2009

Gestational Risks and Psychiatric Disorders Among Indigenous Adolescents

Les B. Whitbeck
University of Nebraska-Lincoln, lwhitbeck2@unl.edu

Devan M. Crawford
University of Nebraska-Lincoln

Published in final edited form as:
Community Ment Health J. 2009 February ; 45(1): 62–72. doi:10.1007/s10597-008-9172-5.

Gestational Risks and Psychiatric Disorders Among Indigenous Adolescents

Les B. Whitbeck and
Department of Sociology, University of Nebraska-Lincoln, 739 Oldfather Hall, Lincoln, NE 68588-0324, USA e-mail: lwhitbeck2@unlnotes.unl.edu

Devan M. Crawford
Department of Sociology, University of Nebraska-Lincoln, 739 Oldfather Hall, Lincoln, NE 68588-0324, USA

Abstract

This study reports on the effects maternal prenatal binge drinking, cigarette smoking, drug use, and pregnancy and birth complications on meeting criteria for psychiatric disorders at ages 10–12 and 13–15 years among 546 Indigenous adolescents from a single culture in the northern Midwest and Canada. Adolescent DSM-IV psychiatric disorders were assessed with the Diagnostic Interview Schedule for Children-Revised (DISC-R). Results indicate that maternal behaviors when pregnant have significant effects on adolescent psychiatric disorders even when controlling for age and gender of adolescent, family per capita income, living in a single mother household, and adolescent reports of mother's positive parenting.

Keywords

Gestational risk; Psychiatric disorder; Indigenous adolescents; American Indian adolescents

There is a rapidly growing literature on the effects of prenatal exposure to alcohol, drugs, and cigarette smoking on child development. Recent longitudinal studies suggest that the effects of prenatal substance abuse reach into adolescence (Autti-Ramo 2000; Howell et al. 2006; Schonfield et al. 2005) and young adulthood (Streissguth 2007). Streissguth reports increased risk for substance use disorder, passive aggressive personality disorder, and antisocial personality disorder among young adults aged 25 years who were exposed to one or more binge alcohol episodes prenatally (Barr et al. 2006; Knopik et al. 2006). Adolescent behavioral effects such as attention deficit-hyperactivity disorder (Knopik et al. 2006; Lee et al. 2007; O'Malley and Nanson 2002) academic problems (Howell et al. 2006) and conduct problems (Autti-Ramo 2000; Nash et al. 2006) also have been documented even when potentially confounding effects of family environment and social context are controlled. Similarly, numerous studies have linked maternal cigarette smoking during pregnancy to conduct problems and antisocial behaviors (Wakshlag et al. 2002; Pratt et al. 2006) Results for the effects of prenatal drug use vary by type of substance (Williams and Ross 2007), but there is evidence for effects on conduct problems, violence, and substance abuse (Williams and Ross 2007; Day et al. 2006).

These prenatal influences have life-long consequences. Indeed, the effects may be cumulative. Early neurological deficits that affect learning, social judgment, impulsivity, interpersonal skills, and antisocial behavior may set in motion chains of negative consequences such as

Correspondence to: Les B. Whitbeck.

academic failure, substance abuse, and involvement in the criminal justice system that become increasingly important as adolescents move into young adulthood (Jacobson and Jacobson 2002; McGloin et al. 2006). Among the most serious consequences of prenatal exposure to teratogenic substances are early onset psychiatric disorders. In this report we investigate the influence of prenatal binge drinking, cigarette smoking, and drug use on meeting criteria for psychiatric disorders at ages 10–12 and 13–15 years among Indigenous adolescents.

Substance Use During Pregnancy

Alcohol Use

Nationally, about one-half of women at risk for pregnancy (i.e., of child bearing age and not using birth control) use alcohol and about 12% report binge drinking. Among women who were pregnant approximately ten percent used alcohol and two percent engaged in binge drinking (CDC 2004a). Estimates from the National Survey on Drug Use and Health are similar: nine percent of pregnant women reported drinking alcohol and three percent reported binge drinking (NSDUH 2004). There are no definitive estimates of prenatal alcohol use among Indigenous women. Because Indigenous people make up such a small proportion of the population, sampling procedures for CDC risk estimates result in such small non-representative samples of Indigenous women that they are not included in ethnic breakouts. Also, any estimate for all American Indian/Alaska Native people masks the substantial diversity between and within Indigenous ethnic groups (May 1991; May and Hymbaugh 1989). Estimates we were able to locate conflict. For example, the Urban Indian Health Institute reports that urban Indigenous women (4.4%) were about twice as likely as other ethnic groups (1.2%) to drink when pregnant (UIHI 2006). However, a Minnesota study indicated that the rate of binge drinking among Indigenous women (6%) was lower than that reported for European Americans (9%) (Minnesota Department of Health 2002).

Cigarette Smoking

The Centers for Disease Control (CDC) report that 11.4% of women giving birth in 2002 smoked cigarettes during their pregnancy (CDC 2004b) and the 2002 National Survey on Drug Use and Health (NSDUH 2004) indicated that past month cigarette use among pregnant women was 17% with higher rates among younger women. Neither report provides estimates for Indigenous women. However, a 1999 U.S. Department of Health and Human Services report indicated that Indigenous women smoked during pregnancy at a rate 1.5 times that of women of all other ethnic groups (U.S. Department of Health and Human Services 1999). Cigarette smoking is more common among Indigenous adults and adolescents than those from other ethnic groups. Twenty-eight percent of Indigenous adolescents smoked cigarettes compared to about 16% of European American adolescents, 10% of Latino adolescents and 6% of African American adolescents (NSDUH 2002; Tarter et al. 2007). Past month cigarette use among individuals aged 12 years or older was higher among Indigenous people (34.8%) than among any other ethnic group (NSDUH 2006). The Urban Indian Health Institute reports that 15.9% of Indigenous mothers smoked during pregnancy compared to 9% of other ethnic groups (UIHI 2006). A Minnesota study indicated that 41% of Indigenous women smoked during their pregnancy compared to 12% of non-Indigenous women (Scott et al. 2004).

Drug Use

We have much less information regarding the prevalence of drug use during pregnancy. Estimates tend to be lower than those for alcohol use or cigarette smoking. In 2002, about three percent of pregnant women reported they had used an illicit drug, with marijuana the drug of choice. The rate of drug use when pregnant was approximately twice that (6.8%) among younger women aged 15–25 years (NSDUH 2004). There are concerns that drug use is under reported by pregnant women and that the actual rates may be several times higher than reported

estimates (Williams and Ross 2007). We were able to locate no estimates of prenatal illicit drug use among Indigenous women.

Mental Health Effects of Prenatal Substance Use

Over the past decade both human and animal neurological studies have shown that depending on dosage and duration, prenatal alcohol and drug use during sensitive periods of fetal brain development may result in long lasting changes in the formation and function of brain structure, pharmacology, and cell signaling in the prefrontal cortex affecting impulsivity, distractibility, irritability, task persistence, stress responsiveness, and emotion regulation (Chapman et al. 2007; Stanwood and Levitt 2004). These characteristics associated with childhood conduct disorder (CD), attention deficit/hyperactivity disorder (ADHD) and also have been linked to early onset substance use disorders during adolescence (Tarter et al. 2003). The physiological effects of prenatal substance use are compounded by parent-child interactions where substance using parents are less emotionally available, inconsistent caregivers and disciplinarians, and may model inappropriate substance use (Glantz and Chambers 2006; Chapman et al. 2007). Because the research on the effects of prenatal substance abuse typically focuses on particular substances, we will review the research by type of substance.

Alcohol Related Effects

Since it was introduced in 1973 (Jones and Smith 1973; Jones et al. 1973; Calhoun and Warren 2007) there has been increasing research on fetal alcohol syndrome (FAS), now usually denoted as fetal alcohol spectrum disorders (FASD) to include various levels of the syndrome such as fetal alcohol effect (FAE), partial fetal alcohol syndrome (PFAS), alcohol-related birth defects (ARBD) and alcohol-related neurodevelopmental disorder (ARND) (Manning and Hoyme 2007). Very early, Indigenous people became a focus of FASD research because of cultural stereotyping regarding drinking patterns (May 1991) and because specific Indigenous communities in the U.S. and Canada had extremely high levels of FASD. Some of the high rates were attributable to multiple births, but rates in some isolated Canadian Indigenous communities were extremely high (Bray and Anderson 1989) and rates among some U.S. Indigenous communities were higher than those for non-Indigenous people (May 1991).

Different research methods for assessing prevalence of FASD yield different estimates of prevalence, however, May and Gossage (2001) in a recent review that takes into account method variance estimate the overall U.S. prevalence at 0.5 to 2.0 per 1,000 births or 0.2%. The rates among high risk populations are substantially higher. Regardless of the method of estimating prevalence, FASD was higher among Indigenous populations with ranges of 1.4 to 2.00 births per thousand among Southwestern cultures, 9.00 to 9.8 births per thousand among Northern Plains cultures and 3.0 to 5.20 births per thousand among Alaska Natives (May and Gossage 2001).

The potential mental health effects of these rates of FASD are numerous. FASD is associated with ADHD in cross-sectional studies (Lee et al. 2004; Nash et al. 2006; O'Malley and Nanson 2002), longitudinal studies (Autti-Ramo 2000) and twin studies (Knopik et al. 2006). It also has been linked to impulsivity, conduct problems (Autti-Ramo 2000; Nash et al. 2006; O'Connor et al. 2006), antisocial behavior and substance abuse (Steinhausen et al. 2003 Steinhausen et al. 2004, 2007).

Cigarette Smoking Related Effects

Prenatal cigarette smoking has been linked to child conduct problems for years (Brook et al. 2006; Monuteaux et al. 2006; Wakshlag et al. 2002). Several recent studies indicate life-long effects on antisocial behaviors (McGloin et al. 2006), though the effect size of maternal

smoking on adult antisocial behavior is very small when other contributing factors are taken into account (Pratt et al. 2006). Maternal smoking during pregnancy also is associated with ADHD (Schmitz et al. 2006; Thapar et al. 2003) and an increased likelihood of nicotine dependence among offspring (O'Callaghan et al. 2006; Roberts et al. 2005). At least one study has shown that prenatal cigarette smoking is associated with negative affect among infants (Schuetze and Eiden 2007), and there is an extensive literature linking nicotine and depressive symptoms (Jane-Llopis and Matytsina 2006), though the causal relationship remains unclear (Fergusson et al. 2003).

Drug Related Effects

Because of the number to illicit drugs, potential variations in toxicity, problems with access and reporting, and the relatively fewer number of women who use drugs when pregnant, less is known about the effects of maternal drug use when pregnant on child outcomes. A recent review indicates that prenatal use certain drugs affect brain development (e.g., PCBs) and prenatal marijuana use and attention deficits have been linked (Williams and Ross 2007). Prenatal marijuana exposure also is associated with child depressive symptoms (Gray et al. 2005) and child marijuana use even when psychosocial variables and other substance use were controlled (Day et al. 2006).

Theory and Hypotheses

Regardless of the type of substance used prenatally, the behavioral effects are transmitted through neurological changes in the fetus. According to Moffitt (1997) and others (Caspi and Moffitt 1995), such neurological damage in the contexts of ineffective parenting, poor neighborhoods, and affiliations with non-conventional peers can result in developmental trajectories characterized by academic failure, social problems, and disruptive behaviors that have cumulative consequences as the child matures. Although maternal substance abuse while pregnant may set the stage for negative developmental trajectories, it is one factor among many that affect child outcomes.

Simple correlational analyses may mask important psychosocial and environmental variables that explain most of the variance in adolescent outcomes. For this reason we have hypothesized positive relationships between maternal binge drinking, cigarette smoking, and drug use and meeting criteria for five adolescent psychiatric diagnoses (major depressive disorder, substance use disorder, conduct disorder and attention deficit hyperactivity disorder) in early (ages 10–12 years) and mid-adolescence (ages 13–15 years) when controlling for the effects of other risk factors such as family per capita income, living in a single mother headed household, and protective factors such as positive parenting. We also investigated the relationship between birth complications and maternal substance abuse when pregnant and models investigating the effects of birth complications on adolescent psychiatric diagnoses.

Method

These data were collected as part of a lagged sequential study currently underway on four American Indian reservations in the Northern Midwest and five Canadian First Nation reserves. The data are from Wave one of the study collected on two U.S. reservations from February through October 2002, and Wave one on a second pair of U.S. reservations collected from February through October 2003. The reservations share a common cultural tradition and language with minor regional variations in dialects. The sample represents one the most populous Native cultures in the United States and Canada.

The project was designed in partnership with the participating reservations and reserves. Prior to the application funding, the research team was invited to work on these reservations, and

tribal resolutions were obtained. As part of this agreement, the researchers promised that participating reservation names would be kept confidential in published reports. An advisory board was appointed by the tribal council at each participating reservation and is responsible for advising on difficult personnel problems, questionnaire development, reading reports for respectful writing, and assuring that published reports protected the identity of the respondents and the culture. Upon advisory board approval of the questionnaires, the study procedures and questionnaires were submitted for review and approved by an Institutional Review Board. All participating staff on the reservations were approved by the advisory board and were either tribal members themselves or non-members who are spouses of tribal members. To ensure quality of data collection, all interviewers underwent special training for conducting pencil-and-paper and computer-assisted personal interviewing for diagnostic measures, including feedback sessions. In addition, all of the interviewers completed a required human subject's protection training that emphasized the importance of confidentiality and taught procedures to maintain the confidentiality of data.

Each tribe provided lists of families of enrolled children aged 10–12 years who lived on or proximate to (within 50 miles) the reservation or reserve. We attempted to contact all families with a target child within the specified age range. Families were recruited via personal visits from Indigenous interviewers during which they were given an explanation of the project, a traditional gift, and an invitation to participate. After agreement to participate and later completion of interviews, each participating family member received $40 for their time. This recruitment procedure resulted in an overall response rate of 79.4% for the first wave.

Sample

This study includes adolescent report and adult report data from Waves 1–3 of the study. Only those adolescents whose biological mother answered questions on substance use during pregnancy were included in analyses ($n = 546$). Among those biological mothers in the sample, some chose not to answer the questions regarding substance use and complications during pregnancy. Response rates on most of the questions regarding drinking, smoking, and birth complications were high. Only 8 respondents did not answer questions regarding binge drinking, 5 respondents did not answer questions regarding smoking, and 6 respondents did not answer questions regarding birth complications. Thirty respondents have missing data on the question related to drug use during pregnancy.

Measures

Gestational Risk—Gestational risk was measured by four retrospective dichotomous indicators (0,1) assessing if the mother used drugs, smoked, engaged in binge drinking or had experienced pregnancy or birth complications (e.g., c-section, gestational diabetes, premature birth, breech birth) during pregnancy with the designated child.

Control Variables—Age was a continuous variable assessing the child's' age in months at baseline. This variable was computed by taking the child's birth date from the date of interview at wave one. *Female* is a dichotomous variable indicating if the child is male (0) or female. *Single Mother wa*s dummy variable for living in a single-mother household and is used as our measure of household structure. A score of 1 indicates that the adolescent lived in a family with a mother caretaker only and a score of 0 indicates other types of family structure. *Income* was measured by household per capital yearly income. Families were asked to indicate whether their overall household incomes were above or below $25,000 in the past year. Two additional questions narrow these responses to within $10,000 ranges. The midpoints of each of these ranges were used to sum the two variables, which were then divided by the number of people living within the household at least 50% of the time, thus assessing per capita family income.

Positive Parenting—Positive Parenting was measured by summing two standardized measures of maternal warmth and support and maternal approval. Maternal warmth and support was measured at Wave 1 using a seven item scale assessing how often a mother is too busy to do things with her child, how often the child talks with her about things that bother them, how often she consults with the child on family matters, how often she gives her child reasons for her decisions, how often she asks the child what they think about decisions, how often she lets them know she is pleased with them, and how often she can figure out how to deal with problems between her and her child. Response categories were always, often, sometimes, seldom, and never. Internal consistency assessed using Chronbach's alpha was .71. Maternal approval was measured at Wave 1 using a six-item scale assessing how often the child is told that their behavior was pleasing, how often they got special attention from family members, how often they received encouragement, how often they are shown approval, how often they are given rewards, and how often they are given compliments. Response categories were always, sometimes, and never. Internal consistency assessed using Chronbach's alpha was . 76. Warmth and support and approval correlated at .167 ($P < .001$) and were standardized before being combined into a single measure of positive parenting.

Diagnostic Interviews—Diagnostic interviews were conducted at Waves 1 (ages 10–12 years) and Wave 4 (ages 13–15 years). Child diagnostic information from parents and child reports were obtained for 11 diagnoses. The substance abuse disorders (alcohol abuse, alcohol dependence, marijuana abuse, marijuana dependence, nicotine dependence), major depressive episode, dysthymic disorder, general anxiety disorder, oppositional defiant disorder, conduct disorder, and inattention/hyperactivity disorder modules were used from the Diagnostic Interview Schedule for Children-Revised (DISC-R). The DISC-R is a highly regarded, structured interview intended for use with trained interviewers. Test-retest reliability for self-reports of children under 11 years of age varies by diagnostic category with younger children being particularly unreliable reporters of onset and duration of symptoms. Parents tend to report more symptoms and to report them more reliably than children. Reliability of parent reports was excellent for inattention/hyperactivity, and fair for overanxious disorder, oppositional defiant disorder, and conduct disorder (Shaffer et al. 1993). The DISC-R has been used extensively for children aged 11 years and older 50. Reliability research on various versions of the DISC indicate that parent reports are the most reliable and that combined parent-child reports are more reliable than child reports alone (Schwab-Stone et al. 1996). Bird and colleagues suggest that parents and children may each provide unique information regarding symptoms and that both sources of information are important for meaningful diagnosis (Bird et al. 1992). Similarly, Jenson and colleagues argue that although discrepant caretaker and child reports provide meaningful information in some cases (e.g., attention deficit hyperactivity disorder) child reports should be treated cautiously (Jensen et al. 1999). Given the propensity of research that indicates combined reports provide the most inclusive information, we relied on combined caretaker and child reports for our multivariate analyses. If diagnostic criteria are met by either parent or child, or if the combined reports of symptoms meet criteria, they represent caseness in our analyses.

Results

Prevalence of Risk Behaviors

About 20% of the biological mothers told us that they drank alcohol during their pregnancy with the study child (Table 1). Of those who ever drank while pregnant, nearly one-half (46.8%) told us that they had engaged in binge drinking while pregnant with the study child (9.5% of the total study sample). Nearly one-half (46%) of the women had smoked cigarettes and about eight percent had taken drugs when pregnant with the study child. Nineteen percent of the

women indicated that they had experienced pregnancy or birth complications with the study child such as gestational diabetes, premature birth, and breech birth.

Gestational Risk and Adolescent Internalizing Disorders

Two types of maternal behaviors when pregnant were associated with adolescent major depressive episode (MDE) at Waves 1 and 4. Maternal cigarette smoking when pregnant increased the likelihood of MDE at Wave 1 3.6 times. Maternal drug use when pregnant increased the likelihood that the adolescent would meet criteria for MDE at Wave 4 more than four times (OR = 4.22, Table 2). Co-occurring smoking and binge drinking when pregnant increased the likelihood of adolescent MDE at Wave 4 by 4.8 times. None of the control variables were statistically significant.

Gestational Risk and Adolescent Externalizing Disorders

Even when controlling for social context and parenting, maternal binge drinking when pregnant increased the likelihood of the adolescent meeting diagnostic criteria for conduct disorder (CD) at Wave 1 of the study more than three times (OR = 3.29, Table 3). For each year of age, the odds of the adolescent meeting criteria for CD increased 1.64 times. For each unit increase in the positive parenting scale, the odds of meeting criteria for CD decreased by 30%.

Birth complications increased the likelihood of the adolescent meeting criteria for attention deficit hyperactivity disorder (ADHD) nearly three times (Wave 1 OR = 2.73; Wave 4 OR = 2.84). Males were more likely than females to meet ADHD criteria at Wave 1. Birth complications also increased the odds of the adolescent meeting criteria for conduct disorder (CD) at Wave 1 by three times (OR = 3.13). Each year of age nearly doubled the odds of meeting criteria for CD (OR = 1.86) as did living in a single mother household (OR = 2.17). Positive parenting reduced the likelihood of meeting criteria for CD at Wave 4 by one-third (OR = .67).

Co-occurring smoking and binge drinking increased the odds of the adolescent meeting criteria for CD at Wave 1 nearly four times (OR = 3.93). In this model, for each year of age, the odds of meeting criteria for CD increased 1.67 times, and positive parenting reduced the likelihood of meeting criteria for CD by 30% (OR = .70). Co-occurring smoking and birth complications followed a similar pattern, increasing the likelihood of CD 2.6 times at Wave 1. Each year of age increased the odds of meeting criteria for CD 1.7 times, living in a single mother household doubled the odds (OR = 2.02), and positive parenting reduced the likelihood of meeting criteria for CD 30%.

Gestational Risk and Substance Use Disorders

Binge drinking when pregnant increased the odds of the study adolescent meeting criteria for any substance use disorder (SUD) at Wave 1 (OR = 4.01, Table 4). In this model, for each year of age, the likelihood of meeting criteria for any SUD increased 3.5 times. Maternal drug use when pregnant doubled the odds (OR = 2.07) of meeting criteria for any SUD at Wave 4 (Table 4). In this model, each year of age increased the likelihood of meeting criteria for any SUD 1.7 times. For each unit increase in family per capital income the odds of meeting criteria for any SUD decreased by 12% (OR = .88).

When we broke out the substance use disorders into individual substance use disorders, maternal binge drinking when pregnant increased the odds of Wave 4 adolescent nicotine dependence nearly 2.5 times (OR = 2.47). For each year of age the likelihood of meeting criteria for nicotine dependence increased 1.6 times. Co-occurring maternal cigarette smoking and binge drinking when pregnant increased the odds of the study adolescent meeting criteria for alcohol abuse/dependence 3.4 times at Wave 4. Each year of age increased the odds of meeting

criteria for alcohol abuse/dependence 1.59 times. These co-occurring behaviors also contributed to adolescent marijuana use and dependence ($P = .06$). Prenatal maternal cigarette smoking and binge drinking increased the odds of adolescent marijuana use more than two times (OR = 2.24). In this regression model, each year of adolescent age increased the likelihood of marijuana use 1.6 times and for each unit increase in per capita family income the odds of the adolescent using marijuana decreased 16% (OR = .84).

Maternal smoking in combination with birth complications more than doubled the odds (OR = 2.3) of adolescent Wave 4 alcohol abuse/dependence. Each year of age increased the odds of meeting criteria for alcohol abuse/dependence 1.59 times, and each unit increase of family per capita income reduced the odds eight percent (OR = .92).

Discussion and Conclusions

The importance of these findings is that maternal risk behaviors when pregnant with the study adolescent were associated with psychiatric diagnoses during early (ages 10–12 years) and mid-adolescence (ages 13–15 years) even when controlling for potential confounding variables such as age of child, gender, living in a single mother headed household, family per capita income, and positive parenting. Although these control variables reduce but do not eliminate the potential for other confounding maternal behaviors and social contexts that have occurred since pregnancy, this is evidence that the effects of mothers' drinking and drug behaviors have persisted beyond pregnancy and influenced development.

We had no way of evaluating adolescent FASD, so psychiatric diagnoses provide a kind of proxy. Congruent with the literature regarding FASD, binge drinking and co-occurring maternal alcohol use and maternal cigarette smoking were associated with CD when the children were aged 10–12 years, but the effects become non-significant by mid-adolescence (ages 13–15 years). There were no effects of maternal binge drinking on meeting criteria for ADHD. The only consistent predictor of ADHD was mother report of birth complications. None of the gestational risk factors was associated with birth complications (analyses not shown). Maternal binge drinking was positively related to Wave 1 and Wave 4 SUDs, and nicotine dependence at Wave 4. Co-occurring maternal smoking and binge drinking was associated with adolescent meeting criteria for alcohol abuse/dependence at Wave 4. This suggests that maternal binge drinking was associated with numerous behavioral problems in early and mid-adolescence, however, we are far from accounting for the complexity of FASD symptoms.

Our findings for maternal cigarette smoking when pregnant with the study adolescent did not fit the typical linkages with antisocial behaviors. Rather, maternal smoking was associated with adolescent MDE at Wave 1 and co-occurring maternal smoking and binge drinking was associated with adolescent MDE at Wave 4. Maternal drug use also was associated with adolescent MDE at Wave 4. It is noteworthy that maternal warmth, support, and approval had no effect on adolescent MDE with the gestational risk variables in the models. Maternal cigarette smoking when pregnant was only associated with externalizing behaviors when it co-occurred with other risk factors such as drinking when pregnant and or with birth complications.

In addition to its effects on Wave 4 MDE, maternal drug use when pregnant doubled the odds of the study adolescent meeting criteria for a substance use disorder at Wave 4 which is congruent with other research on the effects of maternal drug use and child outcomes (Day et al. 2006).

The strength of the associations between gestational risk factors and psychiatric disorders deserves comment. Odd ratios ranged from 2.0 to more than 4.0 with no statistically significant

odds ratio less then 2.0. These are robust effects especially when controlling for economic status, single mother households and parenting.

Some of the associations were significant in early adolescence (10–12 years) and became non-significant three years later (13–14 years). Others were statistically significant only for the older adolescents. SUDs take longer to emerge and the pattern of our findings is congruent with this expectation. CD was more likely to be significant at Wave 1 and than at Wave 4. This may be due to more proximal variables such as peer influences affecting disruptive behaviors as the child matures into mid-adolescence.

Limitations

Studies dealing with gestational risk are relatively rare primarily because there are so many challenges to this type of research. The foremost challenge is that we relied on mothers' retrospective self-reports. However, in the absence of longitudinal studies of Indigenous mothers and children that follow children from birth through adolescence, these are the best data we have. Moreover, the expectation is that mothers will under report these risk behaviors so that any bias will be conservative. A second limitation of this research has to do with the sensitivity of DISC-R and UM-CIDI measures for assessing American Indian and Canadian First Nations adolescents. For example, definitions of depression may vary across Indigenous cultures. However, this study uses the same measures as recent population studies of American Indian people to provide the best estimates possible (Beals et al. 2005). Finally, it is important to note that these results are from a single culture and may not be generalizable across the diversity of North American Indigenous cultures. Furthermore, even though our data are from several sites, and represent the within culture diversity very well, they reflect the attitudes and behaviors of people who live on or near rural and remote reservations and reserves. They may not represent urban Indigenous people even from the same cultural background.

Implications for Prevention

Efforts at raising awareness of the effects of alcohol during pregnancy have modestly reduced drinking by women who know they are pregnant or who intend to become pregnant (Hankin 2002). Targeted educational programs have been ongoing on many Indigenous reservations and reserves for years (May 1995) and may be the reason for the Minnesota finding that fewer pregnant Indigenous women drank alcohol when pregnant than non-Indigenous women (Minnesota Department of Health 2002). However, a small percentage of women probably will remain at risk for substance use when pregnant which means that targeted prevention efforts should focus on substance abuse among mothers and fathers of newborns and beyond. As Moffitt (1997). points out many of the mothers of neurologically impaired children are those least prepared to cope with or remediate impairment from prenatal substance use. The parent-child relationship is not unidirectional. Difficult children invoke more negative responses from parents and fewer positive responses (Mun et al. 2001). What begins as a lower level of emotional engagement with newborns by mothers who abused substances when pregnant (Molitor et al. 2003) across time may result in three to twelve times greater risk of child maltreatment in families with prenatally alcohol and drug exposed children (Jaudes et al. 1995; Kelley 1998; Wasserman and Leventhal 1993).

There are numerous models of effective prevention programs that focus on parenting skills (e.g., Brody et al. 2006; Spoth et al. 2001) on life skills and alcohol and drug prevention among children and adolescents (e.g., Schinke et al. 2000), and innovative combinations of both approaches (e.g.; Brody et al. 2002). But the most effective interventions may well prove to be the earliest. There is evidence that women who use substances when pregnant have serious post partum parenting deficits in maternal-child interaction, maternal responsiveness, emotional engagement, and feeding their infants (Hans 2002; LaGasse et al. 2003; Minnes et

al. 2005). If prevention of substance use during pregnancy fails, intervention at birth may offer a window of opportunity to reduce the insidious interactions of neurological deficits and poor parenting.

Conclusions

These findings add to a growing literature on gestational risk in several ways. First, they provide information regarding self-reported maternal risk behaviors for a large Indigenous culture. Good estimates of these behaviors are rare. Second, the findings indicate long-term psychiatric effects of gestational risk behaviors even when social and family influences are controlled. Third, the findings point to the need for education and prevention programs on Indigenous reservations and reserves. Although many reservations and reserves already have strong educational programs pertaining to FASD, less is being done regarding maternal cigarette smoking when pregnant or exposure to second-hand smoke within families. Nearly one-half of the mothers in our sample smoked during pregnancy. With increasing research linking prenatal nicotine use to later behavioral problems, this is represents a critical public health concern and indicates the need for smoking cessation programs.

Acknowledgements

This research was funded by the National Institute on Drug Abuse (DA13580) and the National Institute of Mental Health (MH67281).

References

Autti-Ramo I. Twelve-year follow-up of children exposed to alcohol in-utero. Developmental Medicine and Child Neurology 2000;42:406–411.10.1017/S0012162200000748 [PubMed: 10875527]

Barr H, Bookstein F, O'Malley K, Connor P, Hugguns J, Streissguth A. Binge drinking during pregnancy as a predictor of psychiatric disorders on the structured clinical interview for DSM-IV among young adult offspring. The American Journal of Psychiatry 2006;163:1061–1065.10.1176/appi.ajp.163.6.1061 [PubMed: 16741207]

Beals J, Manson S, Whitesell N, Spicer P, Novins D, Mitchell C. Prevalence of DSM-IV disorders and attendant help-seeking in 2 American Indian reservation populations. Archives of General Psychiatry 2005;62:99–108.10.1001/archpsyc.62.1.99 [PubMed: 15630077]

Bird H, Gould M, Staghezza B. Aggregating data from multiple informants in child psychiatry epidemiological research. Journal of the American Academy of Child and Adolescent Psychiatry 1992;31:78–85.10.1097/00004583-1992 01000-00012 [PubMed: 1537785]

Bray D, Anderson P. Appraisal of the epidemiology of fetal alcohol syndrome among Canadian Native people. Canadian Journal of Public Health 1989;80:42–45.

Brody G, Dorsey S, Forehand R, Armistead L. Unique and protective contributions of parenting and classroom processes to the adjustment of African American children living in single-parent families. Child Development 2002;73:274–286. 10.1111/1467-8624.00405 [PubMed: 14717257]

Brody G, Murry V, Gerrard M, Gibbons F, McNair L, Brown A, et al. The African American families program: Prevention of youths' high-risk behavior and test of a model of change. Journal of Family Psychology 2006;20:1–11.10.1037/0893-3200.20.1.1 [PubMed: 16569084]

Brook D, Znang C, Rosenberg G, Brook J. Maternal cigarette smoking during pregnancy and child aggressive behavior. The American Journal on Addictions 2006;15:450–456.10.1080/10550490600998559 [PubMed: 17182447]

Calhoun F, Warren K. Fetal alcohol syndrome: Historical perspectives. Neuroscience and Biobehavioral Reviews 2007;31:168–171.10.1016/j.neubiorev.2006.06.023 [PubMed: 17224346]

Caspi, A.; Moffitt, T. The continuity of maladaptive behavior: From description to understanding in the study of antisocial behavior. In: Cicchetti, D.; Cohen, D., editors. Developmental Psychology. Vol. II. New York: Wiley; 1995. p. 472-511.

CDC. Alcohol consumption among women who are pregnant of who might become pregnant-United States, 2002. Morbidity and Mortality Weekly Report 2004a;53:1178–1181.

CDC. Smoking during pregnancy-United States, 1990–2002. Morbidity and Mortality Weekly Report 2004b;53:911–915.

Chapman K, Tarter R, Kirisci L, Cornelius M. Childhood neurobehavior disinhibition amplifies risk of substance use disorder: Interaction of parental history and prenatal alcohol exposure. Journal of Developmental and Behavioral Pediatrics 2007;28:219–224.10.1097/DBP.0b013e3180327907 [PubMed: 17565289]

Day N, Goldschmidt L, Thomas C. Prenatal marijuana exposure contributes to the prediction of marijuana use at age 14. Addiction (Abingdon, England) 2006;101:1313–1323.10.1111/j.1360-0443.2006.01523.x

Fergusson D, Goodwin R, Horwood L. Major depression and cigarette smoking: Results of a 21-year longitudinal study. Psychological Medicine 2003;33:1357–1367.10.1017/S0033291703008596 [PubMed: 14672244]

Glantz M, Chambers J. Prenatal drug exposure effects on subsequent vulnerability to drug abuse. Development and Psychopathology 2006;18:893–922.10.1017/S0954579406060 445 [PubMed: 17152406]

Gray K, Day N, Leech S, Richardson G. Prenatal marijuana exposure: Effect on child depressive symptoms at ten years of age. Neurotoxicology and Teratology 2005;27:439–448. 10.1016/j.ntt.2005.03.010 [PubMed: 15869861]

Hankin J. Fetal alcohol syndrome prevention research. Alcohol Research & Health 2002;26:58–65. [PubMed: 12154653]

Hans S. Studies of prenatal exposure to drugs: Focusing on parental care of children. Neurotoxicology and Teratology 2002;24:329–337.10.1016/S0892-0362(02)00195-2 [PubMed: 12009488]

Howell K, Lynch M, Platzman K, Smith G, Coles C. Prenatal alcohol exposure and ability, academic achievement, and school functioning in adolescence: A longitudinal follow-up. Journal of Pediatric Psychology 2006;31:116–126.10.1093/jpepsy/jsj029 [PubMed: 15829611]

Jacobson J, Jacobson S. Effects of prenatal alcohol exposure on child development. Alcohol Research & Health 2002;26:282–286. [PubMed: 12875038]

Jane-Llopis E, Matytsina I. Mental health and alcohol, drugs, and tobacco: A review of the comorbidity between mental disorders and the use of alcohol, tobacco, and illicit drugs. Drug and Alcohol Review 2006;25:515–536.10.1080/0959523060094 4461 [PubMed: 17132571]

Jaudes P, Ekwo E, Voorhis J, Kelley. Association between drug abuse and child abuse. Child Abuse and Neglect 1995;19:1065–1075.10.1016/0145-2134(95)00068-J [PubMed: 8528813]

Jensen P, Rubio-Stipec M, Canino G, Bird H, Dulcan M, Schwab-Stone M, et al. Parent and child contributions to diagnosis of mental disorder: Are both informants always necessary? Journal of the American Academy of Child and Adolescent Psychiatry 1999;38:1569–1579. [PubMed: 10596258]

Jones K, Smith D. Recognition of the fetal alcohol syndrome in early infancy. Lancet 1973;3:999–1001.10.1016/S0140-6736(73)91092-1 [PubMed: 4127281]

Jones K, Smith D, Ulleland C, Streissguth A. Pattern of malformation in offspring of chronic alcoholic mothers. Lancet 1973;3:1261–1271.

Knopik VS, Heath AC, Jacob T, Slutske WS, Bucholz KK, Madden PA, et al. Maternal alcohol use disorder and offspring ADHD: Disentangling genetic and environmental effects using a children-of-twins design. Psychological Medicine 2006;36:1461–1471.10.1017/S0033291706007884 [PubMed: 16734942]

LaGasse L, Messinger D, Lester BM, Seifer R, Tronick EZ, Bauer CR, et al. Prenatal drug exposure and maternal and infant feeding behavior. Archives of Disease in Childhood. Fetal and Neonatal Edition 2003;88:391–399.10.1136/fn.88.5. F391

Lee K, Mattson S, Riley E. Classifying children with heavy prenatal alcohol exposure using measures of attention. Journal of the International Neuropsychological Society 2004;10:271–277. [PubMed: 15012847]

Manning M, Hoyme H. Fetal alcohol spectrum disorders: A practical clinical approach to diagnosis. Neuroscience and Biobehavioral Reviews 2007;31:230–238.10.1016/j.neubiorev. 2006.06.016 [PubMed: 16962173]

May P. Fetal alcohol effects among North American Indians. Alcohol Health and Research World 1991;15:329–339.

May P. A multilevel comprehensive approach to the prevention of fetal alcohol syndrome (FAS) and other alcohol related birth defects (ARBD). The International Journal of the Addictions 1995;30:1549–1602. [PubMed: 8557409]

May P, Gossage J. Estimating the prevalence of fetal alcohol syndrome: A summary. Alcohol Research & Health 2001;25:159–167. [PubMed: 11810953]

May P, Hymbaugh K. A macro-level fetal alcohol syndrome prevention program for Native Americans and Alaska Natives: Description and evaluation. Journal of Studies on Alcohol 1989;50:508–518. [PubMed: 2586104]

McGloin J, Pratt T, Piquero A. A life course analysis of the criminogenic effects of maternal cigarette smoking during pregnancy: A research note on the mediating impact of neuropsychological deficit. Journal of Research in Crime and Delinquency 2006;43:412–426.10.1177/0022427806292340

Minnes S, Singer L, Arendt R, Satayathum S. Effects of prenatal cocaine/polydrug use on maternal-infant feeding interactions during the first year of life. Journal of Developmental and Behavioral Pediatrics 2005;26:194–200.10.1097/00004703-200506000-00005 [PubMed: 15956868]

Minnesota Department of Health. Taking a closer look: Drinking during pregnancy in Minnesota. Minnesota: Department of Health; 2002.

Moffitt, TE. Developmental theories of crime and delinquency. In: Thornberry, TP., editor. Adolescent-limited and life-course persistent offending: A complementary pair of developmental theories. New Brunswick, NJ: Transaction Publishers; 1997. p. 11-55.

Molitor A, Mayes L, Ward A. Emotion regulation behavior during a separation procedure in 18-month old children of mothers using cocaine and other drugs. Development and Psychopathology 2003;15:39–54.10.1017/S0954579403000038 [PubMed: 12848434]

Monuteaux M, Blacker D, Biederman J, Fitzmaurice, Buka SG, Buka S. Maternal smoking during pregnancy and offspring overt and covert conduct problems: A longitudinal study. Journal of Child Psychology and Psychiatry and Allied Disciplines 2006;47:883–890.10.1111/j.1469-7610.2005.01566.x

Mun E, Fitzgerald H, Von Eye A, Puttler L, Zucker R. Temperamental characteristics as predictors of externalizing and internalizing child behavior problems in the contexts of high and low parental psychopathology. Alcoholism Treatment Quarterly 2001;22:393–415.

Nash K, Rovet J, Greenbaum R, Fantus E, Nulman I, Koren G. Identifying the behavioural phenotype in fetal alcohol spectrum disorder: Sensitivity, specificity, and screening potential. Archives of Women's Mental Health 2006;9:191.10.1007/s00737-006-0130-3. 186

NSDUH. National survey on drug use and health. Cigarette use among American Indian/Alaska Native Youths 2002 January;25:2002.

NSDUH. National survey on drug use and health. Pregnancy and substance use. The NSDUH Report 2004 January;2:2004.

NSDUH. National survey on drug use and health past month cigarette use among racial and ethnic groups. The NSDUH Report 2006 January;2:2006.

O'Callaghan F, O'Callaghan M, Najman J, Williams G, Bor W, Alati R. Prediction of adolescent smoking from family and social risk factors at 5 years, and maternal smoking in pregnancy at 5 and 14 years. Addiction (Abingdon, England) 2006;101:282–290.10.1111/j.1360-0443.2006.01323.x

O'Connor M, McCracken J, Best A. Under recognition of prenatal alcohol exposure in a child inpatient psychiatric setting. Mental Health Aspects of Health Disparities 2006;9:105–108.

O'Malley K, Nanson J. Clinical Implications of a link between fetal alcohol spectrum disorders and attention-deficit hyperactivity disorder. Canadian Journal of Psychiatry 2002;47:349–354.

Pratt T, McGloin J, Fearn N. Maternal cigarette smoking during pregnancy and criminal/deviant behavior: A meta-analysis. International Journal of Offender Therapy and Comparative Criminology 2006;50:672–690.10.1177/0306624X06286623 [PubMed: 17068192]

Roberts K, Munafo M, Rodriquez D, Drury M, Murphy M, Neale R, et al. Longitudinal analysis of the effect of prenatal nicotine exposure on subsequent smoking behavior of offspring. Nicotine & Tobacco Research 2005;7:801–808. 10.1080/14622200500262840 [PubMed: 16191751]

Schinke S, Tepavac L, Cole K. Preventing substance abuse among Native American youth: Three-year results. Addictive Behaviors 2000;25:387–397.10.1016/S0306-4603(99) 00071-4 [PubMed: 10890292]

Schmitz M, Denardin D, Silva T, Pianca T, Hutz MH, Faraone S, et al. Smoking during pregnancy and attention-deficit hyperactivity disorder, predominantly inattentive type: A case-control study. Journal of the American Academy of Child and Adolescent Psychiatry 2006;45:1338–1345. [PubMed: 17075356]

Schonfield A, Mattson S, Riley E. Moral maturity and delinquency after prenatal alcohol exposure. Journal of Studies on Alcohol 2005;66:545–554. [PubMed: 16240562]

Schuetze P, Eiden R. The association between prenatal exposure to cigarettes and infant and maternal negative affect. Infant Behavior and Development 2007;30:387–398.10.1016/j.infbeh.2006.10.005 [PubMed: 17683750]

Schwab-Stone M, Shaffer D, Dulcan M, Jensen PS, Fisher P, Bird HR, et al. Criterion validity of the NIMH diagnostic interview schedule for children version (2.3) (DISC-2.3). Journal of the American Academy of Child and Adolescent Psychiatry 1996;35:878–888. [PubMed: 8768347]

Scott, S.; Day, S.; Irving, J.; Oakes, M. Reducing tobacco use among pregnant American Indian women: Final report. Minneapolis, MN: MPAAT; 2004. 2004

Shaffer D, Schwab-Stone M, Fisher P, Lucas C, Dulcan M. The diagnostic interview schedule for children-revised version (DISC-R): I. Preparation, field testing, interrater reliability, and acceptability. Journal of the American Academy of Child and Adolescent Psychiatry 1993;32:643–650.10.1097/00004583-199305000-00023 [PubMed: 8496128]

Spoth R, Redmond C, Shinn C. Randomized trial of brief family interventions for general populations: Adolescent substance use outcomes 4 years following baseline. Journal of Consulting and Clinical Psychology 2001;69:627–642.10.1037/0022-006X.69.4.627 [PubMed: 11550729]

Stanwood G, Levitt P. Drug exposure early in life: Functional repercussions of changing neuropharmacology during sensitive periods of brain development. Current Opinion in Pharmacology 2004;4:65–71.10.1016/j.coph.2003.09.003 [PubMed: 15018841]

Steinhausen H, Metzke C, Spohr H. Behavioural phenotype in foetal alcohol syndrome and foetal alcohol effects. Developmental Medicine and Child Neurology 2003;45:179–182.10.1017/S0012162203000343 [PubMed: 12613774]

Streissguth A. Offspring effects of prenatal alcohol exposure from birth to 25 years: The Seattle prospective longitudinal study. Journal of Clinical Psychology 2007;14:81–101.

Streissguth A, Bookstein F, Barr H, Sampson P, O'Malley K, Young J. Risk factors for adverse life outcomes in fetal alcohol syndrome and fetal alcohol effects. Journal of Developmental and Behavioral Pediatrics 2004;25:228–238.10.1097/00004703-200408000-00002 [PubMed: 15308923]

Tarter R, Kirisci L, Mezzich A, Cornelius J, Pajer K, Vanyukov M, et al. Neurobehavioral disinhibition in childhood predicts early age at onset of substance use disorder. The American Journal of Psychiatry 2003;160:1078–1085.10.1176/appi.ajp.160.6.1078 [PubMed: 12777265]

Thapar A, Fowler T, Rice F, Scourfield J, Van Den Bree M, Thomas H, et al. Maternal smoking during pregnancy and attention deficit hyperactivity disorder symptoms in offspring. The American Journal of Psychiatry 2003;160:1985–1989.10.1176/appi.ajp.160.11.1985 [PubMed: 14594745]

Urban Indian Health Institute. Fact sheet: Maternal and child health disparities. UIHI; 2006. 2006

U.S. Department of Health and Human Services. Regional differences in Indian health 1998–1999. Washington D.C.: US DHHS, Indian Health Service, Office of Public Health, Division of Community and Environmental Health, Program Statistics Team; 1999.

Wakshlag L, Pickett K, Cook E, Benowitz N, Leventhal B. Maternal smoking behavior during pregnancy and severe antisocial behavior in offspring: A review. American Journal of Public Health 2002;92:966–974. [PubMed: 12036791]

Wasserman D, Leventhal J. Maltreatment of children born to cocaine abusing mothers. Journal of Diseases of Children 1993;147:1324–1328.

Williams J, Ross L. Consequences of prenatal toxin exposure for mental health in children and adolescence: A systematic review. European Child and Adolescent Psychiatry 2007;16:243–253.10.1007/s00787-006-0596-6 [PubMed: 17200791]

Table 1

Frequency table of behaviors during pregnancy

	%	(n)	N
Ever drank	20.4	110	539
Ever drank who binge drank	46.8	51	109
Binge drank all women	9.5	51	538
Took drugs all women	7.9	41	516
Smoked cigarettes all women	46.0	249	541
Birth complications all women	19.4	105	540

Table 2

Logisitic regression of pregnancy risk on internalizing diagnoses

	Major depression Wave 1 (*n* = 509)		Major depression Wave 4 (*n* = 430)		Major depression Wave 4 (*n* = 457)	
	B	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**
Control variables						
Age	.10	1.11	−.09	.92	−.10	.91
Female	.04	1.04	.47	1.60	.59	1.80
Single mom	.21	1.23	.27	1.31	.28	1.32
Income	−.07	.94	−.01	.99	−.01	.99
Positive parenting	.00	1.00	−.13	.88	−.11	.90
Pregnancy risk factors						
Drug use			1.44	4.22***		
Smoking	1.29	3.63*				
Binge drinking						
Birth complications						
Smoke and binge						
Smoke and drug					1.57	4.79***
Smoke and birth complications						
Constant	−4.86	.01	−2.01	.13***	−1.98	.14

† $P \leq .10$,

* $P \leq .05$,

** $P \leq .01$,

*** $P \leq .001$

Table 3

Logisitic regression of pregnancy risk on externalizing diagnoses

	Conduct disorder Wave 1 (*n* = 507)		Attention deficit hyperactivity Wave 1 (*n* = 508)		Attention deficit hyperactivity Wave 4 (*n* = 451)		Conduct disorder Wave 1 (*n* = 508)		Conduct disorder Wave 1 (*n* = 514)		Conduct disorder Wave 1 (*n* = 453)	
	B	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**
Control variables												
Age	.49	1.64*	−.18	.84	−.06	.95	.62	1.86**	.51	1.67*	.54	1.71*
Female	.05	1.05	−.84	.43**	−.20	.82	.00	1.00	.06	1.06	.09	1.09
Single mom	.61	1.85†	.61	1.84†	.54	1.72	.77	2.17*	.65	1.92†	.70	2.02*
Income	−.06	.94	.00	1.00	−.04	.96	−.08	.92†	−.06	.95	−.08	.93
Positive parenting	−.36	.70***	−.02	.98	−.15	.86	−.40	.67***	−.35	.70***	−.36	.70***
Pregnancy risk factors												
Drug use												
Smoking												
Binge drinking	1.19	3.29**										
Birth complications			1.00	2.73**	1.04	2.84*	1.14	3.13**				
Smoke and binge									1.37	3.93***		
Smoke and drug												
Smoke and birth complications											.95	2.59*
Constant	−8.20	.00***	−.42	.66	−2.30	.10	−9.75	.00***	−8.49	.00***	−8.66	.00***

$^{\dagger}P \leq .10$,

$^{*}P \leq .05$,

$^{**}P \leq .01$,

$^{***}P \leq .001$

Table 4

Logisitic regression of pregnancy risk on substance use diagnoses

	Substance use Wave 1 (*n* = 507)		Substance use Wave 4 (*n* = 430)		Nicotine dependence Wave (4 *n* = 449)		Alcohol abuse or dependence Wave 4 (*n* = 457)		Marijuana abuse or dependence Wave 4 (*n* = 457)		Alcohol abuse or dependence Wave 4 (*n* = 453)	
	B	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**	**B**	**Exp(B)**
Control variables												
Age	1.25	3.50**	.51	1.66***	.44	1.55*	.47	1.59**	.49	1.63**	.46	1.59*
Female	.09	1.10	.11	1.11	.47	1.60	−.12	.89	.03	1.03	−.13	.88
Single mom	−.26	.77	.24	1.27	.04	1.04	.06	1.07	.29	1.34	.03	1.04
Income	−.06	.94	−.13	.88***	−.08	.92	−.08	.93†	−.17	.84***	−.08	.92*
Positive parenting	−.07	.93	.05	1.05	.09	1.09	.01	1.01	.06	1.06	.00	1.00
Pregnancy risk factors												
Drug use			.73	2.07*								
Smoking												
Binge drinking	1.39	4.01*			.90	2.47*						
Birth complications												
Smoke and binge												
Smoke and drug							1.23	3.42**	.81	2.24a		
Smoke and birth complications											.83	2.30*
Constant	−17.77	.00***	−6.49	.00***	−7.35	.00**	−6.80	.00***	−6.54	.00***	−6.71	.00***

†$P \leq .10$,

a$P < .06$,

*$P \leq .05$,

**$P \leq .01$,

***$P \leq .001$