Hayes DK. Racial and ethnic disparities in preconception risk factors and preconception care. *Journal of women's health (2002).* Jul 2012;21(7):720-729.
73. Vital and Health Statistics. *Summary Health Statistics for US Adults: National Health Interview Survey, 2011.* Atlanta2012.
74. Whitesell NR, Beals J, Crow CB, Mitchell CM, Novins DK. Epidemiology and etiology of substance use among American Indians and Alaska Natives: risk, protection, and implications for prevention. *Am. J. Drug Alcohol Abuse.* Sep 2012;38(5):376-382.
75. Beauvais F, Jumper-Thurman P, Burnside M. The changing patterns of drug use among American Indian students over the past 30 years. *Am. Indian Alsk. Native Ment. Health Res.* 2008;15(2):15-24.
76. Beals J, Spicer P, Mitchell CM, et al. Racial disparities in alcohol use: comparison of 2 American Indian reservation populations with national data. *Am. J. Public Health.* Oct 2003;93(10):1683-1685.
77. O'Connell JM, Novins DK, Beals J, Spicer P. Disparities in patterns of alcohol use among reservation-based and geographically dispersed American Indian populations. *Alcohol. Clin. Exp. Res.* Jan 2005;29(1):107-116.
78. Spicer P, Beals J, Croy CD, et al. The prevalence of DSM-III-R alcohol dependence in two American Indian populations. *Alcohol. Clin. Exp. Res.* Nov 2003;27(11):1785-1797.
79. Indians.org. Northern Plains Indian Tribes. http://indians.org/tribal-directory-northern-plains-indian-tribes.html.
80. Indians.org. Southwest Indians. http://indians.org/articles/southwest-indians.html.
81. Mulligan CJ, Robin RW, Osier MV, et al. Allelic variation at alcohol metabolism genes (ADH1B, ADH1C, ALDH2) and alcohol dependence in an American Indian population. *Hum. Genet.* Sep 2003;113(4):325-336.
82. Compton WM, Thomas YF, Stinson FS, Grant BF. Prevalence, correlates, disability, and comorbidity of DSM-IV drug abuse and dependence in the United States: results from the national epidemiologic survey on alcohol and related conditions. *Arch. Gen. Psychiatry.* May 2007;64(5):566-576.

83. Wall TL, Garcia-Andrade C, Wong V, Lau P, Ehlers CL. Parental history of alcoholism and problem behaviors in Native-American children and adolescents. *Alcohol. Clin. Exp. Res.* Jan 2000;24(1):30-34.
84. Goldstein RB, Dawson DA, Saha TD, Ruan WJ, Compton WM, Grant BF. Antisocial behavioral syndromes and DSM-IV alcohol use disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Alcohol. Clin. Exp. Res.* May 2007;31(5):814-828.
85. Department of Health and Human Services: Substance Abuse and Mental Health Services Administration. Frequently Asked Questions about FASD. 2014; http://fasdcenter.samhsa.gov/fasdfaqs.aspx.
86. May PA. Fetal alcohol effects among North American Indians: evidence and implications for society. *Alcohol Health Research World.* 1991;15:239-248.
87. Khan BA, Robinson RF, Smith JJ, Dillard DA. Prenatal alcohol exposure among Alaska Native/American Indian infants. *Int. J. Circumpolar Health.* 2013;72.
88. Westphal LL. Prenatal alcohol use among urban American Indian/Alaska Native women. *Am. Indian Alsk. Native Ment. Health Res.* 2000;9(3):38-48.
89. Kvigne VL, Bull LB, Welty TK, Leonardson GR, Lacina L. Relationship of prenatal alcohol use with maternal and prenatal factors in American Indian women. *Soc. Biol.* Fall-Winter 1998;45(3-4):214-222.
90. Oregon Health Authority. Alcohol use. *Oregon Perinatal Data Book*2007:36-39.
91. Washington State Department of Health. *Maternal and Child Health Data Report, Alcohol Use Before and During Pregnancy.* Seattle, WA: Washington State Department of Health;2010.
92. Kogan MD, Martin JA, Alexander GR, Kotelchuck M, Ventura SJ, Frigoletto FD. The changing pattern of prenatal care utilization in the United States, 1981-1995, using different prenatal care indices. *JAMA.* May 27 1998;279(20):1623-1628.
93. United Health Foundation. America's Health Rankings. 2013.
94. Alexander GR, Kotelchuck M. Assessing the role and effectiveness of prenatal care: history, challenges, and directions for future research. *Public Health Rep.* Jul-Aug 2001;116(4):306-316.
95. Moos MK. Prenatal care: limitations and opportunities. *J. Obstet. Gynecol. Neonatal Nurs.* Mar-Apr 2006;35(2):278-285.
96. US Department of Health and Human Services. *Healthy People 2010.* 2000.
97. Sunil TS, Spears WD, Hook L, Castillo J, Torres C. Initiation of and barriers to prenatal care use among low-income women in San Antonio, Texas. *Maternal and child health journal.* Jan 2010;14(1):133-140.
98. Hulsey TM. Association between early prenatal care and mother's intention of and desire for the pregnancy. *J. Obstet. Gynecol. Neonatal Nurs.* May-Jun 2001;30(3):275-282.
99. Long CR, Curry MA. Living in two worlds: Native American women and prenatal care. *Health Care Women Int.* May-Jun 1998;19(3):205-215.
100. Horn B. Northwest coast Indians: The Muckleshoot. . In: Kay M.A., ed. *Anthropology of Human Birth*. Philadelphia, PA: F.A. Davis; 1982:361-376.

101. Pearson EH. Native American Customs of Childbirth. 2010; http://teachinghistory.org/history-content/ask-a-historian/24097. Accessed April, 2014.
102. Knoki-Wilson UM. Keeping the Sacred in Childbirth Practices: Integrating Navajo Cultural Aspects into Obstetric Care. 2008.
103. Baldwin LM, Grossman DC, Casey S, et al. Perinatal and infant health among rural and urban American Indians/Alaska Natives. *Am. J. Public Health.* Sep 2002;92(9):1491-1497.
104. Grossman DC, Baldwin LM, Casey S, Nixon B, Hollow W, Hart LG. Disparities in infant health among American Indians and Alaska natives in US metropolitan areas. *Pediatrics.* Apr 2002;109(4):627-633.
105. Sugarman JR, Brenneman G, LaRoque W, Warren CW, Goldberg HI. The urban American Indian oversample in the 1988 National Maternal and Infant Health Survey. *Public Health Rep.* Mar-Apr 1994;109(2):243-250.
106. Johnson PJ, Call KT, Blewett LA. The importance of geographic data aggregation in assessing disparities in American Indian prenatal care. *Am. J. Public Health.* Jan 2010;100(1):122-128.
107. Ventura SJ, Martin JA, Curtin SC, Mathews TJ. Births: final data for 1997. *Natl. Vital Stat. Rep.* Apr 29 1999;47(18):1-96.
108. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S. Births: final data for 2004. *Natl. Vital Stat. Rep.* Sep 29 2006;55(1):1-101.
109. Centers for Disease Control and Prevention. PRAMS Methodology. 2012. Accessed February 12, 2014.
110. Colley Gilbert BJ, Johnson CH, Morrow B, Gaffield ME, Ahluwalia I. Prevalence of selected maternal and infant characteristics, Pregnancy Risk Assessment Monitoring System (PRAMS), 1997. *MMWR CDC Surveill. Summ.* Sep 24 1999;48(5):1-37.
111. Kim SY, Tucker M, Danielson M, Johnson CH, Snesrud P, Shulman H. How can PRAMS survey response rates be improved among American Indian mothers? Data from 10 states. *Maternal and child health journal.* Jul 2008;12 Suppl 1:119-125.
112. United States Department of Health and Human Services Office of the Assistant Secretary for Planning and Evaluation. Prior HHS Poverty Guidelines and Federal Register References. 2013; http://aspe.hhs.gov/poverty/figures-fed-reg.cfm.
113. Morrow B. CDC Federal Poverty Level measurement. 2/24/2014.
114. Tong VT, Dietz PM, Morrow B, et al. Trends in smoking before, during, and after pregnancy--Pregnancy Risk Assessment Monitoring System, United States, 40 sites, 2000-2010. *MMWR Surveill. Summ.* Nov 8 2013;62(6):1-19.
115. Centers for Disease Control and Prevention. Prevalence of Binge Drinking Among Adults, Behavioral Risk Factor Surveillance System 2010. 2010.
116. Malloy MH, Kao TC, Lee YJ. Analyzing the effect of prenatal care on pregnancy outcome: a conditional approach. *Am. J. Public Health.* Mar 1992;82(3):448-450.
117. Reyes E, Martinez N, Parra A, Castillo-Mora A, Ortega-Gonzalez C. Early intensive obstetric and medical nutrition care is associated with decreased

prepregnancy obesity impact on perinatal outcomes. *Gynecol. Obstet. Invest.* 2012;73(1):75-81.

118. Canadian Centre on Substance Abuse. Substance Use during Pregnancy. 2014; http://www.ccsa.ca/Eng/topics/Treatment-and-Supports/Substance-Use-during-Pregnancy/Pages/default.aspx.
119. Oregon Health Authority. Prenatal care. *Oregon Perinatal Data Book* 2007:26-29.
120. Hawai'i PRAMS. *Kauai County PRAMS Report 2000-2008.* Honolulu, HI: Hawai'i Department of Health;2011.
121. Skagerstrom J, Alehagen S, Haggstrom-Nordin E, Arestedt K, Nilsen P. Prevalence of alcohol use before and during pregnancy and predictors of drinking during pregnancy: a cross sectional study in Sweden. *BMC Public Health.* 2013;13:780.
122. Oklahoma State Department of Health Maternal and Child Health Service. *PRAMS Gram: Preconception Care and Its Impact in Oklahoma.* 2010.
123. North Carolina State Center for Health Statistics. 2006-2008 North Carolina Pregnancy Risk Assessment Monitoring System Survey Results: Prenatal Care Timing. 2010; http://www.schs.state.nc.us/schs/prams/2006to2008/State/PNC_1TRM.html.
124. Kentucky Cabinet for Health and Family Services. *Kentucky PRAMS 2008 Data Report.* Frankfort, KY2008.
125. Haines MP, Barker G, Rice RM. The personal protective behaviors of college student drinkers: evidence of indigenous protective norms. *J. Am. Coll. Health.* Sep-Oct 2006;55(2):69-75.
126. Sutfin EL, Light LS, Wagoner KG, et al. Protective behaviors and high-risk drinking among entering college freshmen. *Am. J. Health Behav.* Sep-Oct 2009;33(5):610-619.
127. Delva J, Smith MP, Howell RL, Harrison DF, Wilke D, Jackson DL. A study of the relationship between protective behaviors and drinking consequences among undergraduate college students. *J. Am. Coll. Health.* Jul-Aug 2004;53(1):19-26.
128. Clapp JD, Shillington AM, Segars LB. Deconstructing contexts of binge drinking among college students. *Am. J. Drug Alcohol Abuse.* Feb 2000;26(1):139-154.
129. Shulman HB, Gilbert BC, Msphbrenda CG, Lansky A. The Pregnancy Risk Assessment Monitoring System (PRAMS): current methods and evaluation of 2001 response rates. *Public Health Rep.* Jan-Feb 2006;121(1):74-83.
130. Oetting ER, Donnermeyer JF, Trimble JE, Beauvais F. Primary socialization theory: culture, ethnicity, and cultural identification. The links between culture and substance use. IV. *Subst. Use Misuse.* Aug 1998;33(10):2075-2107.