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Maturation, Peer Context, and Indigenous Girls' Early-Onset Substance Use

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Abstract

This paper examines a biosocial model of the impact of puberty on Indigenous girls' early-onset substance use by considering the potential mediating role of peer context (i.e. mixed-sex peer groups and substance use prototypes) on the puberty and substance use relationship. Data include responses from 360 girls of a common Indigenous cultural group residing on reservations/reserves in the upper Midwest and Canada. Results of structural equation modeling revealed that the statistically significant relationship between girls' pubertal development and early-onset substance use was mediated by both mixed-sex/romantic peer groups and favorable social definitions of substance use. Implications for substance use prevention work include addressing the multiple and overlapping effects of peer influence from culturally-relevant perspectives.

Keywords

Although adolescent substance use and experimentation is a generally normative behavior, earlier onset substance use (i.e. before age 14) is associated with increased risk for a constellation of negative outcomes including school troubles, later drug and alcohol abuse, and increased risk for adulthood problems (Ellickson, Tucker, & Klein, 2003; Kaplow et al., 2002; McGue et al., 2001). Considering these consequences, reports that North American Indigenous (American Indian/First Nations) youth may be more likely than non-Native youth to engage in early-onset (May, 1982, 1986) and non-experimental substance use (Herring, 1994) are especially unfortunate.

A more specific focus on gender and substance use patterns across diverse North American Indigenous cultural groups has yielded inconsistent findings. Whereas some researchers report higher rates of use among Indigenous males (Neumark-Sztainer et al., 1996), others conclude that Indigenous females use drugs and alcohol more often than or at similar rates as their male peers (Spears, Longshore, McCaffrey & Ellickson, 2005). The young girls included in this study sample reported greater growth than boys in substance use patterns across the middle school years (Walls, 2008). This study is an attempt to understand why. The purpose of this paper is to extend existing research to examine the impact of puberty on Indigenous girls' early-onset substance use, with additional consideration of the potentially mediating effects of social context. More specifically, this research tests a biosocial model of the extent to which favorable social definitions towards substance use (i.e. perceived

friends' substance use, perceptions of others who engage in substance use) and affiliation with males and both male/female (mixed-sex) peer groups account for the widely documented relationship between pubertal development and substance use within a specific Indigenous cultural group.

Literature Review

Biosocial Perspectives: Pubertal Development and Substance Use

Pubertal development represents a critical period of transition for girls, and pubertal status has been identified as an important factor in the development of a variety of negative psychological, social, and behavioral outcomes, including depression and psychological distress (Ge, Conger, & Elder, 1996), school troubles (Stattin & Magnusson, 1990), and eating disorders (Keel, Fulkerson, & Leon, 1997). Pubertal development has also been linked to an increased risk for adolescent substance use (Biehl, Natsuaki, & Ge, 2007; Lanza & Collins, 2002; Westling, Andres, Hampson, & Peterson, 2008), although we still have much to learn about the specific mechanisms that account for this relationship (Haynie, 2003).

Biosocial theorizing maintains that biologically-based risk factors for deviant behavior are exacerbated and revealed via exposure to harmful environments (see Brennan & Raine, 1997 for a review). Empirical tests of biosocial theories have included broad definitions for biological influence such as nervous system functioning (Mednick, Pollock, Volavka, & Gabrielli, 1982), prenatal risk and birth complications (Piquero & Tibbetts, 1999), and neuropsychological deficits (Moffitt, 1993) to name but a few (see Raine, 2002 for a comprehensive review). Biosocial explanations for environmental risk likewise have received expansive conceptualizations encompassing family, peer, school, and neighborhood contexts (i.e., Ge, Conger, Simons, Brody, & Murry, 2002; Westling et al., 2008)

Biosocial theorizing can serve as the basis for a more specified *sequential* biosocial effect (Raine, Brennan & Farrington, 1997) whereby pubertal development (biological component) is a developmental process that influences and impacts the social environment. Our conceptual framework begins with the biological onset of puberty. Especially for girls, rapid physical maturation during puberty acts as a "sign stimulus to others in the social environment" (Caspi, Lynam, Moffitt, & Silva, 1993, p. 26). Estrogen effects such as breast and hip development become observable aspects of sexual attractiveness while simultaneous androgen effects influence sexual motivation (Smith, Udry & Morris, 1985). These noticeable changes may attract the attention of boys who have been found to frequently mention physical attractiveness as an important factor in whom to date (Feiring, 1996). Girls' pubertal development thus includes increased affiliation and/or membership with mixed-sex peer groups and the onset of intimate, romantic relationships (Furman & Wehner, 1994; Gottman & Mettetal, 1986; Stattin & Magnusson, 1990).

In addition to growing involvement with males, the shifting orientation and emphasis on peers (rather than parents) throughout the pubertal transition may introduce developing females to more deviant peer groups in general (Haynie, 2003; Stattin & Magnusson, 1990). Further, attitudes (or, prototypes, as they are discussed below) towards substance using-peers have been shown to become increasingly favorable as children enter adolescence (Andrews, Tildesley, Hops, Duncan & Severson, 2003), especially among females who experience physical maturation earlier than their peers (Ge et al., 2006).

Each of these developmentally-linked social changes: involvement with boys, and exposure to deviant peers, can subsequently serve as risk factors for delinquent behaviors including early-onset substance use. An example of such sequential biosocial effects was offered over

twenty years ago by Magnusson and colleagues (1985), who argued that the relationship between pubertal changes and deviant behavior "is most likely to be mediated by an environment that changes as a consequence of changes in the individual" (p. 273). Similarly, Wichstrom (2001) found that much of the association between early puberty and alcohol use among Norwegian students was partially mediated by friends' problem behavior. More recent research revealed a significant partially mediating effect of deviant peers on the association between pubertal timing and substance use for girls but not boys (Westling, Andrews, Hampson & Peterson, 2008). In sum, pubertal development increases adolescent girls level of involvement with delinquent peers and/or males, both of which increase risk for early-onset substance use; the mechanisms through which changing social contexts might influence the start of substance use are more fully elaborated in the following sections.

Opposite-Sex Peers and Romantic Relationships

Past research has explicitly linked girls' delinquency to mixed-sex peer affiliations. For instance, Haynie (2003) reported that two of the strongest mechanisms accounting for the puberty and deviance association were delinquent peers and romantic relationships. While most of the delinquent activity of males occurs in all-male peer groups, female offenses have been shown to be significantly more likely to happen in mixed-sex groups, with the most extreme example of this gender difference occurring in the case of alcohol use (Warr, 1996). Similarly, Caspi and colleagues (1993) found that pubertal development was uniquely important to girls' delinquent behaviors in the context of mixed-sex educational settings as opposed to all-female schools.

Romantic relationships play a particularly influential role on adolescent behavior and are part of an important developmental transition period in which heterosexual adolescents show increasing interest in intimacy and the opposite sex (Furman & Wehner, 1994). The impact of romantic partner behavior has been shown to contribute a unique effect on an adolescent's own delinquency even after controlling for the effects of other friends' behaviors (Haynie, Giordano, Manning, & Longmore, 2005). Criminological research has suggested that boyfriends are linked to the initiation of female crime and delinquency (Steffensmeier & Allan, 1996), and that this "bad boyfriend" effect may be especially strong in terms of "minor" delinquent acts, including substance use (Haynie et al., 2005). Explanations for a romantic-partner influence include emphasis on the intensity of such relationships (Collins, 2003) as well as examination of the social context of dating. For example, youth relationships generally progress from same-sex peer groups to mixed-sex networks, which are followed by the emergence of adolescent romance (Connolly, Craig, Goldberg & Pepler, 2004; Feiring, 1996). Thus, romantic-partner influence in adolescence extends beyond a dyadic relationship and may also occur first and in conjunction with friendship networks.

Peer Behavior and Prototypes

Social milieu relevant to adolescent development also includes the impact and behaviors of peers more generally. The effects of peer influence on adolescent behavior are tremendous. The peer context is one of the strongest and most robust predictors of adolescent substance use in the academic literature (Bauman & Ennett, 1994; Warr, 2002). In fact, Warr (2002) concluded that marijuana and alcohol use specifically occur almost entirely in group settings.

From a related concept, Gibbons and Gerrard's (1995) prototype model of behavior suggests that youths who have favorable perceptions or images of substance-using peers will ultimately be more likely to engage in similar behaviors themselves (Gerrard et al., 2002; Gerrard, Gibbons, Stock, Vande Lune, & Cleveland, 2005). Prototypes are especially

significant in that adolescent substance use is seen as a very social and symbolically meaningful behavior (Gibbons & Gerrard, 1995). Thus, the development of positive substance use prototypes may in fact represent a form of social mediation occurring between the puberty and substance use relationship.

Cultural Context

A search of the relevant literature revealed only one study that examined the link between puberty and substance use within an Indigenous population. Deardorff and colleagues (2005) found that girls who had experienced early puberty were more likely to engage in early-onset substance use, sexual intercourse, and become pregnant as adolescents. Although these authors reported congruent findings across the four (white, black, Latino, Native American) ethnic groups in their sample, they caution readers, calling for further culturally relevant work. In addition, it is unclear whether or not the 159 "Native Americans" included in the study represent a single cultural or tribal group, and the authors acknowledge a study weakness of relying only on women who had experienced an early pregnancy.

Other studies suggest a qualitatively unique social context for Indigenous youth compared to other ethnic groups (Unger, 2003). Particularly for youth living on small, close-knit reservation/reserve communities, peer groups often include relatives (i.e. cousins, siblings) as well as non-related peers. The closeness and importance of family relationships for many Indigenous groups, including the cultural group included in this study, underscores the potentially potent influence of overlapping peer/family networks. Greater familial rates of substance abuse among Indigenous families compared to other ethnic groups in the United States may produce heightened levels of learned substance use behaviors and adolescent exposure to substance use from not only peers (as is often found in the dominant culture) but also from a variety of relatives (Waller, Okamoto, Miles, & Hurdle, 2003). Based on her research on adolescent cigarette use, Unger (2003) concluded that peer influence on smoking was strongest among Indigenous youth than for the other racial/ethnic groups in the study sample. Peer influences have been shown to vary by gender among Indigenous youth in the southwest, where Rayle and colleagues (2006) found that girls reported significantly more drug offers and had more difficulty refusing drugs than did boys; the majority of these drug offers came from cousins, friends, and older peers. Taken together, this body of research suggests that Indigenous youth peer networks often include relatives, and that these networks may be more influential to the onset of substance use than has been found for youths of other race/ethnicities, particularly so for Indigenous girls.

More generally, the unique history and contemporary context of reservation life warrants discussion as a foundation from which to consider the impact and meaning of puberty and peer influence. Colonization has included years of genocide and assimilation attempts including physical and psychological torment and forced removal and relocation that have resulted in a systematic attack on Indigenous culture and community (EchoHawk 1997; Duran and Duran 1995). As a result, many Indigenous communities today face poverty and a lack of economic opportunities and related resources (Roubideaux, 2005). Indigenous youths and their families have thus endured a significant exposure to historical and contemporary stressors that may contribute to substance use and other risky behaviors.

The traditional ways of the Indigenous culture comprising this sample include ceremonies that observe the pubertal transition as a significant shift between the roles of child and adulthood. Adolescent girls traditionally experienced pubertal ceremonies beginning with menarche. The ability of women to bear children and the power and strength associated with monthly menstruation are symbols of respect within the culture and are afforded special recognition in a number of spiritual activities. Although the acculturating effects of colonization have led to fewer pubertal ceremonies in the Indigenous communities included

in our study, the cultural significance of menarche, monthly menstrual cycles, and motherhood persist.

Control Variables

Our analyses include three control variables found to relate to substance use in previous studies. Adolescents living in households that are experiencing higher rates of financial strain than others have been shown to be at higher risk for a variety of negative behavioral and psycho-social outcomes that include substance use (Ge et al., 1992; Hawkins, Catalano, & Miller, 1992; Whitbeck et al., 1991). Family structure has also been linked to substance use. For example, youth living in single parent homes have been found to participate in more serious substance use behaviors than those in dual parent household; this association has been explained in terms of a differential exposure to stressors and deviant peers among those youth who live with only one adult (Barrett & Turner, 2006), and can also be understood in terms of lower opportunities for parental monitoring and discipline when only a single caretaker is engaged in parenting (Whitbeck, Simons, & Kao, 1994; Whitbeck, Simons, & Goldberg, 1996). Remote geographical location is the final control variable included in these analyses. Although all of the reservation and reserve sites may be considered rural, several of the Canadian reserve locations are geographically isolated. Although such isolation might lead one to expect less accessibility to marijuana and alcohol (see, or example, Chiu, Perez, & Parker, 1997), qualitative information and anecdotal evidence from our project community partners suggest otherwise. Due to a these contradictory explanations, the remote location measure is included here as a sample-specific contextual control variable.

Hypotheses

In sum, pubertal development has been linked to both a) girls' substance use, and b) social contexts that increase girls' risk for substance use. As such, we propose the following hypotheses: H1: Level of pubertal development will be positively associated with early-onset substance use. H2: The effects of puberty on substance use will be mediated by both (a) exposure to mixed-sex peer groups and dating, and, (b) more favorable substance use prototypes and substance using peers.

Method

Sample and Methodology

Data for this paper were collected as part of an ongoing longitudinal study designed in partnership with four American Indian reservations in the Northern Midwest, six Canadian First Nation reserves, and a university-based research team. As part of this partnership, the names of the reservations and reserves will be excluded from this paper. Four of the reserves are classified as "remote" in that they are considerable distances from even small towns and are accessed by non-paved roads, by boat, over ice in winter, or by airplane. The sample sites share a single common cultural tradition and language with minor regional variations in dialects.

On each reservation or reserve, Tribal Council appointed advisory boards are responsible for hiring staff/interviewers and handling personnel difficulties, advising the research team on questionnaire development, wording, and cultural appropriateness, and reviewing/approving reports and proposals. All participating staff on the reservations and reserves (i.e., interviewers, site coordinators) were approved by advisory boards and were either enrolled tribal members or spouses of enrollees. Interviewers for this project were trained extensively with regards to human subjects' research ethics and interviewing methodology. Training sessions included several on-site (reservation/reserve) visits from University-based

methodologists and IRB experts and included intensive practice interviews and trainer feedback.

Each participating community provided us a list of families of tribally-enrolled children aged 10 – 12 years who lived on or proximate (within 50 miles) to the reservation or reserve. We attempted to contact all families with a target child within the specified age range in order to achieve a population sample of participating communities of this cultural group. Families were recruited through personal interviewer visits during which they were presented a traditional gift, an overview of the project, and an invitation to participate.

For those families who agreed to participate, both the target adolescent and at least one adult caretaker (and in some cases, two adults) were given $40 upon completion of the interviews. The overall response rate for wave 1 was 79.4%, with 95% retention at wave 2. Interviews were conducted in the respondents' home. Youth and adult interviews were conducted separately and in private areas/rooms of the home, or, in some cases, outside of the house (in backyards, on picnic tables, etc., depending upon the respondent's preferences). Most of the data were collected via face-to-face interviewer-administered paper and pencil surveys. Information regarding pubertal development and dating involvement was collected via youth self-administered surveys which were enclosed in sealed and stamped envelope before being returned to researchers for data entry. Nearly all of the interviewers involved in the project belonged to the same Indigenous culture as respondents, and all were members of the same communities. All families were given the option to work with alternate interviewers if they felt uncomfortable for any reason with the initial interviewer selected. Typical interview duration was between 1 ½ to 2 hours.

This paper includes data from wave 1 of the study collected in 2002. In addition, we include responses to substance use onset at wave 2 (one year later) of the study for our dependent variable. Of the 746 participating adolescents, we include responses from female youth only, thus reducing the sample size for this study to 375. Due to recruitment errors, 12 female youth were aged 9 or 13 at wave 1 and thus fell outside of our target of 10 – 12 year old. We omitted those individuals as well as 3 others who had missing data on the age variable at wave 1, leaving us with a final sample size of 360 female adolescents. In addition, adult female caretaker responses to questions related to our control variables are included in the analyses. Missing data were estimated within Mplus using the WLSMV estimator (see analytic plan, below). Item-level missing data investigation revealed that a majority (89%) of cases had missing responses on one or fewer of the variables included in the analyses. Further examination of differences across study variables for those with full versus missing data revealed no statistically significant differences with one exception: compared to those with full data, cases with missing data on at least one variable in the model were more likely to come from remote reserves.

Measures

The dependent variable, *early-onset substance use, was* measured by three indicators of lifetime prevalence substance use (alcohol, cigarettes, and marijuana). In a series of three separate questions, youth were asked to indicate whether or not they had ever had a drink of beer, wine (not counting religious ceremonies), or other alcoholic beverages. Youth who answered `yes' to any of these questions were also coded as yes in a single overall indicator of *alcohol use*. Similarly, youth were asked in separate questions if they had ever smoked a *cigarette* or smoked *marijuana* (pot). All three dichotomous substance use indicators were coded where *0 = no substance use* and *1 = early-onset substance use*.

Pubertal status was measured using the Pubertal Development Scale developed by Petersen and colleagues (1988). Youth were given a self-administered questionnaire asking about

their growth in height, body hair, and skin changes. In addition, girls were asked about breast growth and whether or not they had experienced menarche. For example, to assess height changes respondents were asked: Would you say your growth in height: (1) Has not yet started more than usual, (2) Has barely started, (3) Has definitely started, or (4) Seems finished. Ordered response categories ranging from *1 = No pubertal changes* to *4 = Completed pubertal changes* were given for each item, with the exception of the menarche question for which a yes/no dichotomous response option was provided. The five items for each adolescent were summed then divided by 5 to retain the original 4-item response scale with a Cronbach's alpha value of .63.

Social definitions of substance use represent a latent construct indicated by *peer substance use* and *substance use prototypes*. Peer substance use was created using youth responses to two questions that ask how many of the respondents' three best friends (a) drink alcohol, and (b) smoke cigarettes. Response categories from both questions ranging from *0 = no friends* to *3 = three friends* were summed then divided by two to retain the 0 – 3 response metric. Substance use prototypes were measured based on youth agreement or disagreement with a series of eight statements regarding images of peers and substance use. Examples of these statements include, I think that girls in my grade at school who smoke are cool, It is OK for boys in my grade at school to drink alcohol, and Most kids in my class think that drinking alcohol is dumb. All dichotomous responses were coded so that a value of 1 corresponds to more positive prototypes of substance use. Youth who answered at least five of the items were included in a final summed scale ranging in value from 0 – 8 with a Cronbach's alpha value of .91.

Mixed-sex peers and dating was assessed with a latent construct measured by three indicators: *dating, friends' dating*, and *steady boyfriend*. Each of these three measures is based on responses from the self-report section of our questionnaire. To assess dating involvement, youth were asked to indicate how often they dated on average. Responses ranging from 0 – 6 were coded so that higher frequencies of dating correspond to higher numeric values (0 = have not yet dated, 1 = only dated once or twice, 5 = dated twice a week, 6 = dated 3 or more times a week, etc.). Youth were then asked how many of their close friends dated. Response values for friends' dating were also coded so that higher values indicate a greater number of friends who date: 0 = none of them, 1 = a few of them, 2 = about half of them, 3 = most of them, and *4 = all of them*. As a final indicator of the construct *mixed-sex peers/dating*, youth were asked, "do you have a steady boyfriend?" Dichotomous responses were dummy coded so those in a steady relationship were coded to 1.

Control variables were included in the structural equations models as three separate manifest constructs. *Financial strain* was measured by adult female caretaker responses to questions regarding their family's financial situation (Conger, Ge, Elder, Lorenz, & Simons, 1994). Respondents stated whether they strongly agreed, agreed, disagreed, or strongly disagreed to the following statements: My family has enough money to (1) afford the kind of home we need; (2) afford the kind of clothing we need; (3) afford the kind of food we need; and *(4) afford the kind of medical care we need*. Two additional questions assess financial strain during the past twelve months: (1) how much difficulty have you had paying your bills; and, (2) generally, at the end of each month [how much money] did you end up with? Responses were coded on a 0 – 3 scale, with a higher score indicating higher financial strain. Cronbach's alpha for this measure was .82. *Single-mother* households were indicated by a dummy variable where *single mom (plus child[ren]) = 1* and *0 = all other household arrangements* (i.e. live-in partners, grandparents, extended family members, etc). Last, we controlled for *remote geographical location* where adolescents living in remote areas were coded as 1 and those in less remote sites were coded to 0.

Analytic Plan

Our plan for analysis included three major phases: 1. Descriptive Statistics, 2. Bivariate Correlations, and 3. Structural Equation Models. Bivariate correlations allowed us to examine relationships among observed study variables while also permitting investigation of the hypothesized positive relationship between pubertal development and substance use (*H1*).

We also ran a series of recursive structural equation models to test our hypotheses. Prior to testing any structural models, measurement models were tested for each of our two mediating latent constructs. The first, *Mixed Sex Peers and Dating*, included three observed indicators: *dating, friends' dating*, and *steady boyfriend*. The second latent mediator, S*ocial Definitions of Substance Use* (Soc Defs), included two observed indicator variables: *peer substance use* and *substance use prototypes*. We then investigated the relationship between puberty and substance use net of the control variables (see Figure 1a; *H1*). Our next two models test for the potentially mediating effects of mixed-sex peers and dating (Figure 1b; *H2a*), and substance using peers and positive substance use prototypes (Figure 1c; *H2b*) on puberty and substance use independently. Last, we test for the cumulative effects of these potential mediators on the puberty and substance use relationship.

All analyses were performed using Mplus version 5.1 (Muthen & Muthen, 1998 – 2007). In certain instances across all models, categorical variables (each measure of substance use and, in Models 2 and 4, having a boyfriend) were utilized as indicators of endogenous constructs. Due to this, a weighted least squares estimator (WLSMV) was utilized for all models. Regression coefficients related to categorical endogenous variables were interpreted as probit estimates, while the remaining coefficients were linear regression estimates.

Results

Table 1 illustrates descriptive information and bivariate correlations for all variables. One-quarter of the girls in this sub-sample (mean age = 11.04 years at year 1) lived in single-mother households, and 11% lived in locations categorized as geographically remote. At year 2 of the study, cigarettes were the most widely used substance among girls (42%), followed by alcohol (34%) and marijuana (25%). Almost one-quarter (23%) of girls said that they were in a `steady' romantic relationship.

Among the bivariate associations, single-mother households were positively associated with financial strain, youth friends' dating, and youth dating and cigarette use. Living in a remote location was negatively associated with pubertal development and time 2 alcohol use. Pubertal development was positively associated with each of our measures of substance use at the bivariate level. In addition, pubertal development was significantly and positively associated with all of our proposed mediators (perceived peer substance use, substance use prototypes, friends' dating, youth dating, and steady boyfriend). Each of our indicators of social definitions of substance use and mixed-sex/dating peer groups were significantly and positively correlated with one another, as were each of our measures of substance use.

Multivariate analyses

Table 3 provides standardized coefficients for the measurement and structural models as well as the coefficients obtained for all models (Models 1 – 3, see analytic plan and Figures 1a – 1c). Goodness of fit indices suggested that each of the models summarized in Table 3 fit the data well.1 Each of our CFI and RMSEA estimates fell within conventionally acceptable levels for model fit (Hu & Bentler, 2000; Kenny, 2003; Scumacker & Lomax, 2004).

The indicators for each of our latent constructs illustrated in Figures 1a – 1c and Figure 2 loaded significantly and at adequate magnitude. Thus, the measurement model suggests that our measures are reasonable indicators of the latent variables they represent (See Table 2 for slight variation in loading estimates for each model).

Model 1 in Table 2 shows that even with the inclusion of the control variables in the model, pubertal development at time 1 was significantly related to the onset of substance use at time 2 (one year later) among the girls in our sample. In addition, living in a remote location was negatively associated with puberty.

Also in Table 2, Model 2 illustrates that the significant effect of puberty on mixed sex peers/ dating, and in turn, the effect of mixed sex peers/dating on early substance use was a statistically significant indirect effect ($\beta = .28$; $p < .001$) that eliminated the statistical significance of the original puberty and substance use focal relationship from $\beta = .37$ ($p < .001$) in Model 1 to $\beta = .10$ ($p = .19$) in Model 3.

Model 3 illustrates that positive social definitions of substance use (prototypes and perceived substance-using peers) partially mediated the relationship between puberty and early-onset substance use. Results of a decomposition of the effect of puberty on favorable social definitions of substance use, and the latter on early-onset substance use revealed a statistically significant indirect effect = .12; $p < .001$) that decreased the original focal relationship between puberty and substance use from it's original magnitude of $\beta = .37$ ($p < .001$) in Model 1 to $\beta = .25$ ($p < .001$) in Model 2.

Model 4 provides the results of our final SEM in which the effects of both latent mediators covary and were included in a single model. Results of this model are shown in full in Table 3, and the major structural paths and full mediation model are illustrated in Figure 2. Both the effects of favorable social definitions of substance use and mixed sex peers/dating on time 2 substance use remained significant when allowed to covary in this model. In addition, the indirect effects of pubertal development on substance use via favorable definitions ($\beta = .08$; $p < .05$) and mixed sex peers/dating ($\beta = .18$; $p < .001$) were significant in the final model.

Girls living in geographically remote locations reported significantly lower levels of pubertal development in our SEM's. In addition, living in single-mother homes was positively associated with young girls' reports of dating.

Discussion

This research is based upon biosocial models of development in which the effects of puberty on early-onset substance use are mediated by social factors (Caspi et al., 1993; Haynie, 2003). We hypothesized that any effects of Indigenous girls' pubertal development on substance use would be mediated by positive social definitions of substance use and affiliation with males. Bivariate analyses and structural equation model results provide some support for the hypotheses.

H1: Level of pubertal development will be positively associated with early-onset substance use

In support of H1, pubertal development was indeed associated with early-onset substance use for the Indigenous girls in this sample. Although research has documented such

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[1]Because our series of Structural Equation Models are not considered nested (or, hierarchical), chi-square difference tests are not allowable and we therefore cannot make any assertions about the *relative* fit of Models 1 – 4.

relationships among diverse racial/ethnic groups (Cota-Robles, Neiss, & Rowe, 2002; Ge et al., 2002), this finding addresses a gap in the literature in terms of documenting similar effects among Indigenous youth (but see Deardorff et al., 2005).

H2: The effects of puberty on substance use will be mediated by both (a) exposure to mixed-sex peer groups and dating, and, (b) more favorable substance use prototypes and perceived substance using peers

One aim of this study was to extend previous research by incorporating broader definitions of peer context (i.e. peers/prototypes *and* mixed sex/romantic peers) as mediating variables in the SEM's. In support of H2a and H2b, each of the two latent indicators of peer context act as statistically significant mediators of the puberty-substance use relationship. That is, the effects of pubertal development on substance use operate to some degree through peer contexts that model and promote substance use behaviors. Previous research has shown that this peer influence is especially strong for some Indigenous youth (Unger, 2003). In addition, compared to boys, Indigenous girls have been shown to have a difficult time saying no to drug offers from substance using peers and relatives (Rayle et al., 2006). Peer pressure may be especially pertinent to American Indian young people because active refusal of substance use offers by friends may violate cultural norms of affiliation and respect (Beauvais, 1980; Weibal, 1982). In light of this, prevention efforts might benefit by promoting girls' refusal skills while acknowledging cultural norms. One example of this might involve presenting youth with scenarios and skills that allow them to turn down substance use in such a way that respects and maintains important relationships.

The impact of both latent mediators was included in the final SEM (Model 4). The association between the mediators in this model was significant and substantial. Even with shared variance between them, the mediating effects of favorable social definitions of substance use and mixed-sex peer affiliations remained significant. These findings suggest that prevention work should focus on multiple domains of peer context while taking into account interrelationships across domains.

Prior research has documented a relationship between financial strain and a variety of negative behavioral and psycho-social outcomes (Ge et al., 1992; Hawkins, Catalano, and Miller, 1992; Whitbeck et al., 1991). The fact that we failed to replicate this relationship may be a result of widespread economic deprivation on the reservations reducing variation in financial strain across families. A cultural tradition of extended family systems may provide intergenerational parenting support for single-mothers, hence explaining the lack of association between single-mother homes and early-onset substance use in our SEM's.

Although unexpected, we found a significant and negative association between living in a remote geographical location and experiencing pubertal development. This association is intriguing and difficult to explain. Part of the explanation may come from differences in diets across study sites (Posner, 2006). Compared to youths on reservations more proximate to small towns and cities, young people residing on geographically isolated reserves may consume more locally harvested foods and/or wild game, while at the same time eating less "fast" and/or processed foods. Other factors known to be related to the onset of puberty, including weight and family history, may also be potential influencing factors (Napieralski & Devine, 1998).

Also not anticipated, living in single-mother homes was positively associated with girls' dating. This finding is intuitive given previous reports that single parents may have less time to engage in parental monitoring than dual-parent families might (Whitbeck, Simons, & Kao, 1994; Whitbeck, Simons, & Goldberg, 1996). Thus, girls in single-mother homes may have more opportunities to associate and/or date boys. The utility of such explanations in

Indigenous reservation and reserve contexts—where extended family members and kinship patterns might qualitatively alter the meaning of `single mom'—has yet to be explored.

Limitations

There are limitations to the current study that should be acknowledged and that indicate the need for further research in this area. Debates continue regarding the significance of selection effects (delinquent youths are more likely to select into friendship networks that are also delinquent; Curran, Stice & Chassin, 1997) versus causation explanations (deviant peer affiliations create adolescent delinquency; Patterson, Dishion, & Yoerger, 2000); however, recent research has illustrated a stronger and more consistent socialization effect (Fite, Colder & O'Connor, 2006; Simons-Morton & Chen, 2006). Our use of two waves of data in these analyses provides support for the temporally ordered effects of peer influence (assessed at time 1) on later substance use (time 2) in this sample of Indigenous girls. Despite this, other factors (i.e., personality or behavior influences on peer selection) may be important mechanisms related to peer influence that our data do not address, and thus causal interpretations are not possible.

Past research has revealed the impact of boyfriend and peer age on early maturing girls' behaviors (Stattin & Magnusson, 1990; Young & d'Arcy, 2005). Our measures of youth dating and peer involvement are further limited in that we do not know the age(s) of girls' romantic-partners and friends. Thus, it is impossible for us to determine if the effects of dating on substance use documented here are not better accounted for by *older* boyfriends.

Our reliance on self-report data might invite social desirability bias (i.e., underreporting problems; Fendrick & Mackesy-Amiti, 2000; Fendrich, Johnson, Wislar, Hubbel, & Spiehler, 2004). Given this, it may be that Indigenous girls' substance use rates are actually greater than reported here. Further, our substance use measures ask youths to report on *lifetime* prevalence of substance use. While this is important in terms of differentiating early and later-onset users, our measures for this paper do not discriminate between experimental versus more frequent use or abuse of drugs.

Notably, our measures of peer behaviors are also based on adolescent self reports. As such, adolescents' perceptions of friend's delinquency may be clouded by his/her own behavior and therefore inflate empirical correlations between the two. Unfortunately, we do not have peer-reported measures in our data and therefore are unable to disentangle these potential effects within these analyses.

Future Research

This study indicates that pubertal development is associated with early-onset substance use (assessed one year later) among Indigenous girls and that these effects are significantly mediated by peer context. From this point, future research should focus on specific cultural contexts of puberty, social forces, and delinquency including substance use across various Indigenous groups. For example, the onset of puberty within this Indigenous group's traditional cultural perspective includes ceremonial practices and activities that emphasize the powerful meaning and significance of the transition from child to adulthood. Indigenous youth who have experienced these events and/or are highly embedded in their culture may show very different patterns of behavior associated with puberty when compared to more acculturated peers.

Although the mediating effects of both social definitions of substance use and affiliation with mixed-sex peers and dating are statistically significant in this study, a variety of social factors not investigated here play a mediating role in this relationship. For example, research

has shown that puberty affects delinquency through both peer and family factors (Haynie, 2003; Westling et al., 2008). Future research should further investigate how these additional social contexts operate with puberty among Indigenous youth.

Finally, we chose to focus on Indigenous girls in light of our recent findings indicating that the females in our sample are at a higher risk for substance use behaviors than are their male peers (Walls, 2008). This is not to say that Indigenous boys themselves are not at risk. Research has documented the negative effects of puberty on (non-Indigenous) boys' development and behaviors (Cota-Robles, Neiss, & Rowe, 2002; Ge, Conger & Elder, 2001). Further, the diverse traditions, languages, and histories across the 562 federally recognized tribes in the Unites States alone preclude the generalizeability of these gender-specific results to other Indigenous communities. Future work should address if and how pubertal development relates to substance use in other Indigenous cultures, including an examination of pubertal effects on Indigenous boys with gender comparisons of the processes through which these effects operate.

Conclusions

This report advances our understanding of some of the specific mechanisms through which the onset of puberty affects early substance use. It indicates that both early romantic relationships/affiliations with males and favorable social definitions toward substance use mediate the effects of puberty on substance abuse among early adolescent Indigenous girls. This is timely given the contemporary context of dating origins within a group context (Connolly, Craig, Goldberg & Pepler, 2004; Feiring, 1996). More importantly, this research contributes to our understanding of a particularly high-risk population of early adolescent girls. The cultural and social context of reservation life may hold special pressures for Indigenous girls. Peer relationships on small geographically isolated reservations may be more influential and all encompassing (Unger, 2003). Social nonconformity and isolation may be more threatening because of cultural values of affiliation and the lack of social alternatives. Puberty may change the size and make-up of the girls' social networks, adding deviant adolescents and romantic partners to the peer group. All of these factors are likely to contribute to their earlier use of substances than their male counterparts.

The ramifications of these findings are critical for Indigenous alcohol and drug prevention programs. They point to the need for prevention efforts timed to respond to the pressures associated with the transitions of puberty. These prevention efforts should focus on culturally appropriate refusal skills and ways to develop and maintain relationships with pro-social peers. Also, this is a culture which has great respect for advice and mentorship of tribal elders. Innovative programs that create links to mentoring elder women for advice and support, teaching of cultural ways regarding menarche and women's traditional roles may serve a protective function. For example, one cultural approach that could provide support and teaching to Indigenous girls might include a wider use of traditional pubertal ceremonies. These ceremonies involve both recognition and teachings that guide a young female in her transition to womanhood. Teachings focused on ways to remain healthy in regards to substance use may be very fitting in the modern reservation context.

Acknowledgments

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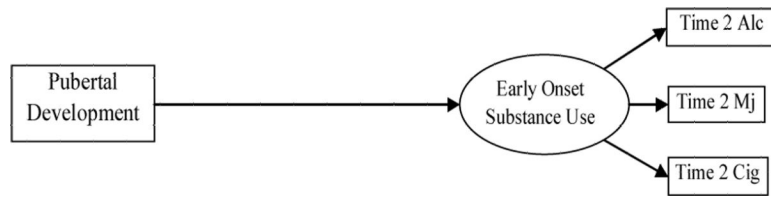
Figure 1a.
Focal Relationship between Puberty and Substance Use (Model 1)
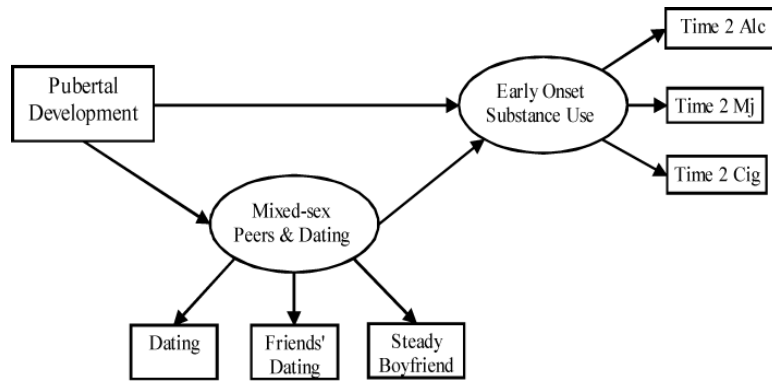
Figure 1b.
Mediating Effects of Mixed-sex Peers/Dating between Puberty and Substance Use (Model 2)

Figure 1c.
Mediating Effects of Favorable Social Definitions of Substance Use (Model 3)

Figure 2.
Standardized Coefficients, Final SEM (Model 4, Table 2)
*p < .05; **p < .01; *** p < .001
Note: Each exogenous construct (Financial Strain, Single Mom, Remote) is regressed upon all endogenous measures. Displaying only statistically significant paths related to these exogenous measures to ease visual presentation.

Table 1

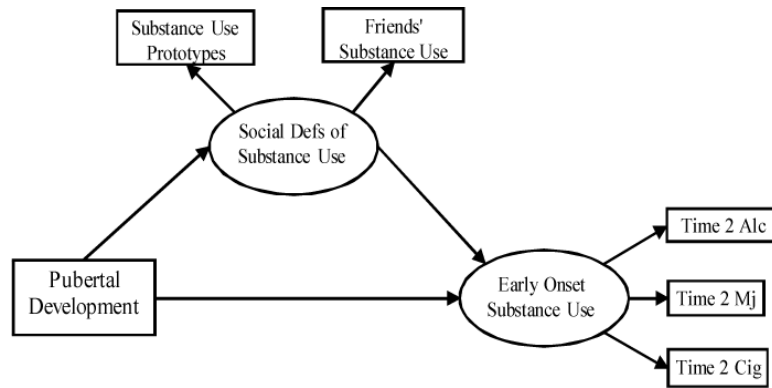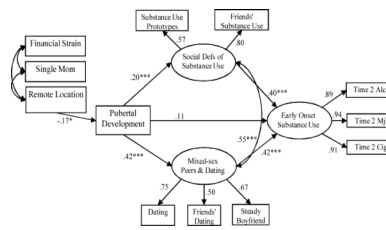Descriptive statistics and bivariate associations among all study variables (N = 360)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Financial Strain	1.00											
2. Single Mom (Single = 1)[a]	.15**	1.00										
3. Remote Location (Remote =1)[a]	−.06	−.08	1.00									
4. Pubertal Development	.05	.09	−.17**	1.00								
5. Friends' Substance Use	.06	.04	.05	.12*	1.00							
6. Substance Use Prototypes	.02	.04	−.07	.14**	.45***	1.00						
7. Friends' Dating	.06	.11*	−.07	.24***	.23***	.15**	1.00					
8. Dating	.04	.13*	−.09	.31***	.27***	.28***	.44***	1.00				
9. Steady Boyfriend	.07	.08	−.06	.27***	.21***	.17**	.17**	.40***	1.00			
10. Alcohol Use – Time 2[a,b]	.08	.06	−.15**	.32***	.32***	.31***	.28***	.40***	.28***	1.00		
11. Cigarette Use – Time 2[a,b]	.04	.14**	−.09	.29***	.56***	.35***	.25***	.37***	.27***	.56***	1.00	
12. Marijuana Use – Time 2[a,b]	.09	.08	−.04	.28***	.59***	.35***	.22***	.42**	.26***	.59***	.59***	1.00
Mean (Standard Deviation)	1.27	.24	.11	2.04	.54	.88	1.28	.60	.23	.34	.42	.25
	(.60)	(.43)	(.31)	(.67)	(.88)	(1.24)	(1.2)	(1.0)	(.42)	(.47)	(.49)	(.43)
Range	0 – 3	0 – 1	0 – 1	1 – 4	0 – 3	0 – 8	0 – 4	0 – 6	0 – 1	0 – 1	0 – 1	0 – 1

[a]Categorical Variables

[b]Self-Reported Substance use = 1

*
p < .05

**
p < .01

***
p < .001

Table 2

Standardized Maximum Likelihood Estimates (N = 360)

	Model 1	Model 2	Model 3	Model 4
Measurement Coefficients				
Friends' Substance Use			.80	.80
Substance Use Prototypes			.57	.57
Friends' Dating		.51		.50
Dating (Youth)		.75		.75
Steady Boyfriend		.63		.67
Alcohol Use	.87	.89	.86	.89
Cigarette Use	.90	.91	.90	.91
Marijuana Use	.95	.93	.96	.94
Structural Coefficients				
Control Variables				
Financial Strain→Pub	.03	.03	.03	.03
Single Mom→Pub	.07	.07	.07	.07
Remote→Pub	−.17[**]	−.17[*]	−.17[**]	−.17[*]
Financial Strain→Date		.05		.05
Single Mom→Date		.13[*]		.13[*]
Remote→Date		−.05		−.05
Financial Strain→Defs			.04	.04
Single Mom→Defs			.05	.05
Remote→Defs			.06	.06
Financial Strain→Sub Use	.07	.03	.04	.03
Single Mom→Sub Use	.07	−.01	.05	−.00
Remote→Sub Use	−.07	−.04	−.11	−.08
Focal Relationship				
Pub→Sub Use	.37[***]	.10	.25[***]	.11
Mediating Constructs				
Pub→Defs			.20[**]	.20[**]
Defs→Sub Use			.61[***]	.40[***]
Pub→Date		.42[***]		.42[***]
Date→Sub Use		.66[***]		.42[***]
Construct Covariances				
Financial Strain ↔ Remote	−.06	−.06	−.06	−.06
Financial Strain ↔ Single Mom	.15[**]	.15[**]	.15[**]	.15[**]
Single Mom ↔ Remote	−.08	−.08	−.08	−.08
Date→Defs				.55[***]
Goodness of Fit Indices				

	Model 1	**Model 2**	**Model 3**	**Model 4**
χ^2	9.53 (df = 7); p =	18.75 (df= 19); p =	16.87 (df= 11); p =	25.79 (df= 22); p =
CFI	.99	1.00	.99	.99
RMSEA	.03	.00	.04	.01

Two-tailed tests.

Note: All measurement model coefficients statistically significant (p < .05). Model 1 includes a test of the focal relationship between puberty (Pub) and substance use (Sub Use). Model 2 adds dating/mixed sex peers (Date) as a mediator. Model 3 includes the focal relationship and social definitions of substance use (Defs) as a mediating construct. Model 4 includes both social definitions and dating as separate and related mediating constructs.

*
p < .05;

**
p < .01;

***
p < .001;