Stress and Substance Use during Pregnancy for Alaska Native and Rural Alaskan Women

Julia Morris

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Jerald Herting, Chair

Hedwig Lee

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Abstract

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Julia Morris

Chair of the Supervisory Committee:
Chair Jerald Herting
Department of Sociology

This study examines the relationship between stress and environmental context on alcohol and tobacco use behaviors during pregnancy among Alaskan women (n=10,520). Alcohol and tobacco use during pregnancy have been shown to negatively impact maternal and fetal health, yet these behaviors are still evidenced despite increased awareness of these risks. Research highlights that stress exposure may increase alcohol and tobacco use, yet the relationship between stress and negative health behaviors during pregnancy is largely under-examined in rural contexts and among indigenous populations. This study finds that stress is significantly associated with higher odds of binge drinking and tobacco use during pregnancy for Alaskan women. Further, living in a rural community or living in a community with restrictions on the sale, importation or possession of alcohol is significantly associated with binge drinking and tobacco use behaviors.

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Introduction

Burgeoning research has established that prenatal behaviors are largely important to maternal and fetal health outcomes. However, negative health behaviors during pregnancy, including alcohol and tobacco use, continue to be evidenced despite increased awareness of these risks (Faden et al., 1997; Hankin et al., 1993; Wang et al., 2002). The impact of stress exposure on alcohol and tobacco use as stress coping mechanisms may play an important role in substance use behaviors during pregnancy. Further, differential exposure to stress may help explain disparities in health outcomes across advantaged and disadvantaged groups (Perreira and Cortes, 2006; Yali and Lobel, 2002).

Low status individuals experience heightened exposure to stress through discrimination, limited resources and environmental hazards resulting from their community context (Gehlert et al., 2008; Lantz et al., 2005; Nurius et al., 2013; OMahony et al., 2012; Pearlin, 1989; Williams et al., 2003). Low status individuals face heightened stress burden resulting from limited resources through which they can positively cope with stress (Lantz et al., 1998). As such, negative health behaviors, including alcohol and tobacco use, may often be utilized to buffer some of the negative mental and emotional consequences of stressful experiences (de Castro, 1990; Peele and Brodsky, 2000; Robinson and Pritchard, 1992). While the impact of context on stress exposure and negative health behaviors has been largely studied in the urban context, research is greatly limited in rural settings where contextual factors promoting or inhibiting certain behaviors may operate differently (Hillemeier et al., 2003; Probst et al., 2004; Sampson, 2003).

In this study, I assess the roles of stress and environmental context on alcohol and tobacco use behaviors during pregnancy among women in Alaska using data from the Alaska Pregnancy Risk Assessment Monitoring System (PRAMS), Phases V (2004-2008) and VI (2009-2011). Alaska provides an important context in which to study this relationship between stress, context and substance use behaviors due to vast geographic isolation and variation in access and exposure to alcohol. First, geographic isolation common to rural Alaskan communities limits access to health care information, resources and services that may promote more healthful behaviors. Second, variation in women's exposure to alcohol

resulting from many communities limiting the sale, importation or possession of alcohol in Alaska may impact the relationship between stress and substance use behaviors across contexts. This study provides an important contribution for understanding how stress and environmental context impact negative health behaviors during pregnancy for populations and areas previously unexplored in the literature.

Background

A large and growing body of research has established that prenatal behaviors are important to both maternal and fetal health outcomes. Positive health behaviors, such as exercise and early and consistent prenatal care, are seen as beneficial to fetal growth and development and promote healthy birth outcomes (Faden et al., 1997). While negative health behaviors, on the other hand, such as alcohol and tobacco use, have been shown to negatively impact fetal growth in utero and hinder development throughout the life course (Coles, 1993; Faden et al., 1997; Jacobson et al., 1994). Indeed, engagement in any number of negative health behaviors during pregnancy has potentially devastating and long-term impacts on maternal and fetal health outcomes.

The link between high levels of alcohol consumption (defined as 3.5+ drinks per day) during pregnancy and fetal alcohol spectrum disorder (FASD) has been well established, with FASD being characterized by restricted fetal growth, facial dysmorphology and abnormal neurological and central nervous system development (Abel et al., 2006; Coles, 1993; Sokol et al., 2003). Research has found that even low to moderate levels of alcohol consumption during early pregnancy can have negative impacts on fetal development (Hanson et al., 1978; Sokol et al., 2003), yet results on the effects of limited alcohol exposure on restricted fetal development have been inconsistent (Henderson et al., 2007; Patra et al., 2011).

The negative health effects of tobacco use during pregnancy are similarly harmful to fetal development. Nicotine in tobacco travels through the placenta and restricts fetal blood flow (Chiriboga, 2003; Lester et al., 2004; Smith et al., 2006). Further, regular smoking during pregnancy has been linked to multiple negative health effects, including restricted fetal growth, preterm delivery and increased perinatal mortality (Andres and Day, 2000;

Chiriboga, 2003; Lester et al., 2004; Smith et al., 2006; Wang et al., 2002). Tobacco use during pregnancy increases the risk of having an infant small for gestational age by twofold due to intrauterine growth retardation and shortened length of gestation (Chiriboga, 2003; Smith et al., 2006). Researchers estimate cigarette smoking during pregnancy is responsible for 15% of preterm births and 20-30% of infants with low birth weight in the United States (Andres and Day, 2000). As a result, maternal smoking is recognized as the most prominent modifiable risk behavior for restricted fetal growth in developed areas (Wang et al., 2002).

Wide-spread dissemination of biomedical knowledge has enabled a shift in the causes of disease from misfortune to individual choices, behaviors and environmental factors that are under human control (Link, 2008). In this way, it is understood that individual knowledge largely influences behaviors and associated outcomes (Link, 2008). In the case of substance use during pregnancy, policies aimed at reducing the negative health outcomes of substance use have largely focused on influencing individual women's choices and behaviors. Particularly, policies mandating warning labels on alcohol and tobacco products include information aimed at pregnant women informing them of the negative health impacts of the products on fetal development (Kees et al., 2006). Mandated messages include "According to the Surgeon General, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects" and "Smoking by Pregnant Women May Results in Fetal Injury, Premature Birth, and Low Birth Weight" (Hankin et al., 1993; Kees et al., 2006). However, research indicates the effectiveness of these labels is limited and has even less impact for women with high levels of substance use (Hankin et al., 1993; Peters et al., 2007). As a result, factors associated with why women continue to engage in negative health behaviors during pregnancy despite awareness of the risks requires further examination.

Stress, Health and Health Behaviors

The stress regulation process links life stressors to health outcomes and disease, and this process provides insight into the biobehavioral connection between stressful experiences and poor health outcomes (Skinner et al., 2011). The body's stress response process includes systems such as the autonomic nervous systems and hypothalamo-pituitary-adrenal (HPA) axis. These systems adapt in order to enable individuals to respond to challenges through

physiological changes (Nurius et al., 2013). The body's ability to maintain homeostatis through responding to changing environmental demands is referred to as "allostatis" (Lantz et al., 2005; McEwen, 1998; Nurius et al., 2013).

While the body's stress response process is well-suited for responding to acute stressors, it is not designed for the management of chronic stress (Gehlert et al., 2008; Juster et al., 2010; Nurius et al., 2013; Shonkoff et al., 2012). When the system is overworked, or fails to shut off, other biological systems are over-exposed to stress hormones causing harmful wear on the body (Geronimus et al., 2010). The negative consequences of the stress system being overworked are referred to as "allostatic load" (McEwen, 1998; Nurius et al., 2013; Pearlin et al., 2005). This "wear and tear" caused by deregulated hormones and associated responses, such as inflammation, negatively affect the brain and an array of organs in the body (Shonkoff et al., 2012). As a result, repeated cycles of allostasis deteriorate physical and mental health (Gehlert et al., 2008; Nurius et al., 2013).

In addition to stress' direct effect on health through physiological pathways, stress also impacts health outcomes through negative health behaviors. It is known that individuals attempt to mitigate the unpleasant experience of stress by managing psychological and physiological symptoms (Mezuk et al., 2013). The methods used to manage stress are influenced by an individual's (1) social context, including race, gender and age, (2) cultural and social norms influencing or promoting specific behaviors, and (3) environmental context, including access to information and resources (Mezuk et al., 2013). For instance, environmental context can influence positive health coping behaviors, such as through providing a safe and convenient place to exercise, or influence negative health coping behaviors, such as through widespread availability of alcohol or tobacco products. When experiencing stress, neural stress-response networks are activated and limit the brain's executive function. In this way, individuals under stress lose some agency in the decision-making process when the brain biases cognition toward emotional coping behaviors (Dallman, 2010). As a result, in addition to the negative physiological impacts of the body's stress-response system itself, negative health behaviors used to cope with stress, such as alcohol and tobacco use, further drive the relationship between stress and health outcomes.

Differential Stress Exposure by Social Status

Stressful experiences tend to be tied to social structure through unequal distribution of resources and opportunities. As such, individuals' stress exposure is directly linked to their placement within the existing social structure resulting from their social and economic status, race and ethnicity, gender and age (Gehlert et al., 2008; Lantz et al., 2005; Nurius et al., 2013; Pearlin, 1989). Low status women are more likely to experience chronic stressors due to discrimination, limited resources and limited control over their own circumstances. They are, therefore, more prone to the cumulative negative health effects of chronic stress compared to higher status women (O'Mahony et al., 2012; Pearlin, 1989; Williams et al., 2003). This additive nature of episodic stressful events, prolonged chronic stressors, and traumas experienced throughout the life course represent an individual's "cumulative stress burden" that weighs on their physical and mental health (Turner et al., 1995). This cumulative burden is heightened by the fact that vulnerable individuals and populations experiencing significant stressors are also more likely to experience stress in the future (Nurius et al., 2013). Through the process of stress proliferation, stressors have the tendency to cause additional stressors (Pearlin et al., 2005). For example, the stressful situation of job loss can then impact familial relationships and/or cause economic strain (Pearlin, 2010; Pearlin et al., 1997).

Research has found that the multitude of stress exposures is not only additive, but is interactive with other features of low status positions, such as race, wherein stress operates differently and at different magnitudes for individuals based on their characteristics, contexts and circumstances (Kessler and Neighbors, 1986). To this effect, Kessler and Neighbors (1986) found that there is an interaction between race and socioeconomic status in predicting psychological stress resulting from stressful experiences, such as discrimination (Kessler and Neighbors, 1986), and the direct effect of race on health remains even when socioeconomic status is controlled (House and Williams, 2000). Particularly, race can be considered both a chronic stressor and a source of acute stress through experiences and threats of discrimination, negative self-views, and diminished perceived and actual social status largely tied to historical injustices (Mezuk et al., 2013; Neblett et al., 2010). In this

way, the relationship between race and stress is largely mediated by social and environmental context (Mezuk et al., 2013).

Role of Community Context on Stress Exposure

A growing body of research identifies myriad of community-level contextual features directly impacting health, independent of individual characteristics and behaviors (Boardman et al., 2001; Diez Roux, 2001; Elliott, 2000; Hillemeier et al., 2003; Robert, 1999; Sampson, 2003). For example, the negative effect of concentrated poverty on health has been well-explored in the urban context (Hillemeier et al., 2003; Sampson, 2003). However, additional mechanisms linking community and environmental features to health outcomes are largely under-explored for rural and minority populations (Hillemeier et al., 2003; Probst et al., 2004). The role of community context on stress exposure and access to resources has been identified as an important area of study for understanding geographic disparities in health (Elliott, 2000; Robert, 1999; Stockdale et al., 2007).

Community context influences individuals' experiences of stress through impacting exposure to stressful or hazardous events, such as crime, or through availability of resources and services that impact how individuals can cope with stressors (Boardman et al., 2001; Elliott, 2000; Stockdale et al., 2007). For instance, geographic proximity to health clinics impacts access to information and resources, such as counseling services or substance use cessation programs, individuals may call upon in times of need (Elliott, 2000). In this way, there is heightened vulnerability to the health impacts of stress for individuals in low-resource contexts, as they often encounter both heightened levels of stress exposure and limited opportunities to call upon services and support as a result of their community structure (Boardman et al., 2001; Elliott, 2000).

Substance Use as a Stress Coping Mechanism

Fundamental causes theory holds that socioeconomic status is related to countless health outcomes (House and Williams, 2000; Link and Phelan, 1995). This relationship operates through multiple pathways, particularly through the employment of key resources, such as knowledge, power and social connections, to avoid or ameliorate risk (Link and Phelan,

1995). A key component of fundamental causes theory is that these resources are flexible. Individuals and groups with high levels of these key resources can continually utilize them, even when individual stressors or circumstances change (Link and Phelan, 1995). Particularly, optimism and social support are two primary resources found to aid individuals in managing experiences of stress (Yali and Lobel, 2002). However, the number of, and access to, these positive resources is largely impacted by education and other factors related to socioeconomic status (Yali and Lobel, 2002). As a result, for low status individuals, limited optimism, self-esteem, control over their own circumstances, and decreased number of social relationships and means of support limit the number and flexibility of resources they can call upon in times of need (Lantz et al., 1998).

When individuals cannot prevent exposure to stressors, or call upon key resources to ameliorate the risks of these stressors, individuals must then navigate handling the psychological and physiological consequences of that experience. In stressful situations resulting from social or environmental conditions, well-being is restricted and results in weakened autonomous motivation (Weinsten and Ryan, 2011). In essence, in times of high stress, individuals lose some sense of self-efficacy due to limited positive self-energy (Weinsten and Ryan, 2011). This negative relationship between stress and autonomous energy is heightened by the fact that low status individuals who are more prone to chronic stressors have fewer resources they can utilize to improve their situations (Link and Phelan, 1995). In this way, stress and behaviors are highly connected. Particularly, positive and effective coping strategies are not equally distributed (Mezuk et al., 2013; Pearlin and Schooler, 1978).

When individuals are placed under stress, they may take specific actions to cope with the experience of stress or buffer its potential negative effects (Pearlin, 1989). Coping refers to behaviors in which individuals attempt to ameliorate the negative impacts of life's problems (Pearlin, 1989; Weinstein and Ryan, 2011). Due to an individual's options and opportunities afforded by their position in the social structure, stress coping behaviors can take myriad of forms (Pearlin, 1989). Coping behaviors may include drinking alcohol or smoking cigarettes, or more positively for both mental and physical health, coping behaviors may include physical exercise or calling on social support (Diez Roux and Mair, 2010; Yali and Lobel, 2002). All of these behaviors can be used effectively to cope with stress, yet

some of these behaviors have deleterious health consequences associated with them.

Despite negative physical health consequences associated with their use, alcohol and tobacco may temporarily improve mental and emotional health for some individuals. Alcohol consumption is thought to reduce anxiety and enhance mood (Jackson et al., 2010; Peele and Brodsky, 2000). In naturalistic studies, subjects reporting moderate alcohol use indicate alcohol consumption has a calming effect (de Castro, 1990; Peele and Brodsky, 2000). Similarly, with tobacco, nicotine ingestion through cigarette smoking can create a sense of mild euphoria and may reduce stress-induced anxiety (Benowtiz, 1996; Jackson et al., 2010). Researchers have found that smokers overwhelming report relaxation and coping with stress as primary motivators for cigarette smoking (Robinson and Pritchard, 1992). In this way, alcohol and tobacco use may buffer some of the negative mental and emotional consequences of stress exposure.

The extent to which alcohol and tobacco use moderate the experience of stress differs according to social and environmental context. A study by Jackson and colleagues (2010) found that the relationship between stressful life events and depression was stronger for Blacks who abstained from cigarette smoking, drinking alcohol or overeating (using BMI of 30 or greater as a proxy measure) than Blacks who did engage in those behaviors (Jackson et al., 2010). This indicates that, for Blacks, negative health behaviors buffer the negative mental health effects of stress. However, the opposite was found for Whites, as the relationship between stress and depression was strengthened by engagement in negative health behaviors for this group (Jackson et al., 2010). These differences by race indicate Blacks may have limited access to more positive stress coping strategies (Jackson et al., 2010).

The importance of access to positive coping strategies and services is further highlighted by researching finding links between neighborhood disadvantage and increased drug use among adults, independent of individual socioeconomic and sociodemographic factors (Boardman et al., 2001; Robert, 1999). In this way, the negative health consequences associated with unhealthy coping behaviors help to explain the connection between high rates of stress exposure and higher rates of tobacco, alcohol and drug use, particularly within disadvantaged neighborhoods and minority populations (Shonkoff et al., 2012). Not only are low status individuals more prone to chronic stressors and the resultant physiological

stress burden, but disparities in the methods used by different groups to cope with stress contribute to health disparities over the life course (Jackson et al., 2010; Shonkoff et al., 2012). While this body of research highlights that disadvantaged populations may engage in negative health behaviors to cope with stress in the absence of more positive coping resources, the ways in which these populations may cope with stress in the absence of alcohol, tobacco or other negative resources has yet to be fully explored.

Rural Alaska

A large and growing body of research focuses on the negative health impacts of living in disadvantaged urban environments. However, the relationship between stress and environmental context on health behaviors is largely understudied in the rural context. Analyzing rural Alaska provides an interesting and important context in which to expand this exploration of stress, behaviors and health. Particularly in the case of alcohol and tobacco use during pregnancy, the extreme geographic isolation of many rural Alaskan communities from health care services may have potentially large impacts on women's access to information regarding health risks and cessation techniques for these behaviors. Further, differential exposure to alcohol in rural Alaskan communities stemming from community-level restrictions on the sale, importation or possession of alcohol poses an interesting analysis into the ways women, particularly disadvantaged women, cope with stress with limited access to alcohol.

The rural Alaskan context is entirely unique compared to rural areas in the continual United States composed of other American Indian groups. At the state level, Alaska has the lowest population density of any state in the nation with 1.2 people per square mile (Hudson, 2011). In addition to low density, about 28% of Alaskan residents live in communities in "roadless" areas, in which travel to urban centers is limited to travel by airplane, boat or snowmachine/snowmobile (Alaska Department of Health and Social Services, 2001; Niven, 2007). This makes travel to health centers for information, services, preventive care or emergencies difficult and expensive, especially in times of severe weather when isolated citizens may be stranded (Alaska Department of Health and Social Services, 2001). Traveling between roadless villages can often take several days, greatly increasing cost and decreasing access to health care services (Thurman et al., 2004). As a result, severe

geographic isolation limits access to health information and key services for rural Alaskan women.

In addition to access to health services and information, limited exposure to alcohol in rural Alaskan communities makes the study of the impact of stress on negative health behaviors in Alaskan communities particularly important. Many communities in Alaska, known as "local option communities", have limited or banned the sale, importation or possession of alcohol (Alcoholic Beverage Control Board, 2013). Research assessing the impact of exposure to alcohol, largely among underage populations, indicates limited exposure through restrictions on alcohol retail outlets decreases alcohol use and binge drinking behavior (Dent et al., 2005; Holder, 2002). As such, these local option communities provide an interesting opportunity to analyze how disadvantaged populations cope with stress when negative health resources are limited or banned. A map of local option communities in Alaska is shown in Figure 1.

Substance Use Among Alaska Native Women During Pregnancy

Alaska Native women compose a vulnerable population for which it is important to study the role of stress and context on negative health behaviors during pregnancy. The state of Alaska has one of the highest rates of problems associated with alcohol abuse in the country (Bearman and Leask, 1994). Alaska Natives have disproportionally high rates of alcohol abuse, and a study (1995) found the majority of Alaska Native respondents believe their village has problems with alcohol (Alaska State Office of Alcoholism and Drug Abuse, 1988; UAA Justice Center, 1995). With elevated rates of alcohol use among the Alaska Native population, it is somewhat surprising that for live births occurring during 2007-2008, Alaska Native women reported lower rates of alcohol use in the last three months of pregnancy than did non-Native women, at 3.5 percent and 6.3 percent, respectively (Young et al., 2011). A factor possibly influencing alcohol use rates during pregnancy for Alaska Native women is limited exposure to alcohol for women in local option communities. As of August, 2013, there are 80 local option communities in Alaska limiting the sale, importation or possession of alcohol in some form (Alcoholic Beverage Control Board, 2013), and residents of local option communities tend to be overwhelming Alaskan Native (97.6% of women in weighted

PRAMS sample residing in local option communities in this study are Alaskan Native).

Less affected by community-level restrictions, reported rates of tobacco use are considerably higher for Alaska Native compared to non-Native women in Alaska (Kim et al., 2009; Kim et al., 2010; Patten, 2012). Previous studies have found that the prevalence of tobacco use among Alaska Native women is two- to three-times higher than that of White women, before, during and after pregnancy (Kim et al, 2010). Alaska Natives start smoking at younger ages than non-Natives (Lanier et al., 1990), and Alaska Native women are less likely to quit smoking and more likely to relapse after quitting attempts than their White counterparts (Kim et al., 2010). Data from the Alaska PRAMS (2007-2008) indicate that 30.5% of Alaska Native women smoke cigarettes during their last trimester of pregnancy compared to 10.2% of non-Native women (Young et al., 2011). The elevated rates of tobacco use among Alaska Native women before, during and after pregnancy is concerning for the maternal, fetal and child health of this population (Andres and Day, 2000).

Another feature unique to the rural Alaskan and Alaska Native context is the use of "iqmik", a traditional smokeless tobacco product made from a mixture of dried tobacco leaves and a fungus (*phellinus igniarius*) ash that is chewed in the mouth (Blanchette et al., 2002; Kim et al., 2009; Wolsko et al., 2009). Also known as "blackbull", iqmik often contains much larger quantities of nicotine than do traditional cigarettes (Blanchette et al., 2002). As a result, there is heightened exposure to nicotine to both mother and fetus resulting from iqmik use than from cigarettes or other tobacco products (Patten, 2012; Patten et al., 2008). Despite these risks, the negative health effects of iqmik are not well understood. In many rural Alaskan communities, iqmik is believed to be safer during pregnancy than cigarettes as it is seen as more "natural" (Blachette et al., 2002; Patten, 2012; Patten et al., 2008). Many women who smoke cigarettes before pregnancy switch to iqmik after discovering they are pregnant, viewing it as a healthier alternative (Blanchette et al., 2002). The case of iqmik highlights the importance and need for access to accurate health information services for Alaska Native women during pregnancy.

The view that iqmik is a healthier alternative to cigarettes aligns with the finding that cultural norms and beliefs heavily influence tobacco choices within Alaska Native communities (Wolsko et al., 2009). Among Alaska Natives who engage in tobacco use, individuals

more strongly connected to their Alaskan Native identities are more likely to use smokeless tobacco products, including iqmik, compared to Alaska Natives more acculturated with mainstream society (Wolkso et al., 2009). In these populations, chewing tobacco is seen as more closely tied to the gathering of food and medicine endemic to subsistence living (Wolsko et al., 2009). As a result, it must be understood that the use of chewing tobacco and iqmik among Alaska Native populations is not only influenced by accurate knowledge of health risks, but by cultural norms and beliefs. As such, how culture impacts tobacco use behavior within the context of pregnancy requires further examination.

Despite elevated levels rates of alcohol and tobacco use during pregnancy among Alaska Native women, few studies have assessed the role of stress, access to health care services, and exposure to alcohol based upon living in a local option community on negative health behaviors during pregnancy. This is an important contribution for understanding stress in disadvantaged populations as it highlights the ways stress impacts health behaviors in environmental contexts previously unexplored in the literature. While previous studies have largely examined how stress impacts behaviors among disadvantaged populations in the urban context, this study is the first to examine the intersections of race, place and stress when access to health care services and exposure to some negative health resources are severely limited.

Expectations

In this study, I use forms of the generalized linear model to assess the relationship of stress, health care service (referred to as "service" in this analysis) and alcohol exposure (referred to as "exposure" in this analysis) with alcohol and tobacco use during pregnancy when demographic characteristics are controlled. Given the impact of stress on alcohol and tobacco use behaviors found in previous studies, I first expect stress to be associated with alcohol and tobacco use rates for women in my sample. Second, given the impact of community context on health behaviors and outcomes outlined in the literature, I expect living in a rural or local option community to be associated with alcohol and tobacco use behaviors. Third, as previous work has emphasized the role of community context on differences in both stress exposure and stress coping behaviors, I expect the size of the

stress coefficients to be lessened with features of the environmental context are controlled. Lastly, due to the interactive nature of demographic and contextual characteristics with the experience of stress found in previous studies, I anticipate interactions between stress with race, service and exposure may be important processes that drive substance use during pregnancy.

Methodology

Data come from Phases V (2004-2008) and VI (2009-2011) of the Alaska Pregnancy Risk Assessment Monitoring System (PRAMS) dataset developed by the Centers for Disease Control (CDC) and conducted by the State of Alaska Division of Public Health, Section of Maternal, Child and Family Health. Approximately one of every six mothers of newborn children in Alaska is selected to participate in PRAMS through random selection of birth records collected by the Bureau of Vital Statistics two to six months following delivery. The primary method of data collection is by mail with multiple contact attempts. Women are sent personalized mailing packages including a preletter, three survey mailings, and a reminder and thank you note sent between the first and second mailings of the survey (Shulman et al., 2006). Telephone contact is utilized for nonresponders to the mailed survey one to two weeks following the mailing of the last survey package (Shulman et al., 2006).

PRAMS includes questions about feelings surrounding pregnancy, use of prenatal care and health behaviors before, during and after pregnancy. Birth certificate data were linked for women in the PRAMS sample by the State of Alaska Division of Public Health. Birth certificate data include additional demographic and geographic indicators. The final sample included 6,971 observations from Phase V and 3,549 observations from Phase VI, totaling 10,520 observations (85,051 weighted). The University of Washington Minimal Risk Subcommittee EC deemed this research to not meet the federal regulatory definition of "human subjects" research under 45 CFR 46.102(f) so did not require review by the Institutional Review Board (IRB).

Measures

Demographic Variables

Assessment of maternal race is taken from birth certificate data and is coded as (1) Alaska Native, (2) White or (3) Other race. Income is reported as total household income (before taxes) during the twelve months prior to the birth of their baby and is grouped as (1) less than $10,000, (2) $10,000 to $24,999, (3) $25,000 to $49,999 and (4) $50,000 or more. Maternal age is taken from birth certificate data at the time of baby's birth. Maternal age is grouped as (1) 19 years and younger, (2) 20 to 24 years, (3) 25 to 29 years, (4) 30 to 34 years and (5) 35 years and older.

Pregnancy Indicators

Weeks at first prenatal care visit is assessed by the reported number of weeks or months the respondent was pregnant when she first had a prenatal care visit. For respondents reporting in months, the value was multiplied by four to approximate the number of weeks pregnant. This indicator is included in analyses to control for variation in timing of when women received confirmation of their pregnancy in order to glean a better understanding of behaviors in relationship to knowledge of pregnancy. Trying to get pregnant is assessed as respondents reporting they were trying to get pregnant at the time of this pregnancy. This indicator is included to control for possible changes in substance use behavior prior to becoming pregnant in anticipation of pregnancy.

Stress

Stress was measured as a count of number of stressful life events experienced by the respondent during the twelve months prior to the birth of their baby. The stressors included in the PRAMS questionnaires derive from a scale developed by Holmes and Rahe (1967) that has been extensively validated for use of assessment of psychological distress in association with health outcomes (See Table A1 of the Appendix for full list of stressors) (Holmes and Rahe, 1967). Counts of stressors were grouped into the following categories: (1) No stress, (2) 1-3 stressors and (3) 4+ stressors (cut at 75^{th} percentile of stress count distribution).

Service

Residence in a rural or urban community is used as a proxy for access to health care services and information. In the PRAMS data, urban communities refer to the following boroughs: Anchorage, Fairbanks, Juneau, Ketchikan, Matanuska-Susitna and Sitka (72.2% of weighted PRAMS sample reside in urban communities). Rural communities constitute all other boroughs or census areas.

Exposure

Exposure to alcohol is assessed by whether or not the respondent resided in a local option community at the time of birth. Following methodology utilized by Perham-Hester and Gessner (1997), zip code of residence was taken from birth certificate data and linked to zip codes of local option communities (Alcoholic Beverage Control Board, 2013). This was performed by the State of Alaska Division of Public Health. The community was considered as local option if there had been a ban on the sale, possession or importation of alcohol for at least one year during the phase of data collection for the mothers included in the survey (Perham-Hester and Gessner, 1997). For Phase V, that is at least any one year during 2004-2008, and for Phase VI, any one year during 2009-2011.

Alcohol Use

Measures of alcohol use in this study include (1) any alcohol consumption and (2) any binge drinking during the last three months of pregnancy. A respondent was coded as having "any alcohol use" if she reported the number of drinks consumed per week during the last three months of pregnancy as being greater than zero. A woman was coded as having "any binge drinking" behavior if she reported the number of times she had "5 or more" (Phase V) or "4 or more" (Phase VI) alcoholic drinks in one sitting during the last three months of pregnancy as being greater than zero. The variation in the number of alcoholic drinks consumed in one sitting assessed as binge drinking reflects changes to the PRAMS questionnaire after Phase V of data collection following updated gender-specific national guidelines for binge drinking thresholds (Chavez et al., 2011). A benefit of assessing alcohol use behavior during the last

three months of pregnancy is that most women are knowledgeable of their pregnancy at this time (94.4% of women in weighted PRAMS sample received prenatal care by 26 weeks of gestation), providing a more salient analysis of behavior in relationship to knowledge of pregnancy. Reporting any alcohol consumption in the twelve months prior to pregnancy is included as a covariate in analyses in order to control for variation in alcohol use before women became pregnant.

Tobacco Use

Measures of tobacco use in this study include (1) any cigarette smoking during the last three months of pregnancy, (2) any chewing tobacco, spit or snuff use during pregnancy and (3) any iqmik, blackbull or ash use during pregnancy. A woman was coded as having "any cigarette use" if she reported the number of cigarettes smoked per week during the last three months of pregnancy as being greater than zero. Reporting any cigarette smoking in the twelve months prior to pregnancy is included as a covariate in analyses for cigarette smoking in order to control for variation in smoking behavior before women became pregnant. A woman was coded as having "any chewing tobacco, spit or snuff use" if she reported ever using "spit tobacco, chew, or snuff" (Phase V) or "chewing tobacco or snuff" (Phase VI) during her pregnancy. A woman was coded as having "any iqmik, blackbull or ash use" if she reported ever using "a mixture of ash and tobacco, sometimes known as iqmik or blackbull" (Phase VI) or "iqmik or blackbull" (Phase V) during her pregnancy. The variation in wording for the smokeless tobacco measures between the two phases reflects wording changes in the PRAMS questionnaire following Phase V of data collection. The timeframe used for the smokeless tobacco measures of at any time during pregnancy is driven by the PRAMS survey data.

Analyses

Forms of the generalized linear model were used to assess the relationships between demographic characteristics, stress, service and exposure with alcohol and tobacco use during pregnancy. Predicted probabilities were computed from final models to assess the differential magnitudes of the stress coefficients on substance use for women with different demographic

characteristics and contexts. Data management, sample weighting and statistical analyses were conducted in Stata. Sample weights were applied using Stata's svyset command following CDC guidelines. Descriptive statistics are weighted and multivariate models are not weighted due to controlling for PRAMS weighting factors within the models.

Results

The weighted and unweighted demographic characteristics of the PRAMS 2004-2011 data are reported in Table 1. The weighted PRAMS sample was 62.8% White, 25.3% Alaska Native and 11.9% women of another race. 27.8% of women reside in a rural community and 6.4% reside in a local option community. The distribution of maternal age in the sample was 9.9% 19 years and under, 28.0% 20-24 years, 29.9% 25-29 years, 20.4% 30-34 years and 11.8% 35 and over. The count of stressors (grouped) experienced by the women during the twelve months prior to the birth of their baby was 28.3% experiencing no stressors, 53.3% experiencing 1-3 stressors and 18.4% experiencing 4+ stressors.

Table 2 provides the average number of stressful events experienced by women in the sample during twelve months before the birth of their baby, and the percent of women reporting substance use behaviors during pregnancy by race, service and exposure. The average number of stressful events experienced by all women in the sample was 1.9 stressors. Alaska Native women, on average, experience more stressors than do White women or women of other races (2.1, 1.7 and 1.9 stressors, respectively), and the differences between these racial groups as statistically significant ($p<0.001$). The average number of stressors is slightly higher for women in urban settings than in rural settings (1.9 and 1.7 events, respectively; $p<0.001$) and higher in non-local option communities than in local option communities (1.9 and 1.7 events, respectively; $p=0.005$). White women reported higher rates of any alcohol use compared to Alaska Native and women of other races (8.3%, 6.2% and 7.7%, respectively; $p=0.02$). Alaska Native women reported higher rates of binge drinking compared to Whites (4.1% and 1.4%, respectively), although slightly lower than women of other races (4.6%), and the differences between these groups are statistically significant ($p<0.001$). Alaska Native women reported the highest rates of use for all tobacco products and the differences between racial groups for all tobacco products were statistically signifi-

cant ($p<0.001$ for all tobacco products).

Women in urban areas report higher rates of any alcohol use compared to women in urban areas (7.9% and 7.1%, respectively), although the difference is not statistically significant ($p=0.34$). However, women in rural areas report higher rates of binge drinking (3.8%; $p=0.002$), cigarette smoking (54.3%; $p<0.001$), spit, chew or snuff use (10.6%; $p<0.001$) and iqmik, blackbull or ash use (18.2%; $p<0.001$) than do women in urban areas (4.6%, 46.8%, 0.3% and 0.95, respectively). Women in local option communities report higher rates of use for all alcohol and tobacco measures compared to women in non-local option communities and the differences between these groups are statistically significant for binge drinking ($p<0.001$), cigarette smoking ($p<0.001$), spit, chew or snuff use ($p<0.001$) and iqmik, blackbull or ash use ($p<0.001$).

Table 3 presents results from generalized linear models assessing the change in log odds of reporting any alcohol use during the last three months of pregnancy. In Model 1, using Wald's test, stress (included as dummy variables of 1-3 stressors and 4+ stressors against referent category of no stressors) was not found to have a significant relationship with alcohol use ($p=0.35$) when basic demographic characteristics and features of pregnancy care and drinking behavior are controlled. Individuals experiencing moderate levels of stress (1-3 stressors) have slightly lower odds of alcohol use compared to those reporting no stress. However, individuals experiencing high levels of stress (4+ stressors) experience higher odds of alcohol use compared to those reporting no stress. However, these differences are not significant ($p=0.78$ and $p=0.32$, respectively).

In Model 2, the context variables of service and exposure were added to Model 1, and found to be non-significantly associated with alcohol use ($p=0.36$). Individuals living in rural settings have slightly lower odds of alcohol use compared to those in urban settings, while those in local option communities have higher odds of alcohol use. However, these differences are not significant ($p=0.56$ and $p=0.16$, respectively), and the size of the stress coefficients do not change when controlling for context. Interactions of Stress X Race, Stress X Service and Stress X Exposure were added independently to Model 2. The interaction terms were not significantly associated with alcohol use ($p=0.71$, $p=0.28$ and $p=0.90$, respectively) so were not added for subsequent analysis.

Table 4 presents results from models examining the change in log odds of reporting any binge drinking during the last three months of pregnancy. In Model 1, stress was not found to be significantly associated with binge drinking (p=0.21). Individuals experiencing moderate levels of stress (1-3 stressors) have slightly lower odds of binge drinking, while individuals experiencing high levels of stress (4+ stressors) have higher odds of binge drinking compared to those reporting no stress. However, these differences are not significant (p=0.69 and p=0.31, respectively).

In Model 2, context was found to be significantly associated with binge drinking (p=0.0004). Individuals living in rural settings have higher odds of binge drinking compared to those in urban settings, although this difference is not significant (p=0.20). Individuals living in local option communities were found to have significantly higher odds of binge drinking (β =1.2; p=0.001). The size of the coefficient of experiencing high levels of stress (4+ stressors) on binge drinking compared to no stress slightly increases when context is controlled. Interactions of Stress X Race, Stress X Service and Stress X Exposure were added independently to Model 2. The interaction terms were not significantly associated with binge drinking (p=0.99, p=0.24 and p=0.20, respectively) so were not added for subsequent analysis.

Table 5 presents results from models examining the change in log odds of reporting any cigarette smoking during the last three months of pregnancy. In Model 1, stress was found to be significantly associated with increased odds of cigarette smoking (p<0.001). In Model 2, context was found to be significantly associated with cigarette smoking (p=0.03). Individuals living in rural settings have significantly higher odds of cigarette smoking compared to those in urban settings (β =0.2; p=0.04). Individuals living in local option communities were found to have higher odds of cigarette smoking, although this difference is not significant (p=0.39). The size of the stress coefficients on cigarette smoking were not affected by controlling for context. Interactions of Stress X Race, Stress X Service and Stress X Exposure were added independently to Model 2. The interaction terms were not significantly associated with cigarette smoking (p=0.40, p=0.053 and p=0.13, respectively) so were not added for subsequent analysis.

Table 6 presents results from models examining the change in log odds of reporting

any spit tobacco, chewing tobacco or snuff use at all during pregnancy. In Model 1, individuals with higher levels of stress have lower odds of use, although the association of stress with use is not significant (p=0.25). In Model 2, context was found to be significantly associated with spit, chew, or snuff use (p<0.001). Individuals living in rural settings have significantly higher odds of use compared to those in urban settings (β =1.43; p<0.001). Individuals living in local option communities also have higher odds of use, although this difference is not significant (p=0.46). The size of the coefficient of experiencing high levels of stress (4+ stressors) on the odds of spit, chew or snuff use (compared to the referent category of no stress) decreases when context is controlled. Further, the size and direction of the coefficient of experiencing moderate stress (1-3 stressors) on the odds of spit, chew or snuff use (compared to the referent category of no stress) changes when controlling for context. Interactions of Stress X Race, Stress X Service and Stress X Exposure were added independently to Model 2. The interaction terms were not significantly associated with use (p=0.93, p=0.09 and p=0.14, respectively) so were not added for subsequent analysis.

Table 7 presents results from models examining the change in log odds of reporting any iqmik, blackbull or ash use at all during pregnancy. In Model 1, Alaska Natives have significantly higher odds of use compared to Whites (β =3.33; p<0.001). Individuals with higher levels of stress have significantly lower odds of use (p=0.0002). In Model 2, context was found to be significantly associated with iqmik, blackbull or ash use (p<0.001). Individuals living in rural settings and those living in local option communities have significantly higher odds of use compared to those in urban or non-local option communities (β =1.83; p<0.001 and β =0.8; p<0.001, respectively). The size of the stress coefficients on the odds of iqmik, black or snuff use decrease when context is controlled.

Interactions of Stress X Race, Stress X Service and Stress X Exposure were added independently to Model 2. The interaction terms of Stress X Service and Stress X Exposure were found to be non-significantly associated with iqmik, black or snuff use (p=0.65 and p=0.09, respectively). The interaction term of Stress X Race was found to be significantly associated with use (p<0.001), potentially indicating the relationship between stress and iqmik, black or snuff use operates differently for individuals based upon their race. However, BIC scores indicate the additive model is preferred (BIC=1874 for additive model;

BIC=1888 for interactive model), so Model 2 is presented as the final model in this study.

To understand how context alters the size of the stress coefficients on the odds of substance use for this population, I generated predicted probabilities of substance use from Model 2 for all outcomes when race, service and exposure variables are held constant to (1) White, urban, and non-local option and (2) Alaska Native, rural, and local option (all other variables held at means). The results from one outcome, binge drinking, are presented as an example. Figure 2 shows the predicted probability of any reported binge drinking during the last three months of pregnancy by level of stress. Particularly, there is a sizeable increase in predicted probability of binge drinking for individuals experiencing high levels of stress (4+ stressors) compared to those with no stress or moderate levels of stress (1-3 stressors). Further, the magnitude of this increase is much larger for Alaska Native, rural and local option individuals than it is for White, urban and non-local option individuals. The figure indicates that the greatest increase in probability of binge drinking occur for individuals most at risk, both in terms of cumulative stress burden and membership in a disadvantaged context and population.

Discussion

In this article, I argue stress and the contextual features of service and exposure may be important indicators of alcohol and tobacco use behaviors during pregnancy. Results from this study show that experiencing high levels of stress (4+ stressors) is related to higher odds of alcohol use, binge drinking and cigarette smoking during pregnancy compared to experiencing no stress. This finding is consistent with other research finding a positive influence of stress experience on substance use behaviors, even when demographic characteristics are controlled.

Surprisingly, the results associating stress with smokeless tobacco use (spit, chew or snuff use and iqmik, blackbull or ash use) found in this study indicate that women experiencing high levels of stress (4+ stressors) have lower odds of use than do women experiencing no stress. While not analyzed in this study, this unexpected finding may result from the cultural significance of smokeless tobacco products in Alaska Native communities (Wolsko et al., 2009). As individuals more strongly connected to their culture and community may

have greater access to social support resources to call upon in times of need (Yali and Lobel, 2002), the relationship between smokeless tobacco products and culture in this population may dampen the possible association between stressful life experiences and use of these tobacco products as stress coping mechanisms. This highlights the importance of analyzing the roles of stress and cultural context on substance use behaviors during pregnancy among rural and indigenous populations, particularly to understand how the pathways and factors relating stress and substance use differ for these populations.

Environmental context was found to be significantly associated with binge drinking and tobacco use behavior during pregnancy, even when demographic characteristics and experiences of stress are controlled. Particularly, the odds of binge drinking and tobacco use are higher for individuals in rural settings compared to those in urban settings. While much work has been done to assess the role of context on substance use behaviors in the urban context, this study sheds light into the importance of analyzing the impact of the rural context on alcohol and tobacco use behaviors during pregnancy.

The importance of studying context on substance use behaviors is also highlighted by the finding that for binge drinking, spit, chew or snuff use and iqmik, blackbull or ash use, the size of the stress coefficients, particularly for high levels of stress, were dampened when context was controlled. As these three behaviors have much higher prevalence among rural and indigenous populations, the mechanisms linking context to these substance use behaviors during pregnancy for these vulnerable populations needs further research.

Given that alcohol and tobacco use behaviors during pregnancy have negative health effects for mother and fetus, continued work assessing the roles of stress and contextual factors contributing to these behaviors during pregnancy is fundamental for public health research and interventions to improve maternal and child health among rural and indigenous populations.

Limitations

A limitation of this analysis includes the inability to capture the true spatial dimension of access to health care services. Utilizing residence in a rural or urban community as a proxy for health care access conceals the heterogeneity of access within these two contexts. Future

research is necessary to understand the impact of geographic isolation and limited access to health care services on alcohol and tobacco use behaviors during pregnancy among rural and indigenous populations. Another limitation includes inability to assess timing of use for smokeless tobacco products during pregnancy. Since the PRAMS questionnaires only collect data on spit, chew or snuff use and iqmik, blackbull or ash use at any time during pregnancy, it is unclear if women in the study only used smokeless tobacco products before they learned they were pregnant. Lastly, the cross-sectional design of this study limits the ability to assess any causal relationships between experiences of stress, access to health care services and alcohol exposure on subsequent substance use behaviors.

Tables and Figures

Table 1: Descriptive Statistics for Women in the 2004-2011 PRAMS Sample

	Weighted (%)	Unweighted (%)
n	85,051	10,520
Race		
White	62.8	39.4
Alaska Native	25.3	49.3
Other	11.9	11.3
Service		
Rural	27.8	31.9
Urban	72.2	68.1
Exposure		
Local Option Community	6.4	8.6
Non-Local Option Community	93.6	91.4
Maternal Age		
19 and under	9.9	10.5
24 to 25	28	28.3
25 to 29	29.9	28.2
30 to 34	20.4	20.1
35 and over	11.8	12.9
Number of stressors		
0	28.3	27.6
1−3	53.3	52.8
4+	18.4	19.6

Table 2: Average Number of Stressors and Percent of Women Reporting any Alcohol or Tobacco Use during Pregnancy by Race, Service and Exposure in the 2004-2011 PRAMS Sample

		Race				Service			Exposure		
	All	White	AN	Other	p-value	Urban	Rural	p-value	Non-LOC	LOC	p-value
Stressors[1]	1.9	1.7	2.1	1.9	<.001	1.9	1.7	<.001	1.9	1.7	<.01
Alcohol											
Any Alcohol Use[2]	7.8	8.3	6.2	7.7	<.05	7.9	7.1		14.4	33.3	
Binge Drinking[2]	2.3	1.4	4.1	4.6	<.001	1.7	3.8	<.01	7.7	9.1	<.001
Tobacco											
Cigarettes[2]	46.6	41.2	56.2	46.8	<.001	42.7	54.3	<.001	1.9	14.6	<.001
Spit, Chew, or Snuff	3.6	0.5	11.9	0.3	<.001	0.7	10.6	<.001	2.7	19.5	<.001
Iqmik, Blackbull or Ash	5.9	2.6	21	0.9	<.001	0.8	18.2	<.001	3.7	44.8	<.001

[1]Average number of stressful events experienced during twelve months before birth of baby.
[2]Last three months of pregnancy.

Table 3: Generalized Linear Models: Change in Log Odds of Any Reported Alcohol Use during Last Three Months of Pregnancy in 2004-2011 PRAMS

	Model 1	Model 2
n	5645	5634
(Intercept)	-3.34	-3.33
Race (White = referent)		
Alaska Native	-0.19 (-0.44, 0.05)	-0.23 (-0.51, 0.05)
Other	-0.22 (-0.63, 0.2)	-0.22 (-0.64, 0.19)
Maternal Age (20 to 24 = referent)		
19 and under	-0.35 (-0.97, 0.26)	-0.34 (-0.96, 0.27)
25 to 29	0.48 (0.16, 0.79)**	0.47 (0.15, 0.79)**
30 to 34	0.91 (0.58, 1.24)***	0.91 (0.58, 1.24)***
35 and over	0.99 (0.62, 1.35)***	0.99 (0.62, 1.35)***
Income ($25,000 to $49,999 = referent)		
Under $10,000	0.65 (0.29, 1.02)***	0.64 (0.27, 1.01)***
$10,000 to $24,999	0.28 (-0.06, 0.61)	0.28 (-0.06, 0.61)
$50,000 and over	0.36 (0.05, 0.68)*	0.36 (0.05, 0.68)*
Maternal Education (12 years = referent)		
Less than 12 years	-0.03 (-0.42, 0.37)	-0.03 (-0.42, 0.37)
13 to 15 years	-0.37 (-0.67, -0.08)*	-0.37 (-0.67, -0.07)*
16 years or more	0.22 (-0.07, 0.52)	0.23 (-0.07, 0.53)
Weeks at first prenatal care visit	0.01 (-0.01, 0.04)	0.01 (-0.01, 0.04)
Trying to get pregnant	-0.21 (-0.44, 0.02)	-0.2 (-0.44, 0.03)
Drank at all 12 months before pregnancy	0	0
Number of stressors (None = referent)		
1−3	-0.04 (-0.29, 0.22)	-0.03 (-0.29, 0.22)
4+	0.17 (-0.16, 0.51)	0.18 (-0.16, 0.51)
Rural		-0.08 (-0.37, 0.2)
Local Option Community		0.35 (-0.13, 0.84)
BIC	2901	2914

*p $\leq$ .05, **p $\leq$ .01, ***p $\leq$ .001

Table 4: Generalized Linear Models: Change in Log Odds of Any Reported Binge Drinking during Last Three Months of Pregnancy in 2004-2011 PRAMS

	Model 1	Model 2
n	3835	3828
(Intercept)	-5.21	-5.34
Race (White = referent)		
Alaska Native	0.73 (0.2, 1.26)**	0.36 (-0.25, 0.98)
Other	0.79 (-0.07, 1.66)	0.83 (-0.04, 1.69)
Maternal Age (20 to 24 = referent)		
19 and under	-0.43 (-1.49, 0.63)	-0.34 (-1.39, 0.71)
25 to 29	0.45 (-0.22, 1.13)	0.49 (-0.19, 1.17)
30 to 34	1.38 (0.7, 2.05)***	1.35 (0.66, 2.03)***
35 and over	1.14 (0.3, 1.98)**	1.11 (0.26, 1.97)*
Income ($25,000 to $49,999 = referent)		
Under $10,000	0.96 (0.26, 1.66)**	0.88 (0.17, 1.59)*
$10,000 to $24,999	0.12 (-0.61, 0.86)	0.07 (-0.65, 0.8)
$50,000 and over	-0.11 (-0.89, 0.66)	-0.08 (-0.86, 0.7)
Maternal Education (12 years = referent)		
Less than 12 years	0.83 (0.23, 1.42)**	0.78 (0.19, 1.38)**
13 to 15 years	-0.51 (-1.2, 0.18)	-0.43 (-1.12, 0.26)
16 years or more	-1.19 (-2.22, -0.16)*	-1.15 (-2.18, -0.12)*
Weeks at first prenatal care visit	0 (-0.05, 0.05)	0 (-0.05, 0.05)
Trying to get pregnant	0.17 (-0.32, 0.66)	0.18 (-0.32, 0.67)
Drank at all 12 months before pregnancy	0	0
Number of stressors (None = referent)		
1−3	-0.13 (-0.77, 0.51)	-0.08 (-0.73, 0.56)
4+	0.36 (-0.34, 1.05)	0.49 (-0.21, 1.2)
Rural		0.37 (-0.2, 0.94)
Local Option Community		1.2 (0.47, 1.92)***
BIC	798	799

*p $\leq$ .05, **p $\leq$ .01, ***p $\leq$ .001

Table 5: Generalized Linear Models: Change in Log Odds of Any Reported Cigarette Smoking during Last Three Months of Pregnancy in 2004-2011 PRAMS

	Model 1	Model 2
n	2898	2894
(Intercept)	-0.66	-0.71
Race (White = referent)		
Alaska Native	0.17 (0, 0.35)	0.07 (-0.12, 0.26)
Other	-0.59 (-0.92, -0.26)***	-0.58 (-0.91, -0.24)***
Maternal Age (20 to 24 = referent)		
19 and under	-0.46 (-0.72, -0.19)***	-0.47 (-0.74, -0.21)***
25 to 29	0.45 (0.25, 0.65)***	0.45 (0.25, 0.65)***
30 to 34	0.66 (0.42, 0.9)***	0.66 (0.41, 0.9)***
35 and over	1.05 (0.72, 1.38)***	1.03 (0.7, 1.36)***
Income ($25,000 to $49,999 = referent)		
Under $10,000	0.44 (0.22, 0.67)***	0.42 (0.2, 0.65)***
$10,000 to $24,999	0.17 (-0.04, 0.39)	0.18 (-0.04, 0.39)
$50,000 and over	-0.35 (-0.6, -0.1)**	-0.36 (-0.61, -0.11)**
Maternal Education (12 years = referent)		
Less than 12 years	0.57 (0.35, 0.78)***	0.57 (0.36, 0.79)***
13 to 15 years	-0.61 (-0.82, -0.4)***	-0.58 (-0.79, -0.37)***
16 years or more	-1.1 (-1.5, -0.71)***	-1.08 (-1.47, -0.68)***
Weeks at first prenatal care visit	0.03 (0.01, 0.04)***	0.03 (0.01, 0.04)***
Trying to get pregnant	-0.27 (-0.43, -0.11)***	-0.28 (-0.45, -0.12)
Smoked at all 12 months before pregnancy	0	0
Number of stressors (None = referent)		
1−3	0.05 (-0.16, 0.26)	0.08 (-0.14, 0.29)
4+	0.46 (0.22, 0.69)***	0.5 (0.26, 0.75)***
Rural		0.2 (0.01, 0.4)*
Local Option Community		0.13 (-0.16, 0.41)
BIC	3808	3812

*p ≤ .05, **p ≤ .01, ***p ≤ .001

Table 6: Generalized Linear Models: Change in Log Odds of Any Reported Spit, Chew or Snuff Use during Last Three Months of Pregnancy in 2004-2011 PRAMS

	Model 1	Model 2
n	5394	5382
(Intercept)	-5.82	-6.36
Race (White = referent)		
Alaska Native	3.04 (2.38, 3.7)***	2.47 (1.78, 3.16)***
Other	-0.88 (-2.95, 1.18)	-0.7 (-2.77, 1.37)
Maternal Age (20 to 24 = referent)		
19 and under	0.23 (-0.25, 0.71)	0.21 (-0.27, 0.69)
25 to 29	0.34 (-0.06, 0.75)	0.3 (-0.11, 0.71)
30 to 34	0.94 (0.52, 1.36)***	0.82 (0.39, 1.25)***
35 and over	0.92 (0.44, 1.4)***	0.79 (0.29, 1.29)**
Income ($25,000 to $49,999 = referent)		
Under $10,000	0.99 (0.54, 1.43)***	0.84 (0.39, 1.29)***
$10,000 to $24,999	0.5 (0.04, 0.96)*	0.45 (-0.01, 0.92)
$50,000 and over	-0.78 (-1.44, -0.13)*	-0.69 (-1.35, -0.03)*
Maternal Education (12 years = referent)		
Less than 12 years	-0.34 (-0.7, 0.02)	-0.32 (-0.68, 0.04)
13 to 15 years	-1.12 (-1.73, -0.51)***	-0.93 (-1.55, -0.31)**
16 years or more	-0.18 (-0.87, 0.5)	0.15 (-0.57, 0.87)
Weeks at first prenatal care visit	0.01 (-0.02, 0.03)	0 (-0.03, 0.03)
Trying to get pregnant	-0.05 (-0.35, 0.24)	-0.09 (-0.39, 0.22)
Number of stressors (None = referent)		
1−3	-0.07 (-0.4, 0.27)	0.05 (-0.29, 0.4)
4+	-0.34 (-0.75, 0.08)	0 (-0.44, 0.43)
Rural		1.43 (1, 1.87)***
Local Option Community		0.13 (-0.22, 0.49)
BIC	1574	1528

*p $\leq$ .05, **p $\leq$ .01, ***p $\leq$ .001

Table 7: Generalized Linear Models: Change in Log Odds of Any Reported Iqmik, Blackbull or Ash Use during Last Three Months of Pregnancy in 2004-2011 PRAMS

	Model 1	Model 2
n	5421	5409
(Intercept)	-6.32	-7.1
Race (White = referent)		
Alaska Native	4.19 (3.31, 5.06)***	3.33 (2.45, 4.2)***
Other	1.23 (-0.02, 2.49)	1.44 (0.16, 2.72)*
Maternal Age (20 to 24 = referent)		
19 and under	-0.3 (-0.71, 0.11)	-0.37 (-0.78, 0.05)
25 to 29	0.49 (0.18, 0.79)**	0.47 (0.14, 0.79)**
30 to 34	0.78 (0.43, 1.13)***	0.67 (0.31, 1.03)***
35 and over	1.03 (0.62, 1.43)***	0.95 (0.52, 1.37)***
Income ($25,000 to $49,999 = referent)		
Under $10,000	0.67 (0.35, 1)***	0.49 (0.15, 0.83)**
$10,000 to $24,999	0.25 (-0.1, 0.59)	0.18 (-0.18, 0.53)
$50,000 and over	-1.17 (-1.74, -0.6)***	-1.07 (-1.65, -0.48)***
Maternal Education (12 years = referent)		
Less than 12 years	0.01 (-0.27, 0.29)	0.02 (-0.27, 0.32)
13 to 15 years	-0.63 (-1.04, -0.22)**	-0.32 (-0.74, 0.1)
16 years or more	-1.77 (-2.93, -0.6)**	-1.38 (-2.56, -0.2)*
Weeks at first prenatal care visit	0.04 (0.02, 0.06)***	0.03 (0.01, 0.05)***
Trying to get pregnant	-0.04 (-0.29, 0.2)	-0.07 (-0.32, 0.19)
Number of stressors (None = referent)		
1−3	-0.21 (-0.48, 0.05)	-0.04 (-0.32, 0.24)
4+	-0.7 (-1.03, -0.36)***	-0.29 (-0.65, 0.06)
Rural		1.83 (1.45, 2.21)***
Local Option Community		0.8 (0.51, 1.08)***
BIC	2042	1874

*p ≤ .05, **p ≤ .01, ***p ≤ .001

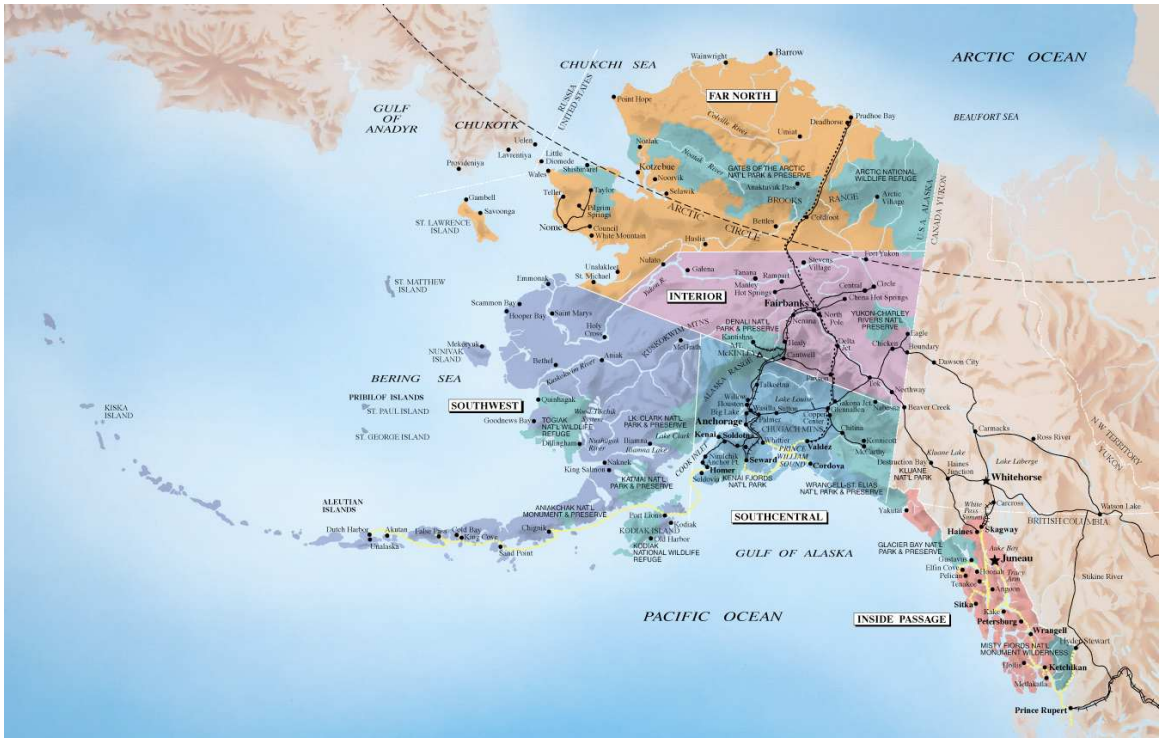

Figure 1: Map of Local Option Communities in Alaska.
Source: Alaska Department of Public Safety Alcoholic Beverage Control Board, 2013.

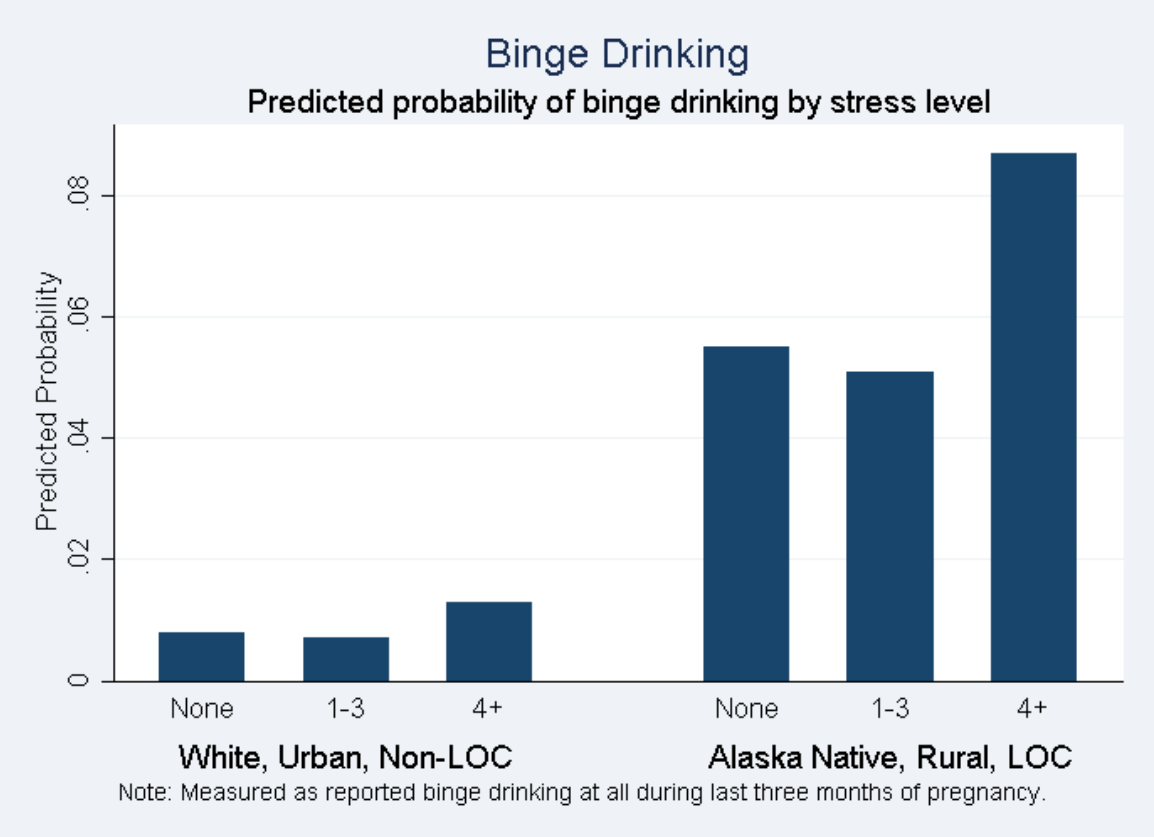

Figure 2: Predicted Probabilities of Binge Drinking during the Last Three Months of Pregnancy (from Model 2) by Number of Stressors for two levels of Race, Service and Exposure (other variables held at means).

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Native Tribal Health Consortium, Alaska Native Epidemiology Center.

Appendix

Table A1. List of Stressful Events Experienced during Twelve Months before Birth of Baby from 2004-2011 PRAMS

This question is about things that may have happened during the 12 months before your new baby was born. For each item, circle **Y** (Yes) if it happened to you or circle **N** (No) if it did not. (It may help to look at the calendar when you answer these questions.)			
		No	**Yes**
a	A close family member was very sick and had to go into the hospital	N	Y
b	I got separated or divorced from my husband or partner	N	Y
c	I moved to a new address	N	Y
d	I was homeless	N	Y
e	My husband or partner lost his job	N	Y
f	I lost my job even though I wanted to go on working	N	Y
g	I argued with my husband or partner more than usual	N	Y
h	My husband or partner said he didn't want me to be pregnant again	N	Y
i	I had a lot of bills I couldn't pay	N	Y
j	I was in a physical fight	N	Y
k	My husband or partner or I went to jail	N	Y
l	Someone very close to me had a problem with drinking or drugs	N	Y
m	Someone very close to me died	N	Y

Note: *Stress measured as count of 'Yes' responses.