

## **EXAMINING CORRELATES OF METHAMPHETAMINE AND OTHER DRUG USE IN PREGNANT AMERICAN INDIAN ADOLESCENTS**

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*Abstract: American Indian and Alaska Native (AI/AN) adolescents have high rates of pregnancy, as well as alcohol, marijuana, cocaine, and, increasingly, methamphetamine (meth) use. The progression of adolescent drug use to meth use could have devastating impacts on AI communities, particularly when youth are simultaneously at risk for teen childbearing. In order to inform future prevention efforts, this study explores correlates of meth use in a sample of pregnant AI teens, with a focus on sociodemographic, familial, and cultural factors and use of other drugs.*

### **INTRODUCTION**

Increasing use of methamphetamine (meth) among adolescents in the U.S. is a serious public health problem, with long-lasting medical, psychosocial, and societal consequences. Meth is a highly addictive drug that causes sustained structural changes in the brain, and cognitive and emotional problems in chronic users. It is also associated with a constellation of other unsafe behaviors and with the spread and progression of HIV and other infectious diseases, such as Hepatitis B and C (National Institute on Drug Abuse, 2009). Nationally, an estimated 4.3% of people aged 12 years and older (Substance Abuse and Mental Health Services Administration, 2006) and 4.5% of high school seniors (Johnston, O'Malley, Bachman, & Schulenberg, 2006) have used meth at least once. Use of meth among adolescents has been found to follow use of alcohol, marijuana, and other illicit drugs (Novins, Beals, & Mitchell, 2001). American Indian/Alaska Native (AI/AN) adolescents, in general, report higher lifetime and past year use of illicit drugs than any other racial or ethnic group (Substance Abuse and Mental Health Services Administration, 2008). Between 2006-2008, approximately 3 times more AI/ANs aged 12 years and older vs. U.S. All Races (1.4% vs. 0.54%) reported using meth in the past year (National Institute on Drug Abuse, 2006).

Considering nearly 2 times as many AI/AN females begin childbearing in adolescence, and bear twice as many children while teenagers as the general U.S. population (Indian Health Service & Department of Health and Human Services, 2001), increasing use of meth among AI/AN adolescents poses significant lifetime risks for young AI/AN mothers and their children, families, and communities. Prenatal meth exposure has been linked to fetal growth restriction, cardiac anomalies, clefting, and neurocognitive defects (Plessinger, 1998; Smith et al., 2003; Chang et al., 2004; Smith et al., 2006). Early childhood exposure to parental meth use is associated with exposure to environmental toxins and dangers, neglect, abuse, and insufficient bonding and nurturing (Haight et al., 2005). More generally, adolescent childbearing has been linked with both drug use and negative parenting practices that predict higher drug use in offspring (Ashery, Roberston, & Kumpfer, 1998). Thus, the intertwining risks of teen pregnancy and drug use among AI/AN adolescent girls may be a critical contributor to multigenerational drug dependence and related behavioral health disparities among AI/AN populations (Howard et al., 1999; Barlow et al., 2006; Walkup et al., 2009). This situation begs further understanding of population-specific risks and potential prevention strategies.

Recent studies have identified risk and protective factors for meth use among youth in the general U.S. population. Risks include: fewer years of education; homosexuality and bisexuality; history of psychiatric disorder; family history of drug use; use of alcohol, cigarettes, marijuana, and heroin/opiates; and peer pressure and the presence of drug-using friends (Russell et al., 2008; Shillington et al., 2005; Sattah et al., 2002). Reservation-based AI adolescents face additional environmental risks that may contribute to higher rates of drug and meth use, including a history of cultural and political oppression, high unemployment and school dropout rates, geographic isolation, underresourced law enforcement agencies, and lower access to services to prevent and treat drug use (Barlow et al., 2006; Walkup et al., 2009; Barlow & Walkup, 1998; Barlow & Walkup, 2008; Office of Technology Assessment, 1990). AI/AN communities also have unique protective factors against drug use, including traditions that support strong linkages to family and clan networks, as well as cultural beliefs and practices that promote alcohol and drug abstinence and maintenance of pure body and mind during pregnancy (Barlow & Walkup, 1998; American Indian Families Project, 2004; Rogers, 2001; Szlemko, Wood, & Thurman, 2006).

As a step toward prevention in AI reservation settings, the goal of this study was to explore demographic, familial, and cultural correlates of meth and other drug use among 322 expectant AI adolescents enrolled in a trial of a home-visiting intervention called Family Spirit (Barlow et al., 2006; Walkup et al., 2009). Family Spirit is designed for delivery by local Native paraprofessionals in their reservation communities, and aims to reduce maternal and child risks for lifetime drug use. The theoretical model underpinning the Family Spirit intervention is based on G.R. Patterson's

theory of how children develop behavior problems (see Patterson, DeBaryshe, & Ramsey, 1989). Patterson's model posits that ineffective parenting mediates a variety of poor child behavior outcomes; conversely, positive parenting protects against the onset of negative behaviors through early, middle, and later childhood.

Consistent with the theoretical model and the behavioral target of the intervention, the primary aim of the baseline analysis conducted for this study was to investigate relationships between drug use and expectant mothers' family of origin functioning. We hypothesized that mothers who reported higher drug use would report lower family functioning. Further, we hypothesized that stronger affinity with traditional values would correlate with both more positive family functioning and lower drug use. In keeping with Patterson's model, we hypothesized that negative demographic factors could exacerbate poor family functioning and ultimately affect mothers' capacity for positive parenting if not addressed. To explore the spectrum of drug use severity, we viewed lifetime and pregnancy meth use and pregnancy use of any drugs as the strongest indicators of drug use risk. We also looked at relationships of meth use to other drug use, to understand the patterns of drug progression in this sample.

## METHODS

### Data Collection

Data were collected at the baseline assessment of the intervention trial, prior to the participants being randomized. The sample included 322 expectant females, aged 12-19 years at the time of conception, from four rural reservation communities in the Southwest (referred to as Sites 1-4). Baseline data were collected from expectant teens between 14 and 35 weeks' gestation (median = 25 weeks) during the period June 2006 to May 2008.

The baseline assessment included a semi-structured interview that elicited sociodemographic and cultural identity information, and standardized self-report questionnaires on drug use and family functioning. All study personnel administered assessments in participants' homes, or another confidential setting (e.g., vehicle or site office) if requested by the participant.

### Measures

**Semi-structured Interview.** Sociodemographic information, including participants' age at conception, parity, marital and educational status, current use of food stamps, number of homes lived in during previous year, and drug use since the time of conception, was collected via a semi-

structured interview. The interview was compiled primarily from the Voices of Indian Teens instrument (Moran, Fleming, Somervell, & Manson, 1999) and a demographic survey that had been developed by the investigators, via an iterative process with Native paraprofessionals, for this and two previous studies (Barlow et al., 2006; Walkup et al., 2009).

**Voices of Indian Teens** (Moran, Fleming, Somervell, & Manson, 1999). The VOICES survey is the product of a rigorous formative and instrument development project conducted with two AI communities that has been found to have acceptable reliability and validity (Mitchell, Beals, & Whitesell, 2008). Selected components of the survey used in this study included questions on cultural identity and family history of suicide. Parental alcohol abuse was measured using a VOICES question that asked participants to indicate whether their birth mother or birth father currently has or in the past had a “serious drinking problem.” VOICES questions about drugs were also used, including a 13-item self-report questionnaire measuring lifetime use, use in past 30 days, and age at first use of alcohol, marijuana, crack/cocaine, meth, barbiturates, and inhalants.

**Problem Oriented Screening Instrument for Teenagers (POSIT)**, Family Relations (range 0-11, Cronbach’s alpha 0.75; Rahdert, 1991). The POSIT is widely used to assess a broad range of functional areas among teens. The instrument has 139 self-report items encompassing 10 functional subscales. The subscale measuring family functioning was included in this study. This subscale is derived from individuals’ responses to 11 yes/no questions, with approximately half of the items being reverse-scored. For clinical and research purposes, the family functioning subscale is typically dichotomized into two categories (low and high risk), based on whether the subscale score exceeds a given cutoff value (i.e., 0-3 indicates low risk;  $\geq 4$  indicates high risk). The POSIT is designed to flag functional problem areas, but is considered conservative in that a ‘high’ risk score is suggestive, but not definitive, of potential underlying problems (Rahdert). Psychometric data on the POSIT indicate high reliability and validity of the instrument (Gruenewald & Klitzner, 1991), and the instrument has been found to be an effective screening tool for maladaptive family functioning among African-American and Latino adolescent drug users (Santisteban, Tejada, Dominicus, & Szapocznik, 1999).

## ANALYSIS

Given the rapid rise of meth in many AI/AN communities, as well as the serious public health and societal consequences associated with its use, our analysis focused primarily on meth use. Two time periods for meth use were created for analyses of correlates. Lifetime meth use was defined as positive when participants noted “ever having tried” meth on the self-report questionnaire. Pregnancy meth use was defined as positive when participants reported (a) using meth since conception during the semi-structured interview, or (b) using meth in past 30 days on the self-report questionnaire.

Due to the increased risks associated with young age ( $\leq 15$  years) at first drug use (Kumpfer, Alexander, McDonald, & Olds, 1998), variables representing ages of participants were dichotomized into two age groups: 12-15 and 16-19 years. Due to limited variation in the distribution of cultural identity items, the 4-point Likert measures were collapsed into two groups (i.e., “Not at all/Not much” versus “Some/A lot”). In interpreting outcomes, the dichotomized groupings of cultural identity were used to differentiate positive or negative affinity with traditional cultural beliefs and practices. (However, the authors recognize that cultural affinity is, in practice, a dynamic and continuous variable, and therefore, the collapsing of positive and negative cultural affinity scores presents a limitation in this study.) Binary variables for alcohol, marijuana, or crack/cocaine use during pregnancy were based on drug use since conception or in past 30 days. Barbiturate and inhalant use during pregnancy were too infrequent ( $n = \sim 1-2$ ) for analysis. The POSIT family functioning scale was dichotomized into low (0-3) and high ( $\geq 4$ ) risk scores, according to the manual instructions regarding clinical cutoff scores (Rahdert, 1991; Santisteban et al., 1999).

Factors associated ( $p < 0.05$ ) with meth use in bivariate analyses were included in multivariate models. Because our sample contained only 17 individuals who had used meth during pregnancy, we expanded the multivariate analysis to include a model of any drug use during pregnancy (i.e., meth, marijuana, crack/cocaine, inhalants, barbiturates, or alcohol). Examination of other drug use during pregnancy is of special interest in understanding intervention needs because of its potential to signal drug use severity, progression, and dependence.

Relative risks (RR) for meth or any drug use were calculated by using modified Poisson regression with robust variance estimation, considered the optimal approach for cross-sectional analysis of relatively frequent outcomes (Barros & Hirakata, 2003; Zou, 2004). RR, a commonly used measure in statistics and epidemiology, is a ratio of the probability of an event or outcome (in this case, drug use) occurring in an exposed versus an unexposed group (i.e., high-risk family functioning versus low-risk family functioning group). While RR is similar to the odds ratio in terms of measuring associations of risk between two variables, it is considered more accurate and appropriate in measuring associations with outcomes that are relatively frequent. Because drug use in this sample was relatively frequent, RR was determined to be the more appropriate measure for this analysis.

Variance inflation factors (VIF) were calculated to test for multicollinearity between covariates. Given high correlation levels ( $VIF > 5$ ; O'Brien, 2007) between lifetime and pregnancy use of substances, multivariate models of pregnancy use excluded lifetime use. Ages at first use for different substances were not included in multivariate models due to reduction in sample size if those variables were used. Exploratory chi-squared analysis was conducted to compare meth and other drug use patterns across individual POSIT family functioning items.

All analyses were conducted using Stata 9.2. Missing data were minimal (< 1% of values). The study protocol was approved by the Johns Hopkins Bloomberg School of Public Health IRB, Indian Health Service (IHS) IRB, and appropriate tribal IRBs and health boards. The manuscript was approved by all relevant tribal and IHS IRBs.

## RESULTS

### **Sociodemographic, Family, and Cultural Characteristics and Drug Use History**

This sample of expectant AI women was young (mean age = 17.6 years), unmarried (97%, n = 311), out of school (59%, n = 191), and highly mobile (51%, or n = 163, lived in 2 or more homes in the previous year). Nearly one quarter (23%, n = 75) had more than one child (See Table 1). Over one third (37%, n = 119) had a family functioning score above or equal to the clinical cutoff indicating high risk for problems in family functioning. More than half (58%, n = 188) reported having at least one parent with a serious drinking problem according to the VOICES self-report item. Approximately 5% (n = 14) had lost an immediate family member to suicide. In terms of cultural identity, 47.5% reported living a traditional way of life vs. 52.5% who said they did not. One third (33.9%) ascribed high importance to having traditional Indian values vs. 66.1% who said living traditionally was less important.

### **Drug Use History**

More than one quarter of participants (26%, n = 83) reported using meth at least once in their lifetimes (Table 1). Reported lifetime meth use was one third of reported alcohol (78%, n = 250) or marijuana (75%, n = 241) use, nearly the same as lifetime crack/cocaine use (23%, n = 75), and approximately 5 times higher than barbiturate or inhalant use (5-6%, n = 17 and n = 21, respectively). Almost half (48%, n = 155) of the sample said they had ever used cigarettes, and 19% (n = 62) reported using cigarettes at least once during pregnancy. Of these 19%, the majority (n = 54; 87%) said they smoked cigarettes occasionally, but not every day, while the remaining 8 respondents (13%) reported smoking 1-10 cigarettes per day.

Approximately 1 in 20 (5.3%, n = 17) reported meth use during pregnancy prior to study enrollment (mean gestational age, 25 weeks). Substances used most during pregnancy were alcohol (14%, n = 45) and marijuana (13%, n = 43).

Initiation of meth use occurred at older ages than for all other substances (mean = 15.7 years). Inhalants were initiated earliest (mean = 13.6 years), followed by marijuana (mean = 14.0 years), tobacco (mean = 14.2 years), then alcohol (mean = 14.6 years).

**Table 1**  
**Participants' Drug Use History (N = 322)**

Drug Use Characteristics	Lifetime Drug Use n (%)	Pregnancy Drug Use n (%)	Age at First Use Mean (SD)
Alcohol	250 (77.6)	45 (14.0)	14.6 (1.8)
Marijuana	241 (74.8)	43 (13.4)	14.0 (2.1)
Methamphetamines	83 (25.8)	17 (5.3)	15.7 (1.7)
Crack/cocaine	75 (23.3)	6 (1.9)	15.4 (1.7)
Barbiturates	21 (6.5)	3 (1.0)	15.3 (2.0)
Inhalants	17 (5.3)	1 (0.3)	13.6 (2.1)
Any of above drugs	276 (85.7)	81 (25.2)	NA
Never used any drugs	46 (14.3)	241 (74.8)	NA

**Factors Associated with Lifetime and Pregnancy Meth Use Risk**

Bivariate test results examining factors associated with increased or decreased likelihood of lifetime or pregnancy meth use are shown in Table 2. Factors most strongly associated with increased lifetime meth use included southern or central geographic locations; high residential mobility; poor family functioning; parental history of alcohol problems; family history of suicide; and lifetime and pregnancy use of alcohol, marijuana, crack/cocaine, barbiturates, and inhalants. Currently attending school, living by traditional way, greater importance ascribed to traditional Indian values, and older ages of initiation of alcohol and marijuana were all associated with decreased lifetime meth use. Although not shown in this table, similar geographical patterns were seen for lifetime and pregnancy use of alcohol, marijuana, and crack/cocaine, with the southern and central locations having the highest levels of use.

**Table 2**  
**Factors Associated with Lifetime and Pregnancy Meth use, with Bivariate Analysis Results**

	Total Number (%) (N=322)	Number (%) who Used Meth in Lifetime (n = 83)	RR	95% CI	Number (%) who Used Meth in Pregnancy (n=17)	RR	95% CI
<i>Sociodemographic Factors</i>							
Geographic location							
Northeast AZ (Site 1)	83 (25.8)	11 (13.3)	1.00		1 (1.2)	1.00	
Southern AZ (Site 2)	65 (20.2)	28 (43.1)	3.25***	1.75, 6.03	8 (12.3)	10.2*	1.3, 79.6
North-central AZ (Site 3)	69 (21.4)	7 (10.1)	0.77	0.31, 1.87	0 (0)	N/A	N/A
Central AZ (Site 4)	105 (32.6)	37 (35.2)	2.66***	1.45, 4.89	8 (7.6)	6.32	0.81, 49.6
Age at time of conception							
12-15 years		6 (18.2)	1.00		1 (3.0)	1.00	
16-20 years		77 (26.6)	1.46	0.69, 3.10	16 (5.5)	1.82	0.25, 13.34
Parity							
0		60 (24.3)	1.00		11 (4.4)	1.00	
≥ 1		23 (30.7)	1.26	0.84, 1.89	6 (8.0)	1.80	0.69, 4.69
Marital status							
Married		2 (18.8)	1.00		0 (0)		
Unmarried		81 (26.1)	1.43	0.40, 5.09	17 (5.5)	N/A	N/A
Current school status							
Not attending school		59 (30.9)	1.00		14 (7.3)	1.00	
Attending school		24 (18.3)	0.59*	0.39, 0.90	3 (2.3)	0.31	0.09, 1.07
Currently use food stamps							
No		36 (21.3)	1.00		5 (3.0)	1.00	
Yes		47 (30.7)	1.44	0.99, 2.10	12 (7.8)	2.65	0.96, 7.35
Number of homes lived in during past year							
1 home		40 (25.2)	1.00		9 (5.7)	1.00	
2-3 homes		37 (24.5)	0.97	0.66, 1.43	6 (4.0)	0.70	0.26, 1.92
≥ 4 homes		6 (50.0)	1.99*	1.06, 3.72	2 (16.7)	2.94	0.72, 12.1

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**Table 2, Continued**  
**Factors Associated with Lifetime and Pregnancy Meth use, with Bivariate Analysis Results**

	Number (%) (N=322)	Lifetime Meth Use (n = 83) Number (%)	RR	95% CI	Meth Use in Pregnancy (n=17) Number (%)	RR	95% CI
<i>Family Factors</i>							
Family functioning (POSIT)							
Low risk: 0-3 score	203 (63.0)	37 (18.2)	1.00		6 (3.0)	1.00	
High risk: ≥ 4 score	119 (37.0)	46 (38.7)	2.12***	1.47, 3.07	11 (9.2)	3.13*	1.19, 8.24
Mother or father has had serious drinking problem							
No	134 (41.6)	22 (16.4)	1.00		4 (3.0)	1.00	
Yes	188 (58.4)	61 (32.4)	1.98***	1.28, 3.05	13 (6.9)	2.32	0.77, 6.95
Family member has committed suicide							
No	308 (95.6)	76 (24.7)	1.00		14 (4.6)	1.00	
Yes	14 (4.4)	7 (50.0)	2.03*	1.16, 3.54	3 (21.4)	4.71**	1.53, 14.54
<i>Cultural Factors</i>							
Degree to which live by traditional way							
Not at all/Not much	169 (52.5)	53 (31.4)	1.00		12 (7.1)	1.00	
Some/A lot	153 (47.5)	30 (19.6)	0.63*	0.42, 0.92	5 (3.3)	0.46	0.16, 1.28
Importance of having traditional Indian values							
Not/somewhat important	213 (66.2)	64 (30.1)	1.00		16 (7.5)	1.00	
Very important	109 (33.9)	19 (17.4)	0.58*	0.37, 0.92	1 (1.0)	0.12*	0.02, 0.91

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**Table 2, Continued**  
**Factors Associated with Lifetime and Pregnancy Meth use, with Bivariate Analysis Results**

	Number (%) (N=322)	Lifetime Meth Use (n = 83) Number (%)	RR	95% CI	Meth Use in Pregnancy (n=17) Number (%)	RR	95% CI
<b>Substance Use Factors</b>							
Ever had a drink of alcohol							
No	72 (22.4)	5 (6.9)	1.00		3 (4.2)	1.00	
Yes	250 (77.6)	78 (31.2)	4.49***	1.89, 10.67	14 (5.6)	1.34	0.40, 4.55
Alcohol use during pregnancy							
No	277 (86.0)	60 (21.7)	1.00		10 (3.6)	1.00	
Yes	45 (14.0)	23 (51.1)	2.36***	1.64, 3.39	7 (15.6)	4.31***	1.73, 10.74
Age at first alcohol use (of those who used)							
≤ 15 years	166 (68.6)	62 (37.4)	1.00		13 (7.8)	1.00	
16-19 years	76 (31.4)	11 (14.5)	0.39***	0.22, 0.69	1 (1.3)	0.17	0.02, 1.26
Ever tried marijuana							
No	81 (25.2)	2 (2.5)	1.00		2 (2.5)	1.00	
Yes	241 (74.8)	81 (33.6)	13.6***	3.42, 54.11	15 (6.2)	2.52	0.59, 10.79
Marijuana use during pregnancy							
No	279 (86.7)	62 (22.2)	1.00		9 (3.2)	1.00	
Yes	43 (13.3)	21 (48.8)	2.20***	1.51, 3.20	8 (18.6)	5.77***	2.35, 14.14
Age at first marijuana use (of those who used)							
≤ 15 years	179 (74.6)	69 (38.6)	1.00		14 (7.8)	1.00	
16-19 years	61 (25.4)	12 (19.7)	0.51*	0.30, 0.87	1 (1.6)	0.21	0.03, 1.56

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**Table 2, Continued**  
**Factors Associated with Lifetime and Pregnancy Meth use, with Bivariate Analysis Results**

	Number (%) (N=322)	Lifetime Meth Use (n = 83) Number (%)	RR	95% CI	Meth Use in Pregnancy (n=17) Number (%)	RR	95% CI
<b>Substance Use Factors</b>							
Ever tried crack/cocaine							
No	247 (76.7)	28 (11.3)	1.00		7 (2.8)	1.00	
Yes	75 (23.3)	55 (73.3)	6.47***	4.49, 9.41	10 (13.3)	4.70***	1.86, 11.93
Crack/cocaine use during pregnancy							
No	316 (98.1)	78 (24.7)	1.00		14 (4.4)	1.00	
Yes	6 (1.9)	5 (83.3)	3.38***	2.25, 5.07	3 (50.0)	1.29***	4.36, 29.18
Age at first crack/cocaine use (of those who used)							
≤ 15 years	33 (44.6)	24 (72.7)	1.00	0.76, 1.33	7 (21.2)	1.00	
16-19 years	41 (55.4)	30 (73.2)	1.01	0.76, 1.33	3 (7.3)	0.34	0.10, 1.23
Ever tried barbiturates							
No	301 (93.5)	74 (24.6)	1.00		16 (5.3)	1.00	
Yes	21 (6.5)	9 (42.9)	1.74*	1.02, 2.97	1 (4.8)	0.90	0.12, 6.43
Ever tried inhalants							
No	305 (94.7)	68 (22.3)	1.00		12 (3.9)	1.00	
Yes	17 (5.3)	15 (88.2)	3.96***	3.01, 5.20	5 (29.4)	7.48***	2.97, 18.79

\*p < 0.05  
 \*\*p < 0.01  
 \*\*\* p < 0.005

**Correlates of Risk**

**Lifetime Meth Use**

Geographic location, family functioning, parental alcohol abuse, and lifetime use of marijuana, crack/cocaine, and inhalants were all independently associated with increased risk of lifetime meth use (Table 3). After controlling for covariates, participants at Site 2 were more likely to report lifetime meth use (RR = 2.53, *p* < 0.005). Regardless of study site, those with higher family dysfunction were 1.44 times (*p* < 0.05) more likely to use meth, compared to those with lower family dysfunction. Findings also suggest that participants who reported having a parent with a serious drinking problem were 1.36 times (*p* < 0.1) more likely to use meth. Controlling for

lifetime use of all other substances, participants who had ever used marijuana were more than 5 times more likely to have ever used meth than non-marijuana users (RR = 5.23,  $p < 0.05$ ); crack/cocaine users were approximately 4 times (RR = 3.96,  $p < 0.005$ ) more likely; and, inhalant users, 1.5 times more likely (RR = 1.51,  $p < 0.05$ ).

**Table 3**  
**Multivariate Analysis of Correlates of Lifetime Meth Use**  
**and Use of Meth and Other Drugs During Pregnancy**

Determinant	Model 1 <i>Lifetime Meth Use<sup>†</sup></i>		Model 2 <i>Use of Any Drugs During Pregnancy</i>		Model 3 <i>Use of Meth During Pregnancy</i>	
	Adjusted RR	95% CI	Adjusted RR	95% CI	Adjusted RR	95% CI
<i>Sociodemographic</i>						
Geographic location						
Northeast Arizona (Site 1)	1 (ref)		1 (ref)		1 (ref)	
Southern Arizona (Site 2)	2.53	1.38, 4.62***	1.26	0.76, 2.11	5.83	0.55, 62.2
North-central Arizona (Site 3)	0.94	0.46, 1.92	0.25	0.10, 0.62***	0.04	0.01, 0.05***
Central Arizona (Site 4)	1.70	1.00, 2.90	0.84	0.51, 1.41	3.43	0.33, 35.5
Current School Status						
Not attending school	1 (ref)		1 (ref)		1 (ref)	
Attending school	0.77	0.54, 1.12	0.96	0.65, 1.42	0.40	0.13, 1.20
# of homes lived in past year						
1 home	1 (ref)		1 (ref)		1 (ref)	
2-3 homes	0.74	0.54, 1.02	1.16	0.80, 1.67	0.55	0.23, 1.32
≥ 4 homes	0.92	0.54, 1.58	1.98	1.15, 3.39**	0.94	0.13, 6.62
<i>Family</i>						
Family functioning (POSIT) score						
Low risk: 0-3	1 (ref)		1 (ref)		1 (ref)	
High risk: ≥ 4	1.44	1.02, 2.04**	1.15	0.79, 1.69	1.84	0.78, 4.34
Parent w/serious drinking problem						
No	1 (ref)		1 (ref)		1 (ref)	
Yes	1.36	0.94, 1.97*	1.76	1.12, 2.75**	1.34	0.42, 4.23
Family member committed suicide						
No	1 (ref)		1 (ref)		1 (ref)	
Yes	1.07	0.58, 1.99	2.22	1.23, 3.98**	4.25	1.25, 14.47**

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**Table 3, Continued**  
**Multivariate Analysis of Correlates of Lifetime Meth Use**  
**and Use of Meth and Other Drugs During Pregnancy**

Determinant	Model 1 <i>Lifetime Meth Use</i> <sup>†</sup>		Model 2 <i>Use of Any Drugs During Pregnancy</i>		Model 3 <i>Use of Meth During Pregnancy</i>	
	Adjusted RR	95% CI	Adjusted RR	95% CI	Adjusted RR	95% CI
<i>Cultural</i>						
Degree to which live by traditional way						
Not at all/Not much	1 (ref)		1 (ref)		1 (ref)	
Some/A lot	1.06	0.70, 1.61	1.01	0.64, 1.58	1.94	0.61, 6.21
Importance of having traditional values						
Not/somewhat important	1 (ref)		1 (ref)		1 (ref)	
Very important	1.02	0.64, 1.63	0.42	0.23, 0.76***	0.17	0.03, 1.20*

<sup>†</sup> Model 1 also adjusted for lifetime use of alcohol, marijuana, crack/cocaine, barbiturates, and inhalants

\*  $p < 0.1$

\*\* $p < 0.05$

\*\*\*  $p < 0.005$

**Exploratory Analysis of Pregnancy Meth and Other Drug Use**

Two independent models of substance use during pregnancy were created: one for any substance use (including meth, alcohol, marijuana, crack/cocaine, barbiturates, or inhalants), and one specifically for meth use. Participants at Site 3 were significantly less likely to use meth (RR = 0.04,  $p < 0.005$ ) or any substances during pregnancy (RR = 0.25,  $p < 0.005$ ) than participants at Site 1. Participants who had lived in four or more homes vs. one home in the previous year were twice as likely to use any substances during pregnancy (RR = 1.98,  $p < 0.05$ ). Participants who reported parent abuse of alcohol were 1.76 times more likely to report substance use during pregnancy ( $p < 0.05$ ). Having an immediate family member who had committed suicide quadrupled participants’ risk of meth use and doubled risk of any substance use during pregnancy (RR = 4.25 [ $p < 0.05$ ] and RR = 2.22 [ $p < 0.05$ ], respectively). Individuals who ascribed greater importance to practicing traditional Indian values were less likely to report meth or any substance use during pregnancy (RR = 0.17 [ $p < 0.1$ ] and RR = 0.42 [ $p < 0.005$ ], respectively).

**Exploratory Analysis of Family Functioning and Meth and Other Drug Use**

Table 4 reports chi-squared results for associations between POSIT family functioning scale items, lifetime meth use, and use of meth or any other drugs during pregnancy. Lifetime meth use was consistently associated with higher family dysfunction scores. Individuals with high vs. low family dysfunction POSIT scores also began alcohol and marijuana use at younger ages (14.1 vs.

14.9 years for alcohol,  $p < 0.001$ ; 13.7 vs. 14.3 years for marijuana,  $p < 0.05$ ), and earlier initiation of drug use correlated with meth use. For every POSIT item, there was a greater proportion of women who had “ever used” meth in the higher family dysfunction category, with 7 of 11 items reaching significance at the  $p < 0.05$  level and 3 of 11 at the  $p < 0.1$  level. Similar POSIT patterns were found for use of meth or any drugs during pregnancy. POSIT items most strongly associated with lifetime and pregnancy drug use included, “Do your parents/guardians argue a lot?” and “Do you and your parents/guardians have frequent arguments which involve yelling or screaming?” Items negatively correlated with drug use included, “Do your parents/guardians and you do lots of things together?” and “Do your parents/guardians have a pretty good idea of your interests?”

**Table 4**  
**Association between POSIT Items and Lifetime and Pregnancy Methamphetamine use and Other Drug use, With Chi-Squared Test Results**

POSIT Family Functioning Items	Lifetime Meth Use		Pregnancy Drug Use		Pregnancy Meth Use	
	% used meth in lifetime	<i>p</i> value	% used any drug in pregnancy	<i>p</i> value	% used meth in pregnancy	<i>p</i> value
Do your parents or guardians argue a lot?						
No	22.1		21.3		3.2	
Yes	37.9	0.009	39.4	0.003	12.1	0.003
Do your parents or guardians refuse to talk with you when they are mad at you?						
No	22.4		22.9		4.0	
Yes	31.1	0.085	28.6	0.256	6.7	0.277
Do your parents or guardians usually know where you are and what you are doing?						
No	39.7		33.3		6.4	
Yes	22.2	0.004	23.0	0.088	4.7	0.583
Do your parents or guardians and you do lots of things together?						
No	35.7		35.7		8.7	
Yes	20.2	0.002	19.2	0.001	3.0	0.024
Do your parents or guardians pay attention when you talk to them?						
No	38.9		33.3		8.3	
Yes	24.0	0.055	23.7	0.206	4.6	0.333
Do your parents or guardians have rules about what you can and cannot do?						
No	31.4		28.0		6.8	
Yes	22.4	0.077	23.4	0.362	4.0	0.269

continued on next page

**Table 4, Continued**  
**Association between POSIT Items and Lifetime and Pregnancy Methamphetamine use and Other Drug use, With Chi-Squared Test Results**

POSIT Family Functioning Items	Lifetime Meth Use		Pregnancy Drug Use		Pregnancy Meth Use	
	% used meth in lifetime	<i>p</i> value	% used any drug in pregnancy	<i>p</i> value	% used meth in pregnancy	<i>p</i> value
Do your parents or guardians know what you really think or feel?						
No	29.7		27.1		5.5	
Yes	19.0	0.035	21.5	0.258	4.1	0.579
Do you and your parents or guardians have frequent arguments which involve yelling or screaming?						
No	21.3		21.7		2.7	
Yes	45.5	0.000	41.8	0.002	16.4	0.000
Do your parents or guardians like talking with you and being with you?						
No	35.7		38.1		9.5	
Yes	24.2	0.111	23.1	0.037	4.3	0.151
Do your parents or guardians have a pretty good idea of your interests?						
No	40.2		34.1		11.0	
Yes	20.6	0.000	21.9	0.027	2.9	0.004
Do your parents or guardians usually agree about how to handle you?						
No	36.0		29.8		5.3	
Yes	19.9	0.002	22.3	0.138	4.8	0.872

Positive family functioning, as measured by the POSIT, was also associated with traditional cultural affinity. For example, 71% of those who said they lived a traditional way of life had positive family functioning vs. 56% who did not believe living a traditional way of life was important ( $p < 0.01$ ). Similarly, 72% of respondents who felt it was more important to have traditional Indian values had positive family functioning, versus 58% of respondents who reported it was less important to have traditional Indian values ( $p < 0.05$ ; data not shown).

## DISCUSSION

### Drug Use

Lifetime meth use in this sample of pregnant AI teens was up to 3 times higher than among previous national samples of AI/AN adolescents (Oetting et al., 2000) and approximately 5 times higher than U.S. All Races adolescents (Springer, Peters, Shegog, White, & Kelder, 2007; Johnston et al., 2006). Past-month use of meth (2.5%) was double past-month use in comparable samples of U.S. All Races youth (Iritani, Hallfors, & Bauer, 2007). Reported meth use during pregnancy (5.3%) was approximately 5 times higher than recent national samples of pregnant women (National Institute on Drug Abuse, 2006).

Mean age at first meth use (15.7 years) was considerably lower than among the general U.S. population (22.1 years in 2004; Substance Abuse and Mental Health Services Administration, 2006). Generally consistent with gateway theory (Kandel, 1975), exposure to meth in this sample occurred later than exposure to other legally available substances (alcohol and inhalants) and marijuana and crack/cocaine. However, in contrast with gateway theory findings in other U.S. adolescent populations (Willner, 2001), participants were more likely to initiate marijuana use prior to alcohol use and had equal exposure to alcohol and marijuana (77.6% vs. 74.8%). Meth use was more highly correlated with marijuana use than with use of alcohol, cocaine, or any other drug. This finding is consistent with another large prospective study of western AI adolescents, which showed that initiation of marijuana use prior to alcohol use increased the risk of substance use progression (Novins & Barón, 2004). Further study is needed to determine if teen pregnancy and early initiation of marijuana use are linked risk factors for substance use progression. Early marijuana use should be an indicator for intervention in the AI communities participating in this study, and potentially in other similar AI/AN communities.

### Correlates of Drug Use Risk

#### Sociodemographic Factors

We found no differences in meth use related to education or marital status, age at conception, parity, or use of food stamps, which may be a function of the limited variability in socioeconomic status among the participating communities. However, we found that geographic location was strongly correlated with meth use risk. The four participating communities vary somewhat in population (ranging from approximately 13,000 to 27,000) and are located on three different reservation lands that differ in topography and proximity to urban areas. Site 2, which had the highest lifetime and pregnancy meth use rates, is the southernmost site and is closest (1-2 hours)



to two large urban population centers. Site 3, which had the lowest rates, is the northernmost and the most geographically distant (> 4 hours) from urban centers. Sites 1 and 4 are in between with respect to geographic isolation and drug use risk. Differences in levels of drug trafficking from southern urban centers may influence adolescents' exposure and use. For example, drug traffickers from Mexico, which controls 70-90% of meth production and distribution to the U.S., may exploit the southernmost AI reservations, which generally have fewer law enforcement resources and face complications in applying legal consequences to outsiders (Brouwer et al., 2006). However, the fact that other drug use was also higher in the sites with high meth use complicates the picture, but may mean that other drug exposure is necessary and facilitates the uptake of meth.

After adjusting for site in multivariate models, family dysfunction and residential instability remained significant risks, and traditional cultural affinity remained significantly protective. High residential mobility in this sample was also correlated with greater family dysfunction (42% of those who had lived in  $\geq 2$  homes in the previous year had high family dysfunction scores, as compared to 31% of those who had lived in only one home,  $p < 0.05$ ).

### **Family factors**

Family factors correlated with meth use in this sample hold clues for prevention. Teen mothers who reported growing up in families with poor functioning and high conflict (e.g., parents who frequently argued, yelled), as measured by the POSIT, were at greatest risk for lifetime meth and pregnancy drug use. In contrast, teens who felt understood by their parents/guardians (e.g., parents/guardians have "good idea of my interests") had lower drug use. These findings are consistent with child development theories indicating that ineffective parenting leads to a variety of poor child behavior outcomes (Patterson et al., 1989), including drug use, and predict drug use will be perpetuated across generations in the absence of family-based intervention.

Our exploration of correlations of severe drug use with other indicators of family dysfunction yields several directions for future research. Parental history of alcohol problems and family history of suicide were correlated with the most severe drug use risk, including pregnancy use of meth and other drugs. We hypothesize that these mothers' serious drug use may be correlated with a more severe history of family dysfunction. The role of family history of psychiatric disorders is unknown in this sample, and is an important piece of the puzzle in understanding the constellation of family-based risks for drug use. Further research is needed to target reduction of children's *in utero* exposure to drugs and the perpetuation of negative mental health outcomes across generations in Native and other similarly challenged communities.

While a growing body of studies has demonstrated that positive parenting interventions are preventive for lifetime child behavior risks (Kumpfer & Alvarado, 2003; Etz, Robertson, & Ashery, 1998), rigorous trials with AI/AN reservation communities have been scarce (see Novins, 2009). Baseline data from the current trial regarding family-based risks that affect drug use among teen mothers, and ultimately the ability of the Family Spirit intervention to reduce drug use in AI teen mothers and their offspring, holds high public health significance for Indian communities.

### **Cultural factors**

Participants who ascribed importance to having strong traditional Indian values were less likely to use meth and other substances during pregnancy, and were also more likely to have positive scores (i.e., low risk of problems) for family functioning. Strong cultural identification has been shown to be protective against substance use among other populations, as well as AIs (Castro et al., 2007; Szlemko et al., 2006). AIs have unique traditions that view pregnancy and childbearing as spiritually sacred (Cesario, 2001). The participating tribes have special cultural practices during pregnancy to honor and protect the growing child spirit, such as avoiding negative thoughts or foreign foods or smells. Engagement in unique traditional Native customs and beliefs has potential to strengthen drug prevention efforts among pregnant AI/AN women. Further, the fact that the majority (80%) of females who used meth in their lifetime did *not* use meth during pregnancy may indicate that pregnancy presents a distinct opportunity for behavioral redirection.

### **Limitations**

There are several limitations to this study. Given the cross-sectional nature of the analyses, we are unable to make assumptions regarding causality of the identified associations. The small sample size and relatively small numbers of teens who used meth ( $n = 17$ ) or any drugs ( $n = 81$ ) during pregnancy limited our ability to draw definitive conclusions. The generalizability of our findings is also limited by potential sampling bias, as we only included AI adolescents who agreed to participate in the Family Spirit intervention study. We suspect that the expectant teens who enrolled in the trial may have had lower meth use risk than their communities' pregnant teen populations at large. Further, substance use, especially illicit drug use, is historically susceptible to underreporting among youth. Our sample may have viewed reporting sensitive information about drug use during and prior to pregnancy as socially undesirable, potentially yielding lower estimates. Family history of drug use is also susceptible to underreporting by adolescent populations.

Meth use estimates during pregnancy were also potentially problematic. In an effort to provide the most statistically robust estimates, the variable for pregnancy meth use was created by combining two questions (use of substance since time of conception, when participants may

not have known they were pregnant yet, and use of substance during past 30 days of pregnancy, when participants knew they were pregnant). Upon running the same multivariate models for the individual questions, similar trends were seen, but with diminished statistical significance. Further, the pregnancy usage captured only the time from conception to study enrollment (mean gestational age 25 weeks) and not use during the third trimester, once again potentially resulting in underestimates of pregnancy use. Finally, dichotomizing groups related to the cultural identity scales potentially oversimplifies the interpretation of participants' cultural affinity.

### **CONCLUSIONS**

High reported rates of meth and other drug use among this sample of expectant teens support disparities found among other AI/AN populations and increase the urgency for determining effective substance abuse prevention strategies among AI/AN adolescents, especially those at risk for pregnancy. The strong association of family and traditional cultural factors with meth and other substance use within this sample suggests that further research on the utility of culturally driven family strengthening approaches to prevent children's drug use is warranted within AI/AN populations. While expectant AI/AN teens are exposed to multiple environmental risks, pregnancy and early childbearing may provide a pivotal developmental time point for effecting lasting behavior change in ways that tap local cultural strengths. Because a large proportion of AI/AN women begin childbearing as teenagers, the success of such interventions has important public health significance to breaking multigenerational cycles of drug abuse.

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## REFERENCES

- American Indian Families Project (2004). *A look at American Indian families in Hennepin County part 4: Voices of American Indian families*. Minneapolis: Hennepin County Office of Planning and Development.
- Barlow, A., Varipatis-Baker, E., Speakman, K., Ginsburg, G., Friberg, I., Goklish, N., et al. (2006). Home-visiting intervention to improve child care among American Indian adolescent mothers. *Archives of Pediatric and Adolescent Medicine*, *160*, 1101-1107.
- Barlow, A. & Walkup, J. (1998). Developing mental health services for Native American children. *Child and Adolescent Psychiatric Clinics of North America*, *7*, 555-577.
- Barlow, A. & Walkup, J. (2008). The First Americans have much to teach us. *Journal of the American Academy of Child and Adolescent Psychiatry*, *47*, 843-844.
- Barros, A. J. & Hirakata, V. N. (2003). Alternatives for logistic regression in cross-sectional studies: An empirical comparison of models that directly estimate the prevalence ratio. *BMC Medical Research Methodology*, *3*, 21.
- Brouwer, K. C., Case, P., Ramos, R., Magis-Rodriguez, C., Bucardo, J., Patterson, T. L., et al. (2006). Trends in production, trafficking, and consumption of methamphetamine and cocaine in Mexico. *Substance Use & Misuse*, *41*, 707-727.
- Castro, F. G., Garfinkle, J., Naranjo, D., Rollins, M., Brook, J. S., & Brook, D. W. (2007). Cultural traditions as "protective factors" among Latino children of illicit drug users. *Substance Use & Misuse*, *42*, 621-642.
- Cesario, S. K. (2001). Care of the Native American woman: Strategies for practice, education, and research. *Journal Obstetric, Gynecologic, and Neonatal Nursing*, *30*, 13-19.
- Chang, L., Smith, L. M., LoPresti, C., Yonekura, M. L., Kuo, J., Walot, I., et al. (2004). Smaller subcortical volumes and cognitive deficits in children with prenatal methamphetamine exposure. *Psychiatry Research*, *132*, 95-106.
- Etz, K.E., Robertson, E.B., & Ashery, R.S. (1998). Drug Abuse Prevention Through Family-Based Interventions: Future Research. In R.S Ashery, E.B. Roberston, & K. L. Kumpfer. *Drug abuse prevention through family interventions* (NIDA Monograph 177, pp. 1-11). Rockville, MD: U.S. Department of Health and Human Services. Retrieved December 3, 2009 from <http://www.nida.nih.gov/pdf/monographs/monograph177/download177.html>

- Gruenewald, P. J. & Klitzner, M. (1991). Results of a preliminary POSIT analysis. In E. Rahdert (Ed.), *Adolescent Assessment Referral System Manual*. Rockville, MD: U.S. Department of Health and Human Services.
- Haight, W., Jacobsen, T., Black, J., Kingery, L., Sheridan, K., & Mulder, C. (2005). "In these bleak days": Parent methamphetamine abuse and child welfare in the rural Midwest. *Children and Youth Services Review*, 27, 949-971.
- Howard, B. V., Lee, E. T., Cowan, L. D., Devereux, R. B., Galloway, J. M., Go, O. T., et al. (1999). Rising tide of cardiovascular disease in American Indians. The Strong Heart Study. *Circulation*, 99, 2389-2395.
- Indian Health Service (2001). *Trends in Indian Health, 1998-1999*. Rockville, MD: U.S. Department of Health and Human Services. Retrieved December 3, 2009 from <http://www.ihs.gov/publicinfo/publications/trends98/trends98.asp>
- Iritani, B. J., Hallfors, D. D., & Bauer, D. J. (2007). Crystal methamphetamine use among young adults in the USA. *Addiction*, 102, 1102-1113.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2006). *Monitoring the Future national results on adolescent drug abuse: Overview of key findings, 2005* (Rep. No. NIH Publication No. 06-5882). Bethesda, MD: National Institute on Drug Abuse.
- Kandel, D. (1975). Stages in adolescent involvement in drug use. *Science*, 190, 912-914.
- Kumpfer, K. L. (1998). *Selective preventive interventions: The Strengthening Families Program*. In R.S Ashery, E.B. Roberston, & K. L. Kumpfer. *Drug abuse prevention through family interventions* (NIDA Monograph 177, pp. 1-11). Rockville, MD: U.S. Department of Health and Human Services. Retrieved December 3, 2009 from <http://www.nida.nih.gov/pdf/monographs/monograph177/download177.html>
- Kumpfer, K. L., Alexander, J., McDonald, L., & Olds, D. L. (1998). Family-focused substance prevention: What has been learned from other fields. In R.S Ashery, E.B. Roberston, & K. L. Kumpfer. *Drug abuse prevention through family interventions* (NIDA Monograph 177, pp. 1-11). Rockville, MD: U.S. Department of Health and Human Services. Retrieved December 3, 2009 from <http://www.nida.nih.gov/pdf/monographs/monograph177/download177.html>
- Kumpfer, K. L. & Alvarado, R. (2003). Family-strengthening approaches for the prevention of youth problem behaviors. *American Psychologist*, 58, 457-465.

- Mitchell, C. M., Beals, J., & Whitesell, N. R. (2008). Alcohol use among American Indian high school youths from adolescence and young adulthood: A latent Markov model. *J.Stud.Alcohol Drugs, 69*, 666-675.
- Moran, J. R., Fleming, C. M., Somervell, P., & Manson, S. M. (1999). Measuring bicultural ethnic identity among American Indian adolescents. *Journal of Adolescent Research, 14*, 405-426.
- National Institute on Drug Abuse (2006). *Methamphetamine Abuse and Addiction*. Bethesda, MD: U.S. Department of Health and Human Services.
- National Institute on Drug Abuse (2009). *Info Facts: Methamphetamine*. Rockville, MD: National Institutes of Health – U.S. Department of Health and Human Services.
- Novins, D. K. & Barón, A. E. (2004). American Indian substance use: the hazards for substance use initiation and progression for adolescents aged 14 to 20 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 43*, 316-324.
- Novins, D. K., Beals, J., & Mitchell, C. M. (2001). Sequences of substance use among American Indian adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*, 1168-1174.
- O'Brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality and Quantity, 41*, 673-690.
- Oetting, E. R., Deffenbacher, J. L., Taylor, M. J., Luther, N., Beauvais, F., & Edwards, R. W. (2000). Methamphetamine use by high school students: Recent trends, gender and ethnicity differences, and use of other drugs. *Journal of Child and Adolescent Substance Use, 10*, 33-50.
- Office of Technology Assessment. (1990). Indian adolescent mental health. Washington, D.C.: U.S. Government Printing Office.
- Patterson, G. R., DeBaryshe, B. D., & Ramsey, E. (1989). A developmental perspective on antisocial behavior. *American Psychologist, 44*, 329-335.
- Plessinger, M. A. (1998). Prenatal exposure to amphetamines. Risks and adverse outcomes in pregnancy. *Obstetrics and Gynecology Clinics of North America, 25*, 119-138.
- Rahdert, E. (1991). *Adolescent assessment/referral system manual*. Rockville, MD: U.S. Department of Health and Human Services.
- Rogers, B. (2001). A path of healing and wellness for Native families. *American Behavioral Scientist, 44*, 1512-1514.

- Russell, K., Dryden, D. M., Liang, Y., Friesen, C., O'Gorman, K., Durec, T., et al. (2008). Risk factors for methamphetamine use in youth: A systematic review. *BMC Pediatrics*, 8, 48.
- Santisteban, D. A., Tejada, M., Dominicis, C., & Szapocznik, J. (1999). An efficient tool for screening for maladaptive family functioning in adolescent drug abusers: The Problem Oriented Screening Instrument for Teenagers. *American Journal of Drug and Alcohol Abuse*, 25, 197-206.
- Sattah, M. V., Supawitkul, S., Dondero, T. J., Kilmarx, P. H., Young, N. L., Mastro, T. D., et al. (2002). Prevalence of and risk factors for methamphetamine use in northern Thai youth: Results of an audio-computer-assisted self-interviewing survey with urine testing. *Addiction*, 97, 801-808.
- Shillington, A. M., Lehman, S., Clapp, J., Hovell, M. F., Sipan, C., & Blumberg, E. J. (2005). Parental monitoring: Can it continue to be protective among high-risk adolescents? *Journal of Child and Adolescent Substance Use*, 15, 1-15.
- Smith, L., Yonekura, M. L., Wallace, T., Berman, N., Kuo, J., & Berkowitz, C. (2003). Effects of prenatal methamphetamine exposure on fetal growth and drug withdrawal symptoms in infants born at term. *Journal of Developmental and Behavioral Pediatrics*, 24, 17-23.
- Smith, L. M., Lagasse, L. L., Derauf, C., Grant, P., Shah, R., Arria, A. et al. (2006). The infant development, environment, and lifestyle study: Effects of prenatal methamphetamine exposure, polydrug exposure, and poverty on intrauterine growth. *Pediatrics*, 118, 1149-1156.
- Springer, A. E., Peters, R. J., Shegog, R., White, D. L., & Kelder, S. H. (2007). Methamphetamine use and sexual risk behaviors in U.S. high school students: Findings from a national risk behavior survey. *Prevention Science*, 8, 103-113.
- Substance Abuse and Mental Health Services Administration (2006). *Results from the 2005 National Survey on Drug Use and Health: National Findings (Rep. No. DHHS Publication No. SMA 06-4194)*. Rockville, MD: Author.
- Substance Abuse and Mental Health Services Administration (2008). *Results from the 2007 National Survey on Drug Use and Health: National Findings (Rep. No. DHHS Publication No. SMA 08-4343)*. Rockville, MD: Author.
- Szlemko, W. J., Wood, J. W., & Thurman, P. J. (2006). Native Americans and alcohol: Past, present, and future. *J Gen Psychol*, 133, 435-451.
- Walkup, J., Barlow, A., Mullany, B. C., Pan, W., Goklish, N., Hastings, R., et al. (2009) Randomized controlled trial of a paraprofessional-delivered in-home intervention for young reservation-based American Indian mothers. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(6), 585-586.

Willner, P. (2001). A view through the gateway: Expectancies as a possible pathway from alcohol to cannabis. *Addiction*, 96, 691-703.

Zou, G. (2004). A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol.*, 159, 702-706.

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