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## Latent Growth Trajectories of Substance Use among Pregnant and Parenting Adolescents

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### Abstract

We examine changes among adolescent girls in substance use during pregnancy and the postpartum period. Three separate latent growth curve analyses assessed the impact of psychosocial, behavioral, and sociodemographic factors on resumption of or change in use of cigarettes, alcohol, and marijuana. The Vulnerable Populations Model for Research and Clinical Practice (Flaskerud & Winslow, 1998) provided the theoretical foundation for this study. This is a secondary analysis of data from a sample of 305 ethnic minority females (245 Latina, 60 African-American), aged 13–18 years, who were pregnant at baseline and were participating in an HIV prevention study conducted in inner-city alternative schools in Los Angeles County. Data collected at four time points captured changes in substance use from pregnancy through the postpartum period. Baseline predictors included ethnicity/race, partner substance use, childhood abuse history, religiosity, acculturation, depressive symptoms, length of gestation at baseline, and prior substance use. Common predictors of greater resumption and/or greater level of use included greater history of use prior to pregnancy, partner substance use, childhood abuse, and a longer time since childbirth. African Americans were more likely to be smoking at baseline when they were still pregnant and to use marijuana postpartum; Latinas were more likely to use alcohol over the course of pregnancy and postpartum. Other variables exerted an influence on specific substances. For instance, religiosity impacted cigarette and alcohol use. Findings may assist prenatal care providers to identify and counsel pregnant adolescents at risk for perinatal substance use and to prevent resumption or initiation of substance use following childbirth.

### Keywords

parenting teens; adolescent substance use; latent growth curve models

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Substance use during pregnancy and the postpartum period is a major health concern for the fetus/newborn and family, with policy implications for healthcare in the U.S. (Button,

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Maughan, & McGuffin, 2007; Knopik et al., 2006; Suarez, Felkner, Brender, Canfield, & Hendricks, 2008). Data from a large national survey show that 4% of pregnant women aged 15–44 years had used some type of illicit drug (e.g., marijuana, hashish, cocaine, crack, heroin, PCP, LSD) in the past month as compared to 10% of non-childbearing women of similar age (Substance Abuse and Mental Health Services Administration [SAMHSA], 2007). The same study identified tobacco and alcohol as the most commonly reported substances used during pregnancy, 16.5% and 11.8%, respectively. In another large study, nearly 16% of pregnant 15- to 17-year-olds reported use of alcohol in the past month, averaging 24 drinks during that month (SAMHSA, 2008). Examination of ethnic/racial differences reveals that non-Hispanic white adult women, regardless of pregnancy and parenting status, report substance use at the highest rates, followed by Hispanics and non-Hispanic blacks (Muhuri & Gfroerer, 2008).

Few studies have described the trajectory of substance use among pregnant and parenting teens over time, although several cross-sectional studies with adolescents and/or adults have assessed substance use during pregnancy and the various factors associated with and predicting use (De Genna, Larkby, & Cornelius, 2007; Goodman & Huang, 2002; Muhuri & Gfroerer, 2008). In this paper, we present findings from a 12-month prospective study examining patterns and predictors of substance use in pregnant adolescents from Latino and African-American backgrounds.

Pregnancy has been shown to moderate substance use in general. Past 30-day use of alcohol, cigarettes, marijuana, psychotherapeutics, or cocaine was reported to be substantially lower among pregnant women age 18 to 44, especially in the second and third trimesters, than among those who were parenting or nonpregnant (Muhuri & Gfroerer, 2008). Substance use in adolescent mothers tends to decrease or cease until the pregnancy ends, and then gradually resume in the first few months postpartum, although often at a lower level than pre-pregnancy (Gilchrist, Hussey, Gillmore, Loir, & Morrison, 1996; Koniak-Griffin, Lesser, Uman, & Nyamathi, 2003). Bailey and colleagues (Bailey, Hill, Hawkins, Catalano, & Abbott, 2008) reported that pregnancy decreased the probability of binge drinking, daily smoking, and marijuana use in young adult women, but use returned to pre-pregnancy levels within 2 years postpartum. Carmichael and Ahluwalia (2000) found that 25.6% of women in their population-based adult and adolescent sample smoked cigarettes before pregnancy; 44.5% of these women quit during pregnancy, but half of those who quit had relapsed within 2–6 months after delivery. Independent correlates associated with increased risk of postpartum relapse included African-American ethnicity, multiparity (having  $\geq 2$  previous births), late or no prenatal care, and stressful life events. In a sample of low-income, pregnant adult Latinas age 18 to 40 ( $N=100$ ), 43% reported alcohol use in the 3 months prior to recognition of the current pregnancy; of these, 8% continued drinking after learning they were pregnant (Chambers et al., 2005).

## Theoretical framework

The Vulnerable Populations Model for Research and Clinical Practice (Flaskerud & Winslow, 1998) provided the theoretical foundation for this investigation. The model relates resource availability and relative risk to health status. Within the context of this model, adolescent mothers from ethnic/racial minority backgrounds represent a vulnerable population that has limited resources and faces increased relative risk for health problems such as depression and perinatal substance use compared with other populations (e.g., white middle-class women). The purpose of this study is to determine and describe predictors of individual differences in the trajectory and resumption of substance use among a group of inner-city, pregnant adolescents of ethnic minority backgrounds, and to examine their substance use over a period of 12 months during late pregnancy and up to at least 6 months postpartum.

The psychosocial, behavioral, and sociodemographic variables selected for examination in this study fall within the domains of this model (e.g., religiosity and family intactness are indicators of resource availability; low self-esteem, romantic partner drug use, depressive symptoms, prior history of abuse and/or substance use represent relative risk). Perreira and Cortes (2006) examined a nationally representative cohort of pregnant adult and adolescent women with hospital birth data from 20 U.S. cities (N=4185). They reported that all women were more likely to report prenatal substance use if their newborn's father also reported substance use. Paternal alcohol and illicit drug use were associated most strongly with maternal alcohol use. Similarly, analyses of data from the National Longitudinal Study of Adolescent Health support the significant influence that romantic partners have on female adolescents' involvement in high risk behaviors (e.g., smoking cigarettes, getting drunk) (Haynie, Giordano, Manning & Longmore, 2005). Greater acculturation has been identified as a risk factor for substance use in adult and adolescent populations. Immigrant youth of varying ethnic origins living in the U.S. less than 6 years report lower lifetime and recent use of alcohol and marijuana ( $p < 0.001$ ) than those living in the U.S. more than 6 years (Blake, Ledsy, Goodenow, & O'Donnell, 2001). Harrison and Sidebottom (2009) found that pre-pregnancy alcohol and drug use among adolescent and adult prenatal patients from four urban clinics was much higher among U.S.-born women than immigrants and among unmarried than married women. Older age and current smoking were predictors of both alcohol and drug use continuation. Pre-pregnancy alcohol use frequency, depression, and physical/sexual abuse by someone other than an intimate partner predicted alcohol use continuation, while drug use continuation was also predicted by pre-pregnancy drug use frequency and race (higher for American Indians and African Americans) (Harrison & Sidebottom, 2009).

In another sample of pregnant adolescents attending a prenatal clinic (De Genna et al., 2007), earlier age at first drink and use of alcohol during first coitus were found to predict problem drinking in the year before pregnancy; the latter variable also significantly predicted drinking during the first trimester. Socioeconomic status was a significant predictor of alcohol use before and during pregnancy, while externalizing problems were a risk factor for alcohol use during the first trimester. Earlier drinkers were more likely to continue use during pregnancy. African-American adolescents were significantly less likely to use alcohol during first coitus, but not less likely to use alcohol during pregnancy.

In research involving non-childbearing adult and adolescent women, similar and additional correlates of substance use have been reported. For example, in a large retrospective study involving over 4,500 adult women, adverse childhood experiences (including physical and sexual abuse) increased the likelihood 2- to 4-fold of early drinking and smoking (Dube et al., 2003). Among adolescent girls, depressive symptoms have been associated with higher levels of alcohol, marijuana, and cigarette use; these positive associations may be due to shared risk factors for depression and substance use (Fleming, Mason, Mazza, Abbott, & Catalano, 2008). High self-esteem has been posited as protective against adolescent substance use, especially among Hispanics. Zamboanga and associates (Zamboanga, Schwartz, Hernandez Jarvis, & Van Tyne, 2009) observed that self-esteem was the most important protective factor against substance use (i.e., cigarette, alcohol, and marijuana) in Hispanic early adolescents (ages 11–15). However, inconsistencies have been observed across studies examining the relationship between (global) self-esteem and drug use among other adolescent populations, possibly because researchers do not appear to have established a consensus as to what is or is not self-esteem (Donnelly, Young, Pearson, Penhollow, & Hernandez, 2008).

Limited evidence suggests that church attendance and family structure serve to protect or reduce risk of substance use. Adolescents who attend church at least once monthly

reportedly may engage in smoking or drinking but are significantly less likely to use marijuana and cocaine as compared to those who infrequently or never attend church (Jang & Johnson, 2001; Chu, 2007). Some comparisons of youth living in intact vs. disrupted families have suggested that living with both parents may have a protective effect on adolescents' illicit drug use (Grunbaum, Kann, Kinchen, Williams, & Ross, 2002; Jeynes, 2001; National Center on Addiction and Substance Abuse, 2003; Sutherland & Shepherd, 2001). Newer research, however, shows that this issue is much more complex than originally believed, as the impact varies with gender, number of family transitions, quality of relationship with parent, changes in socioeconomic resources, possible disruption of peer relationships, and other factors (Krohn, Hall, & Lizotte, 2009; Hair, Park, Ling, & Moore, 2009).

## Hypotheses

Based upon the theoretical model and other past research, it was hypothesized that substance use as represented by smoking, and alcohol and marijuana use among Latino and African-American adolescents in pregnancy and the postpartum period would:

1. Be positively associated with prior use of drugs, depressive symptoms, a history of childhood abuse, current partner's use of drugs, and higher acculturation; and negatively associated with self-esteem, religiosity, and having an intact family, as suggested by the Vulnerable Populations Model.
2. Be positively associated with a greater length of time since giving birth.

## Methods

### Participants and Procedures

Participants included in this secondary analysis represent a subsample from a larger prospective study examining the effects of a four-session (8-hour), theory-based HIV prevention program (Project CHARM, Children's Health and Responsible Mothering; Principal Investigator: D. Koniak-Griffin) on pregnant and parenting adolescents. The intervention focused on maternal protectiveness as an impetus to reduce or eliminate sexual risk-taking behavior, adolescents' vulnerability to HIV/AIDS, and taking on sexual responsibility and accountability. Although substance use was not a major focus of the program, participants learned how drug use may play a role in increasing risk for HIV. Further details of this randomized controlled trial involving 497 adolescents (aged 13–18 years, predominantly from underrepresented minority groups) have previously been reported (Koniak-Griffin, Lesser, Nyamathi, et al., 2003).

The subsample used in the current study included only the 305 Latina and African-American adolescents (245 Latinas, 60 African Americans) who were pregnant at baseline. The adolescents in the larger sample who had already given birth when they entered the study ( $n=168$ ) were not eligible for this analysis, as this study focused on the trajectory of substance use from pregnancy through the postpartum period; those who did not identify as Latina or African American ( $n=24$ ) were also excluded. The original sample and the subsample displayed similar characteristics in terms of age distribution, ethnic/racial characteristics, and other key variables (e.g., marital status). Table 1 presents the characteristics of participants in the current study. Although the large majority of participants in this sample (80%) were Latino, no significant differences were found between this ethnic group and the African Americans on sociodemographic characteristics such as age, marital status, socioeconomic status, or grade in school. Because baseline and follow-up assessments were conducted in small groups, there were minimal amounts of

missing data. The very small amounts of missing data were imputed using the EM (expected-maximization) algorithm (Arbuckle, 1996; Tang & Bentler, 1998).

All informed consent procedures were approved by the University of California's institutional review board, and full informed consent was obtained before data collection. Parental consent was waived, as participation in the study entailed no more than minimal risk such that adolescents might reasonably assume on their own, and obtaining parental consent would have presented an undue hardship to some young women. As part of the informed consent process, adolescents were advised about the procedures to protect and maintain confidentiality of data and assured that school officials would not have access to their questionnaires. A Certificate of Confidentiality was issued by the federal government for this study. Participants were recruited from pregnant minor or young parents' programs within alternative schools of four school districts of Los Angeles County. Schools were randomly assigned by site to either the intervention or comparable length control condition. Questionnaires were read to small groups of adolescents by specially trained research staff within the classroom setting, in the absence of school officials. Participants completed their own questionnaires as the items were read to them. Data were collected over a period of 12 months: at baseline and at 3-, 6-, and 12-month follow-ups, with \$15 compensation provided per administration. The majority of questionnaires were administered within the classroom; however, some follow-up postpartum evaluations were conducted in homes for participants who were no longer attending school. As outlined above, at baseline all participants were currently pregnant. By the 3-month follow-up, 60% had delivered their babies. Only 4% remained pregnant at the 6-month data collection. Additional details have been previously reported (Koniak-Griffin, Lesser, Nyamathi et al., 2003).

### Instruments and Variables

The instrument packet contained a combination of questionnaires and individual items designed to measure background characteristics such as age, race/ethnicity, length of gestation, family composition (intact vs. parents divorced or separated), and various psychosocial variables.

### Substance Use

**Prior use**—At baseline participants estimated their prior use by responding to the questions: “During your life, how many days have you had at least one drink of alcohol?” and “During your life, how many times have you used marijuana (weed) or hashish?” Response categories were the same for alcohol and marijuana: never = 1; one or two times/days = 2; 3 to 9 times/days = 3; 10 to 19 times/days = 4; 20 to 39 times/days = 5; 40 to 99 times/days = 6; 100 or more times/days = 7. The response categories were recoded as: 0 = none/never used, 1 = mild use (1 to 9 times), 2 = moderate use (10 to 19 times), and 3 = heavy use (more than 19 times). The higher options were rarely chosen. Prior cigarette smoking was defined as having “ever smoked cigarettes regularly, that is, at least one cigarette every day for one month” with 0 = no, 1 = yes. (Lifetime measures similar to those for alcohol and marijuana were not available.)

**Current use dependent variables**—Frequency of current use of alcohol, marijuana, and cigarettes was estimated using response categories similar to those for prior use; however, the interval for measurement varied: i.e., participants were asked about use during the past month at baseline and the 12-month follow-up; whereas, the 3-month follow-up assessed frequency of daily use during the past 2 months, and the 6-month follow-up evaluated frequency of daily use in the past 3 months. For cigarettes, the item was worded: During the past month, on the days you smoked, how many cigarettes did you smoke per day (none = 1, less than 1 = 2, 1 per day = 3, 2–5 per day = 4, 6 to 10/day = 5, 11 to 20/day



= 6, more than 1 pack = 7). For alcohol the item was worded: During the past month, on how many days did you have at least one drink of alcohol: 0 days = 1, 1 or 2 days = 2, 3 to 5 days = 3, 6 to 9 days = 4, 10 to 19 days = 5, 20 to 29 days = 6, all 30 days = 7. For marijuana, they were asked how many times they used marijuana and this ranged from 1–6, as follows: 0 times = 1, 1 or 2 times = 2, 3 to 9 times = 3, 10 to 19 times = 4, 20 to 39 times = 5, 40 or more times = 6. Responses based on a greater number of months were scaled so that the responses were equivalent if necessary.

**Drug-using boyfriend**—The participants were asked whether they had a current boyfriend who used heroin, cocaine, or methamphetamines. These three items were used as indicators of a latent variable labeled “Drug-using boyfriend.” The participants were queried about this because the content of the intervention included information about HIV-risk behaviors. High-risk male partners, including injecting drug users and other heavy substance users, are believed to increase HIV risk for their female partners (Koniak-Griffin, Lesser, Nyamathi, et al., 2003).

### Psychosocial and Behavioral Variables

**History of physical/sexual abuse**—This was measured by responses to the question, “Have you ever been physically abused by an adult (where an adult caused you to have a scar, black and blue marks, welts, bleeding or broken bones)?” Sexual abuse was assessed by response to the question, “Have you ever been sexually abused by someone (that is, someone in your family or someone else) who did sexual things to you that you did not want or forced you to touch them sexually?” The options for both questions ranged from 0 to 4 (“Never” = 0, “Once” = 1, “2 or 3 times” = 2, “4 to 10 times” = 3, “More than 10 times” = 5). These two items were used as indicators of a latent variable representing abuse history.

**Depressive symptoms**—The 20-item Center for Epidemiological Studies Depression Scale (CES-D) was used to assess symptoms of clinical depression (Radloff, 1977). On this scale, the participant reports how frequently he/she experienced a symptom in the *past 7 days*. Each item is rated from 0 to 3 (0 = rarely; 1 = some of the time; 2 = occasionally; 3 = most of the time). In the larger CHARM study, the coefficient alpha was .84 (Koniak-Griffin, Lesser, Uman, et al., 2003), and it was .84 in the smaller subsample as well.

**Global self-worth**—Global self-worth was measured by a subscale of the Self-Perception Profile for Children, a self-reporting inventory for assessing children’s and adolescents’ perceptions of themselves in various specific domains of their life, as well as their sense of global self-worth (Harter, 1985). The scale consists of five items. A typical item is: “Some teenagers are often disappointed with themselves BUT other teenagers are pretty pleased with themselves.” Responses for each question were coded in two parts: part A indicates which part of the statement they agree with; part B indicates 0 if “sort of true for me” or 1 if “really true for me.” Cronbach’s alpha was 0.72 in the larger sample (Koniak-Griffin, Lesser, Uman, et al., 2003) and the same in the subsample.

**Religiosity**—Religiosity was measured by participants’ self-report of the number of times they attended religious services in 1 year and their perceived degree of religiosity. Response options ranged from 0 (“Not at all”) to 5 (“More than once a week”). On the second measure, “How religious are you?” the response options ranged from “Not at all” (0) to “Very religious” (4). A composite of the two measures comprised the religiosity score.

**Acculturation**—Acculturation was measured by the Acculturation Rating Scale for Mexican Americans (ARSMA)(Cuellar, Harris, & Jasso, 1980), which was administered to evaluate Latinas’ language preference and their degree of reading and writing skills (range =

1–5). This measure was used because the large majority of Latinas in the study were of Mexican or Mexican-American origin (see Table 1). African-American participants did not complete this measure; however, a score of 5 was assigned to them because the rating reflects a high level of acculturation.

**Intact family**—The dichotomous intact family variable was measured by a single question, “Are your parents divorced or separated?” (Yes = 1, No = 0).

**Pregnancy/Postpartum status**—The pregnancy status of each participant was determined at the beginning of the study by asking “When is your baby due?” The date given was used to calculate the length of gestation in weeks at the time of the baseline questionnaire. Higher values indicate that the adolescent was further along in her pregnancy. Adolescents varied in their length of gestation at baseline when they were recruited for the study, and this variable helped to control for length of pregnancy in predicting substance use.

**Intervention group membership**—Group membership (HIV-prevention intervention group vs. control) was also included as a control variable, as membership could possibly have impacted their substance use behaviors even though substance use was not a major focus of either the experimental (HIV-prevention intervention) or control condition (general health promotion program).

## Analysis

Latent growth curve (LGC) modeling was used to predict the trajectory of changes in substance use through pregnancy and the postpartum period using the previously identified variables as predictors. Separate models assessed predictors of change in cigarette smoking, alcohol use, and marijuana use. LCG modeling is ideal for studying longitudinal change in behavior, as it provides a means of studying individual differences reflected in developmental functions. The *intercept* corresponds to the initial status of the participants’ substance use at Time 1 (baseline). The intercept is a constant for any individual across time and represents information concerning the mean of the collective individual intercepts that characterize each individual’s growth curve. The second factor, labeled *slope*, represents the rate of change (increase or decrease) in substance use over the period of study.

The EQS structural equations program (Bentler, in press) was used to assess the latent growth models and also provided information on the relationships among the psychosocial, behavioral, and sociodemographic variables and prior use of each of the three substances. Goodness-of-fit of the models was assessed with the maximum-likelihood  $\chi^2$  statistic; the Comparative Fit Index (CFI); the Satorra-Bentler  $\chi^2$  (S-B  $\chi^2$ ), the Robust Comparative Fit Index (RCFI), and the root mean squared error of approximation (RMSEA) (Bentler, in press; Bentler & Dudgeon, 1996; Hu & Bentler, 1999; Steiger, 1990). The RMSEA should be less than 0.06, and values at or above .95 for the CFI and RCFI are desirable (Hu & Bentler, 1999). The Robust S-B  $\chi^2$  was used in addition to the maximum likelihood  $\chi^2$  because it is more appropriate when the data depart from multivariate normality. Mardia’s normalized multivariate kurtosis estimates were high in all three models:  $z$ -statistic = 48.23, 72.64, and 45.89 for cigarettes, alcohol, and marijuana, respectively, rejecting multivariate normality (Bentler & Dudgeon, 1996). Standard errors were corrected for the extent of their nonnormality using the robust scaled statistics (Bentler & Dijkstra, 1985). This was essential because the skewness in the data reflected the little to no substance use by many of the girls in the study.

An initial confirmatory factor analysis (CFA) was performed among all of the hypothesized independent measured and latent variables with each hypothesized latent construct predicting its measured indicators. All latent constructs and the single-item variables were correlated with no assignment of temporal ordering. This analysis assessed the adequacy of the proposed factor structure (measurement model) and the relationships among the latent and measured variables. Then an LGM for each substance was tested in which the independent variables predicted the trajectories of the resumption of substance use among the pregnant and postpartum adolescents. All possible predictive paths from the independent variables to the growth curve latent variables were included and gradually dropped if they were nonsignificant.

## Results

### Substance Use Rates During Pregnancy and Postpartum

Baseline substance use rates, when all participants were still pregnant, were low although most had some degree of experience with the substances before their pregnancies (see Table 1). Four percent reported smoking cigarettes, 2% drinking alcohol, and 2.6% using marijuana. Only cigarette smoking and marijuana use were reported by African Americans, whereas Latinas reported using all three substances. Preliminary analyses ascertained that use of the three substances increased significantly over time as assessed at 3, 6, and 12 months after baseline (see Table 2). If there had been no increase in use, then LGM would not have been appropriate. Once it was established that rates increased, then LGM was used to determine which background predictors influenced the trajectories of increased use (slopes) as well as initial levels (intercepts).

### Confirmatory Factor Analysis

Fit indexes for the three initial separate CFA models (that did not yet include the substance use measures at baseline, 3, 6, and 12 months, but did include prior use of the particular substance) are uniformly excellent: Cigarettes: ML  $\chi^2 = 42.11$ , 31 *df*; CFI = .97, RMSEA = .034; S-B  $\chi^2 = 35.30$ , 31 *df*; RCFI = .99, RMSEA = .021; Alcohol: ML  $\chi^2 = 34.17$ , 31 *df*; CFI = .99, RMSEA = .018; S-B  $\chi^2 = 31.46$ , 31 *df*; RCFI = .99, RMSEA = .007; Marijuana: ML  $\chi^2 = 42.59$ , 31 *df*; CFI = .97, RMSEA = .004; S-B  $\chi^2 = 37.83$ , 31 *df*; RCFI = .98, RMSEA = .027. Correlations are reported in Table 3. Of note, lifetime smoking and drinking were significantly and positively correlated with a substance-using boyfriend ( $p \leq .001$ ,  $p \leq .01$  respectively), a history of abuse ( $p \leq .001$ ,  $p \leq .01$  respectively), and depressive symptoms ( $p \leq .001$ ,  $p \leq .05$  respectively). Prior marijuana use was significantly correlated with a history of abuse ( $p \leq .001$ ), depressive symptoms ( $p \leq .01$ ), and greater acculturation ( $p \leq .01$ ). Other significant relationships are evident as well (see Table 3).

### Latent Growth Models

Figures 1 through 3 present the significant predictive paths in the final trimmed LGMs. For readability, the figures do not depict the significant relationships among the predictors. They are available in Table 3. The fit indexes of the path models are excellent: Cigarettes: ML  $\chi^2 = 155.95$ , 128 *df*; CFI = .97, RMSEA = .028; S-B  $\chi^2 = 136.05$ , 128 *df*; RCFI = .98, RMSEA = .014; Alcohol: ML  $\chi^2 = 135.19$ , 112 *df*; CFI = .96, RMSEA = .026; S-B  $\chi^2 = 124.54$ , 112 *df*; RCFI = .97, RMSEA = .019; Marijuana: ML  $\chi^2 = 138.72$ , 122 *df*; CFI = .98, RMSEA = .021; S-B  $\chi^2 = 131.79$ , 122 *df*; RCFI = .99, RMSEA = .016. These models are larger and more complex due to the addition of the 4 time periods in addition to mean structures of the individual variables.

In the cigarette model (Figure 1), prior smoking ( $p \leq .05$ ), abuse history ( $p \leq .05$ ), and being African American ( $p \leq .01$ ) predicted greater initial levels of smoking during pregnancy.



Over the period of the study, prior smoking ( $p \leq .001$ ), less religiosity ( $p \leq .05$ ), and childbirth ( $p \leq .05$ ) significantly influenced the resumption of and increased cigarette smoking. In other words, the further along the adolescent was in her pregnancy at baseline, the sooner she would resume smoking. Note that due to the flattening out of the linear trend in resumption of cigarette smoking by 12 months, the fixed estimate at 12 months is not 3 but 2.5.

In the alcohol model (Figure 2) few variables predicted the initial level of alcohol use, partially due to the fact that drinking was rare at baseline. Being African American and being in the control group had significant negative effects on the level of use of alcohol at baseline. However, several variables influenced resumption and/or more drinking behavior during the postpartum period: a history of alcohol use ( $p \leq .001$ ), a history of abuse, having a drug-using boyfriend, a higher level of acculturation, less religiosity (all  $p \leq .05$ ), and lower self-worth ( $p \leq .01$ ). As the women gave birth, they were much more likely to increase their use of alcohol ( $p \leq .001$ ).

In the marijuana model (Figure 3), only a later stage of pregnancy predicted level of marijuana use at baseline. The steepness of the slope was impacted by abuse history, having a substance-using boyfriend (both  $p \leq .05$ ), prior use of marijuana ( $p \leq .001$ ) and being African American ( $p \leq .01$ ).

## Discussion

The Vulnerable Populations Model provided a broad perspective for informing and modeling factors influencing Latina and African-American young mothers' resumption or initiation of substance use. The unique design of this longitudinal study facilitated our understanding of behavior change in use of substances across time by not only considering levels of use but also predicting steeper resumption and initiation trajectories that could only be discerned through the latent growth models. Major findings demonstrate that although the majority of these pregnant, inner-city adolescents never used, discontinued, or decreased their frequency of use of cigarettes, alcohol, and marijuana during gestation, many resumed or initiated use of these substances within 6 months following childbirth. Resumption and increases were predicted by elements of the Vulnerable Population Model (Hypothesis One) as well as the prediction of Hypothesis Two.

### Hypothesis One: Vulnerable Population Model

For all three substances, more pre-pregnancy use, which is a risk in this population, predicted greater use and a steeper resumption curve in the postpartum period for cigarettes, and steeper slopes for alcohol and marijuana. Results of this study support the findings of previous studies of substance use among pregnant adolescents (Gilchrist et al., 1996; Teagle & Brindis, 1998; Wiemann & Berenson, 1998) and of national surveys on past-month substance use among pregnant adolescent and adult women (SAMHSA, 2005). However, the rate of perinatal substance use reported in our sample was far below national rates, which might be explained by differences in ages, sampling and methodology. Our sample is quite young. In addition, because participants in this study were attending special prenatal and parenting programs, it is also possible that the protected educational environment influenced their behaviors.

These findings also substantiate other previous research suggesting that those who reported use of alcohol and cigarettes prior to pregnancy had a greater propensity for later and regular use of these substances (Young et al., 2002). The more rapid resumption of smoking or other substances, especially among those who had a prior history of use (a relative risk), may be attributed to habit and possibly to stressors associated with the transition to parenthood.

Similar findings have also been described in other studies of pregnant and parenting substance use (Fang et al., 2004; MacLean, Estable, Sims-Jones, & Edwards, 2002) where transitions to motherhood and transitions to become nonsmokers were in conflict.

Another important predictor of resumption and use emerged for all three substances: past history of childhood physical and/or sexual abuse. Abuse predicted higher initial usage of cigarettes and predicted a steeper slope for both alcohol and marijuana. Our findings demonstrate the detrimental impact that childhood maltreatment and sexual abuse may have on adolescents' health risk behaviors. Other researchers have reported potential negative effects of childhood physical and sexual abuse on adults, e.g., alcoholism, eating disorders, severe obesity, depression, suicide, sexual promiscuity, antisocial and abusive behavior, and certain chronic diseases (Arnou, Hart, Hayward, Dea, & Barr-Taylor, 2000; Chartier, Walker, & Naimark, 2007; MacMillan et al., 2001; Thomas, Hyppönen, & Power, 2008). The finding in our study of an impact on use of all substances reinforces the pervasive and negative effect of abuse, which increases vulnerability to a variety of dysfunctional outcomes.

In the case of both alcohol and marijuana use, having a partner who used illicit drugs also significantly affected the behavior of adolescent mothers, providing support for Hypothesis One. This finding demonstrates the importance of examining dyadic influences in substance use studies involving adolescent mothers. Another important predictor variable found in the smoking and alcohol models was religiosity as measured by church attendance and self-perception of religiousness. Congruent with findings of other studies, religiosity, a resource in the Vulnerable Populations Model, was a protective factor that had an inverse relationship with a more rapid use of cigarettes and alcohol (Jang & Johnson, 2001; Sinha, Cnaan, & Gelles, 2007; Wills, Yaeger, & Sandy, 2003).

Our findings only provided partial support for the components of the Vulnerable Population Model. For instance, depressive symptoms as reflected in the CES-D did not predict any levels or acceleration of substance use over time. However, depression was correlated with prior use of all substances, so its impact may have been indirect and antecedent to initial drug use. Depression was also significantly associated with a history of childhood abuse, low self-worth and having a substance-using boyfriend. Available data do not allow examination of the predictive relationship between depressive symptoms and early onset of substance use; i.e., which one preceded the other. Research suggests that depressive symptoms and substance use share associations with important risk and protective factors, such as parental psychopathology, parenting problems, child exposure to violence, school problems, sexual activity, and love relationships (Harrison & Sidebottom, 2009; Barnett, Duggan, Wilson, & Joffe, 1995). Other predictors that were considered in the model included a higher acculturation level and lower self-esteem, which were predictors of a steeper alcohol slope only, and not living in an intact family. An intact family actually predicted more smoking, which was counter to our predictions. We also found some ethnic differences. African Americans' intercepts were lower for alcohol but higher for cigarettes, and the slope for African American ethnicity was steeper for use of marijuana. Our findings differ from earlier reports that Hispanic and Black women do not differ significantly for smoking during pregnancy (Perreira & Cortes, 2006). The impact of socioeconomic background on the ethnic differences observed in our sample is unknown. Further research is recommended to understand these differences.

### **Hypothesis Two: Postnatal Use Increases over Time**

As predicted by Hypothesis 2, a later gestational status (more weeks pregnant at baseline) was a major predictor of use of all three substances over time. Once the baby was born, the adolescent would be more likely to return to, or possibly initiate, use of cigarettes, alcohol,

and/or marijuana. In the case of alcohol, the slope was particularly steep; for marijuana, the influence was on the intercept. This finding is a reminder to health care providers of young mothers that these adolescents are vulnerable to resuming health risk behaviors such as illicit substance use postpartum, and more so over time, and that continuing patient education during well-baby check-ups may be a necessary part of their interactions with these teen mothers.

### Limitations

There were several limitations to this study that warrant consideration. First, the substance use data were based upon self-report rather than direct physiologic measures. Participants' self-reporting of substance use could not be verified or quantified precisely, thus underestimation is a possibility. Because the reporting periods for substance use varied somewhat at different evaluation points, selected substance use items needed to be equalized through statistical procedures. Second, the variables selected for the current analyses were confined to those in the original investigation. Other critical factors found to influence perinatal substance use were unexamined; for example, stressful life events (Carmichael & Ahluwalia, 2000); current psychopathology and unemployment (e.g., Havens, Simmons, Shannon, & Hansen, 2009). The wording of the question evaluating parental marital status and whether the girl resided in an intact family restricted examination of other possible family constellations (e.g., unmarried parents living together, step-parents or other caregiver status). Third, although gestational stage was included as a control, variations in gestational stage of participants enrolling in the study created differences in the length of pregnancy and time from childbirth evaluated among subjects within the 1-year trajectory profiled in this study. The different timings of the transition from pregnant to postpartum status is an important limitation in our findings, particularly at the 6-month (96% postpartum) and 12-month follow-up evaluations, because past research shows that length of time from childbirth influences reinstatement of substance use among adolescent mothers. However, inclusion of a variable representing weeks pregnant at baseline helps to control for this problem. Finally, this sample may not be representative of other pregnant and parenting teens due to geographical, ethnic, and socioeconomic considerations.

### Conclusion

Despite these limitations, findings of this study have several important implications for clinical practice. It is particularly important for prevention efforts to be strengthened during the prenatal period in order to avert postpartum resumption of use among young mothers with a history of substance use prior to pregnancy, even if they are currently abstaining from substances. Pregnancy and the early postpartum period offer a window of opportunity to assist adolescents in maintaining their positive behavior changes. Smoking, alcohol, and marijuana cessation programs should be integrated into prenatal care programs and teen parenting curricula. Our findings also suggest that involving male partners in these efforts may be beneficial, because their behavior has a strong impact on young mothers' return to use. Young fathers also may benefit from prevention efforts directed toward maintaining family health through substance-free environments.

The findings of this study demonstrate that from pregnancy through the postpartum period many young mothers, particularly those with a prior history of substance use, return to using the same drugs or increase their usage over time, although often to levels lower than reported prior to pregnancy. Particularly important predictors of resumption or initiation of substance use include past history of substance use, length of time following delivery (postpartum status), having a partner who uses drugs, and past childhood abuse. Maternal protectiveness may serve as a motivator for positive behavior for some young mothers. The

growth curve analysis used in this study provided a powerful means of modeling behavior change at an individual level and has utility for behavioral change research.

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**Figure 1.** Final structural path model predicting cigarette use. Regression coefficients are standardized. Circles designate latent variables; rectangles represent single-indicator items. Single-headed arrows represent regressions. Correlations are not depicted among predictors for readability. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .



**Figure 2.** Final structural path model predicting alcohol use. Regression coefficients are standardized. Circles designate latent variables; rectangles represent single-indicator items. Single-headed arrows represent regressions. Correlations are not depicted among predictors for readability. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .



**Figure 3.** Final structural path model predicting marijuana use. Regression coefficients are standardized. Circles designate latent variables; rectangles represent single-indicator items. Single-headed arrows represent regressions. Correlations are not depicted among predictors for readability. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

**Table 1**

Demographics and Summary Statistics of Predictor Variables in the Latent Growth Model (LGM)

Variables (range)	Mean (%)	SD	Factor Loading
<i>Demographics<sup>a</sup></i>			
Age (13–18 years)	16.51	1.07	—
Grade in school (7–12)	10.37	1.11	—
<i>Predictors</i>			
Prior smoking (0–1)	(61%)	—	—
Prior drinking (0–3)	1.62	1.08	—
0 = 28%, 1 = 2%, 2 = 51%, 3 = 19%			
Prior marijuana use (0–3)	1.36	1.11	—
0 = 37%, 1 = 2%, 2 = 49%, 3 = 12%			
<i>Drug-using boyfriend</i>			
Heroin	(2%)	—	.28 <sup>b</sup>
Methamphetamines	(5%)	—	.69
Cocaine	(6%)	—	.52
<i>Abuse history (0–4)</i>			
Physical	1.21	0.69	.58
Sexual	1.30	0.79	.50
Depression (0–60)	19.60	10.07	—
Self-esteem (1–4)	2.97	0.70	—
Intact family	(37%)	—	—
Religiosity (1–5)	2.56	1.10	—
Acculturation (1–5)	3.77	0.95	—
Weeks pregnant (7 – 40)	25.57	6.95	—
In Control Group	(27%)	—	—
African American	(20%)	—	—

<sup>a</sup>Not included in LGM.<sup>b</sup>All factor loadings significant,  $p \leq .001$ .



**Table 2**

Substance use over time among 305 adolescents pregnant at baseline (245 Latinas, 60 African Americans)

	Latinas Mean/S.D.	African Americans Mean/S.D.	Total Mean/S.D.	<i>p</i>
Cigarettes				
Baseline	1.04 (0.24)	1.22 (0.96)*	1.08 (0.48)	.01
3 months	1.21 (0.91)	1.25 (0.93)	1.22 (0.91)	.75
6 months	1.41 (1.18)	1.53 (1.55)	1.44 (1.26)	.51
12 months	1.49 (1.24)	1.65 (1.72)	1.52 (1.35)	.40
Alcohol				
Baseline	1.02 (0.15)	1.00 (.00)	1.02 (0.14)	.22
3 months	1.12 (0.46)	1.02 (0.13)	1.10 (0.42)	.08
6 months	1.36 (0.75)	1.32 (0.79)	1.35 (0.76)	.70
12 months	1.39 (0.70)	1.52 (1.03)	1.42 (0.78)	.27
Marijuana				
Baseline	1.04 (0.30)	1.10 (0.66)	1.05 (0.39)	.30
3 months	1.06 (0.30)	1.15 (0.76)	1.08 (0.43)	.15
6 months	1.22 (0.73)	1.42 (1.04)	1.26 (0.81)	.10
12 months	1.21 (0.69)	1.55 (1.23)*	1.28 (0.83)	.01

\* African-Americans significantly higher than Latinas. Possible ranges: cigarettes (1–7), alcohol and marijuana (1–6).

**Table 3**

Correlations among independent variables in Latent Growth Curve analysis

Independent Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Prior smoking	---												
2. Prior drinking	N/A	---											
3. Prior marijuana use	N/A	N/A	---										
4. Drug-using boyfriend	.24***	.16**	.12	---									
5. Abuse history	.43***	.20**	.25***	.26**	---								
6. Depression	.18***	.12*	.17**	.23***	.28***	---							
7. Self-Esteem	-.11	-.07	-.02	-.14*	-.20**	-.41***	---						
8. Intact family	.01	-.06	-.09	-.12*	-.11	.02	-.06	---					
9. Religiosity	-.07	-.14**	-.10	-.12*	.04	.03	.07	.12*	---				
10. Acculturation	.03	.11*	.23***	.05	.12	.07	.15***	-.18***	-.02	---			
11. Weeks pregnant	.00	.01	-.05	-.00	-.11	-.18***	.14**	-.00	.10	-.04	---		
12. In Control Group	.02	.03	-.04	-.17***	-.08	-.01	-.02	.05	.01	.01	.11*	---	
13. African American	.11*	-.11	.02	-.18***	.06	.04	.23***	-.24***	.06	.64***	-.01	.03	---

\* p ≤ .05;

\*\* p ≤ .01;

\*\*\* p ≤ .001.