

Exploring the Link Between Substance Use and Abortion: The Roles of Unconventionality and Unplanned Pregnancy

By Steven C. Martino, Rebecca L. Collins, Phyllis L. Ellickson and David J. Klein

Steven C. Martino is a behavioral scientist at the RAND Corporation, Pittsburgh. Rebecca L. Collins and Phyllis L. Ellickson are senior behavioral scientists, and David J. Klein is a quantitative analyst at the RAND Corporation, Santa Monica, CA.

CONTEXT: Several studies have found a relationship between abortion and prior substance use, suggesting that a reduction in substance use might help decrease abortion rates. However, such a conclusion requires a greater understanding of the processes linking abortion and prior substance use.

METHOD: Path analysis of longitudinal data from 1,224 women was used to simultaneously test two pathways from adolescent substance use to abortion by age 29, one mediated by higher rates of unplanned pregnancy and the other independent of unplanned pregnancy rates. The model was then expanded to examine how these pathways change when unconventional attitudes and behaviors (such as rebelliousness and low religiosity) are taken into consideration.

RESULTS: In the analysis that did not control for unconventionality, women who reported smoking cigarettes or using marijuana or hard drugs at age 18 had an increased likelihood of subsequent unplanned pregnancy and, as a result, higher rates of abortion. In addition, women who had used marijuana had an increased likelihood of abortion independent of unplanned pregnancy rates. In the final model, unconventionality strongly predicted both abortion and unplanned pregnancy. Moreover, it explained the associations between the use of hard drugs or marijuana and abortion that were due to higher unplanned pregnancy rates.

CONCLUSIONS: Unconventionality mediates certain associations between substance use and abortion, perhaps because unconventional women are more likely both to use substances and to engage in behaviors that increase their risk of unplanned pregnancy. Hence, it seems unlikely that reducing substance use will result in substantially fewer abortions.

Perspectives on Sexual and Reproductive Health, 2006, 38(2):66–75

About half of the more than six million pregnancies that occur each year in the United States are unintended, and half of these are terminated by abortion.¹ Several studies have found a relationship between abortion and prior substance use.² For example, Newcomb and Bentler found that women's substance use during adolescence was positively associated with their likelihood of having an abortion by young adulthood.³ These studies suggest that one way of reducing abortion rates might be to decrease adolescent substance use. However, such a conclusion requires considerably more understanding than we currently have of the link between abortion and prior substance use.

One possible explanation for the link is that substance users are more likely than nonusers to engage in behaviors that increase their risk of unplanned pregnancy,⁴ which in turn places them at higher risk for abortion. The precise nature of the association between substance use and risky sexual behavior is, however, a matter of debate. Some authors have posited that cognitive deficits resulting from substance use lead to risky sexual behavior.⁵ According to one popular model, intoxication restricts a substance user's attention to inhibiting cues (e.g., the possible long-term consequences of unprotected sex) and increases attention to impelling ones (e.g., the immediate hedonic effects of sexual contact).⁶ Others have argued that the association be-

tween substance use and risky sexual behavior mainly reflects the influence of personality.⁷ One broad personality characteristic that is inversely related to both substance use and risky sexual behavior is conventionality,⁸ defined as "an orientation toward and involvement with the conventional institutions of family, school and church."⁹ Whereas conventional individuals tend to be positively engaged with these institutions and committed to their values and goals, unconventional individuals tend to be disengaged from these institutions and to not adhere to their norms. Through either or both of these processes, substance users may experience elevated rates of unplanned pregnancy and, therefore, abortion.

An alternative explanation, however, is that the link between substance use and abortion is independent of pregnancy rates. This hypothesis, too, builds on the idea that substance users differ from nonusers in their orientation toward conventional institutions and values. Because they are less engaged with these institutions and their norms, substance users may be more likely than nonusers to obtain an abortion when they have an unplanned pregnancy. On average, women who have abortions, compared with those who carry their pregnancies to term, are less conventional, politically more liberal and less likely to have moral or religious objections to the procedure;¹⁰ these char-

acteristics tend also to describe adolescent substance users.¹¹ Therefore, we might expect to find higher rates of abortion among adult women who used substances in adolescence than among those who did not, even after accounting for any differences between the two groups in their rates of unplanned pregnancy.

The literature to date provides little information by which to distinguish these processes. The relationship that Newcomb and Bentler observed between substance use and abortion dissolved when the researchers took social conformity into account, suggesting that an inclination toward unconventional behavior underlies both substance use and the decision to have an abortion.¹² However, because Newcomb and Bentler compared women who had an abortion with women who did not have an abortion regardless of rates of unplanned pregnancy in the two groups, the nature of the relationship between substance use and abortion that they uncovered—and why it dissolved when social conformity was taken into account—is unclear. To more fully understand the relationship, it is necessary to consider both rates of unplanned pregnancy and rates of abortion (after controlling for any differences in the number of unplanned pregnancies).

In an attempt to address this issue, Yamaguchi and Kandel analyzed retrospective data from a sample of young adult women who were not married at the time of their pregnancies.¹³ They found that women who resolved these pregnancies through abortion were no more likely to have used marijuana or other illicit substances prior to the pregnancy than were women who did not have an abortion. These results, however, must be considered in light of a key weakness of the study: its reliance on recollections of month-by-month substance use over a period of nine years. Retrospective data such as these are subject to problems with recall bias.¹⁴ In addition, Yamaguchi and Kandel's analysis assumed that all nonmarital pregnancies were unplanned. Although most nonmarital pregnancies are indeed unintended,¹⁵ some women choose to become pregnant outside of marriage.¹⁶ If such women were included in Yamaguchi and Kandel's sample, associations between substance use and abortion may have been distorted.

In the only other study of this issue of which we are aware, Mensch and Kandel used event-history analysis to investigate the prospective relationship between illicit substance use and abortion among a sample of women who had nonmarital pregnancies as teenagers.¹⁷ In contrast to Yamaguchi and Kandel's results, this study found that women who had an abortion were significantly more likely than women who carried their pregnancies to term to have used illicit substances (other than marijuana) prior to the pregnancy. However, the study suffered from the same methodological weakness as Yamaguchi and Kandel's work in assuming that all nonmarital pregnancies were unintended. In addition, Mensch and Kandel did not control for unconventionality, leaving open the possibility that this personality characteristic explains the relationship they observed between substance use and abortion.

CURRENT STUDY

In the current study, we used longitudinal data to investigate the prospective relationship between substance use during adolescence and the likelihood of abortion by late young adulthood (age 29), as well as the processes that might explain any observed associations. Using path modeling, we tested, simultaneously, two pathways from adolescent substance use to abortion: one that is mediated by unplanned pregnancy (suggesting that substance users are prone to having unplanned pregnancies and thus are more likely to have abortions) and one that is direct (indicating that substance users are more likely to resolve pregnancies through abortion irrespective of unplanned pregnancy rates).

We also examined how the relationship between substance use and abortion changes when six indicators of unconventional attitudes and behaviors—low religiosity, low academic achievement, dropping out of school, low parental bonds, rebelliousness and deviance—are taken into consideration. These variables tap connectedness to family, school, religion and other conventional social institutions. If substance use is related to abortion primarily because it causes cognitive impairment that leads to risky sexual behavior (and then unplanned pregnancy), we would expect to find only an indirect effect of substance use on abortion. Moreover, we would expect that controlling for indicators of unconventionality would not diminish this effect.

On the other hand, if substance use is related to abortion primarily because it reflects a proclivity toward unconventionality, then both indirect and direct effects are possible. In other words, unconventional youth may be more likely than their conventional counterparts to have abortions both because they are more likely to engage in behaviors that put them at risk for unplanned pregnancy (e.g., having sex more frequently, using birth control less consistently or using less effective contraceptive methods) and because they are more likely to choose an abortion once they become pregnant. In this scenario, controlling for indicators of unconventionality should eliminate both types of relationship.

Finally, if adolescent substance use relates to abortion both because it impairs decision making surrounding sex and because it reflects unconventionality, we would again expect to observe both direct and indirect effects of substance use on abortion. After indicators of unconventionality are added to the model, the direct effects should disappear, and the indirect effects should weaken.

In our analyses, we treated the various types of substance use as distinct entities, because different substances may be associated with abortion for different reasons. For example, alcohol use is very common among high school students¹⁸ and thus is unlikely to be indicative of unconventionality; we would expect alcohol use, therefore, to be related to abortion only through its effect on unplanned pregnancy, if at all. In contrast, cigarette smoking and use of illicit substances during adolescence are believed to be strongly indicative of unconventionality¹⁹ and thus may have both direct and indirect effects on abortion. Unlike alcohol and

illicit substances, however, cigarettes are unlikely to produce cognitive deficits that may lead to risky sexual behavior; thus, unconventionality, rather than cognitive impairment, probably explains any relationship that may exist between cigarette use and unplanned pregnancy.

In examining the association between substance use and abortion, it is important to control for demographic characteristics that are associated with these variables, including race and ethnicity, socioeconomic status and family background. The abortion rate is highest among black and Hispanic women, and lowest among white women.²⁰ The disproportionately high abortion rate among Hispanic women is due wholly to this group's having a disproportionately high rate of unintended pregnancy.²¹ Black women, on the other hand, are more likely both to have unintended pregnancies and to resolve these pregnancies through abortion than are nonblack women.²² Race and ethnicity are likewise related to substance use: Black and Asian adolescents and young adults consistently report less use of alcohol and illicit drugs than their white and Hispanic counterparts.²³ Finally, research has shown that women who were raised by two parents or whose family was of higher socioeconomic status have a reduced probability of substance use²⁴ and unplanned pregnancy²⁵ but an increased likelihood of abortion (given an unplanned pregnancy).²⁶

METHODS

Study Participants

Study participants were a subsample of women who participated in Waves 7 and 9 of the RAND Adolescent/Young Adult Panel Study. The cohort was originally recruited in 1985, when participants were in grade seven (mean age, 12.7), to take part in a substance use prevention intervention and its evaluation.²⁷ The baseline panel of 6,527 adolescents (including 3,135 females) was drawn from 30 middle and junior high schools in eight California and Oregon school districts, including urban, suburban and rural communities. Nine of the schools had a minority population of 50% or more, and 18 served neighborhoods with incomes below the state median. Forty-four percent of baseline participants came from disrupted families. About half of baseline participants' fathers (53%) and mothers (53%) had a high school education or less; for 39% of participants, neither parent had advanced beyond high school. Sixty-seven percent of participants were white, 10% Hispanic, 10% black, 8% Asian and 4% from other backgrounds. The response rate at baseline was 86%. Analyses of demographic and school achievement data from nonrespondents showed that nonresponse did not bias the baseline sample on these dimensions.²⁸

Sixty-seven percent of the initial sample (4,390 youth, including 2,354 females) completed the Wave 7 survey, which was conducted about five years after baseline, when participants' average age was 18.0. The Wave 9 survey was conducted approximately 11 years later, when participants' mean age was 29.4; the 2,586 respondents (including 1,447 females) represented 40% of the initial sample.

Because we wanted to predict unplanned pregnancy and

abortion from our Wave 7 measures, we excluded 94 women who reported having an abortion before Wave 7. We also excluded 35 women who did not report an abortion but who had a single unplanned pregnancy before Wave 7, as well as 20 women for whom Wave 9 data on unplanned pregnancy or abortion were missing. An additional 74 women were excluded because they had completed the Wave 9 survey but not the Wave 7 survey. The resulting analytic sample consisted of 1,224 women.

Procedure

Participants completed self-administered surveys in school at baseline and by mail at Waves 7 and 9. To examine the validity and reliability of self-reported tobacco use over the study's initial four waves, RAND collected saliva samples prior to the survey and compared levels of cotinine (a chemical made by the body from nicotine) with self-reports of smoking. The results suggest that participants were generally honest about their tobacco use; at baseline and 15 months later, 95% of participants with cotinine levels that identified them as recent tobacco users had admitted on their questionnaires to smoking cigarettes or using smokeless tobacco.²⁹

Prior work with this sample also examined the consistency of self-reported use of cigarettes, alcohol and marijuana over time. Across four waves of data collected during adolescence, the proportion of participants who denied using one of these substances after previously admitting use averaged about 5%. Retractions of frequent use averaged substantially less than 1%.³⁰

Measures

•**Abortion.** At Wave 9, participants reported whether they had ever had an abortion. Because we excluded from our analysis women who reported at Wave 7 that they had had an abortion, our analyses assumed that women who reported at Wave 9 that they had had an abortion did so between ages 18 and 29.

•**Unplanned pregnancy.** At Wave 9, women were asked how many times they had been pregnant and how many of their pregnancies had happened either "sooner than you wanted to get pregnant but when you knew you wanted to have a baby in the future," or "when you didn't want a new baby and knew you would not want one sometime in the future." These items were based on questions developed for the 1995 National Survey of Family Growth.³¹ Women who reported that they had had at least one unwanted or mistimed pregnancy between Waves 7 and 9 were given a score of 1 on our index of unplanned pregnancy; all others were given a score of 0. As noted earlier, we excluded from our analytic sample women who had an unplanned pregnancy prior to Wave 7.

•**Substance use.** At age 18, participants reported the number of times in the past year (on a scale of 0=none to 6=40 or more) they had used alcohol, cigarettes and marijuana. They also reported how often in the past year they had used each of the following drugs (which we will refer to as hard drugs): cocaine, hallucinogens, nonprescription sedatives

TABLE 1. Percentage of female participants in the RAND Adolescent/Young Adult Panel Study, by selected baseline characteristics, according to survey wave

Characteristic	Baseline (N=3,135)	Wave 9 (N=1,373) [†]	
	Unweighted	Unweighted	Weighted
Race/ethnicity			
White	67.3	74.5	67.0
Black	10.5	7.0	10.9
Hispanic	10.2	7.4	10.1
Asian	7.8	8.5	7.6
Other	4.2	2.6	4.4
Ever used cigarettes	52.0	43.3	53.1
Ever used alcohol	75.8	74.5	76.9
Ever used marijuana	19.3	11.7	19.3

[†]Includes all women who completed surveys for both Wave 7 and Wave 9; the final analytic sample excluded 149 women who had an unplanned pregnancy or abortion before Wave 7 or were missing data on unplanned pregnancy or abortion at Wave 9. Note: Participants were in grade seven (mean age, 12.7) at baseline and were approximately 29 years old at Wave 9.

and tranquilizers, nonprescription stimulants, heroin and narcotics other than heroin (0=no use in past year to 4=10 or more times in past year). We used responses to these items to create five mutually exclusive categories of past-year drug use: none (19% of participants), alcohol use only (35%), use of cigarettes but not marijuana or hard drugs (15%), use of marijuana but not hard drugs (16%), and use of hard drugs (15%). We chose these categories rather than using four indicators (one per substance type) for each participant because substance use tends to be sequenced; use of later substances in this sequence is highly related to use of earlier substances.³² As a result, measures of use of different substances are subject to strong multicollinearity. Our approach allows us to limit collinearities that might render interpretation of path analysis results difficult, while preserving information about different forms of use. In our sample, 85% of women who had used cigarettes in the past year had also used alcohol, all women who had used marijuana had also used either alcohol or cigarettes, and 80% of women who had used hard drugs had also used marijuana.

•**Demographic characteristics.** Demographic characteristics, measured at age 13, were race and ethnicity and whether participants lived in a household with two biological parents. As an indicator of socioeconomic background, we used the highest level of education attained by either parent at the time the participant was in grade seven, on a scale of 0 (did not graduate high school) to 3 (college graduate or beyond).

•**Unconventionality.** At Wave 7, we measured a set of factors that indicate psychosocial unconventionality and are known to be associated with adolescent substance use, unplanned pregnancy and abortion.³³

To form a measure of low religiosity, we standardized and averaged participants' responses to two items (alpha=0.89): "Religion is very important in my life" (1=strongly agree to 4=strongly disagree) and "How much do your religious beliefs influence the way you live your life" (1=a great deal to 5=not at all). We used four items (alpha=0.60) to measure rebelliousness, including "I get away with as much as I possibly can" and "I feel guilty when I break a rule" (reverse

coded; 1=strongly disagree to 4=strongly agree). To measure deviance, we averaged participants' responses to questions regarding how often in the past year (0=not at all to 5=20 or more times) they had engaged in each of 20 deviant behaviors, including stealing, skipping school, carrying a hidden weapon and participating in gang fights (alpha=0.86). To measure low parental bonding, we averaged responses to six items (alpha=0.76), which included "My parents respect my feelings," "My parents can sense when I am upset" and "My parents know where I am or what I am doing" (1=strongly disagree to 4=strongly agree). At Wave 7, participants indicated their school grades and college board scores; they also rated the importance of getting into college, the degree to which they felt that time in school would be better spent working and their parents' attitude toward schooling. We standardized responses to these items and averaged them to form an index of low academic orientation (alpha=0.68). Finally, participants who reported at Wave 7 that they were not enrolled in school and had not graduated or received a high school diploma were categorized as high school dropouts.

Handling of Missing Data

Care was taken to track participants. However, by Wave 9, the proportions of participants who were black or Hispanic, or who had used cigarettes, marijuana or alcohol by grade seven, had declined from baseline. For this reason, all statistics presented below are weighted to better represent the original sample. Weights were inversely proportional to the predicted probability of response at ages 18 and 29, based on a logistic regression using more than 80 seventh-grade characteristics, including demographic, academic, personality and substance use variables. Use of these weights removed 90% of the attrition bias related to race and ethnicity and substance use (Table 1).

Although the nonresponse weights reduce attrition bias, they do not address the problem of missing data for participants who remained in the study but did not respond to all survey items. Rates of nonresponse on individual items were low (0–3%); however, omitting participants with any missing values from our multivariate analyses would have resulted in the loss of 8% of the sample. To avoid any bias and loss of information that would occur by excluding these women, we imputed missing values using least-squares regression imputation. This commonly used method is an efficient procedure for handling missing data and produces more reliable results than are obtained by excluding the participants from the analysis, as long as the missing values are infrequent and spread uniformly across the data.³⁴ To impute missing values, we selected 30 measures that would likely be associated with our set of predictors (e.g., age, race, gender, religiosity, income, household composition, mental health and education) and used them in a series of least-squares regressions to generate a predicted value for the relevant variable. This predicted value was then substituted for the missing value.³⁵ We did not, however, impute missing data on unplanned pregnancy or abortion.

TABLE 2. Coefficients (and standard errors) from logistic regression analyses examining bivariate associations between selected characteristics and unplanned pregnancy and abortion between ages 18 and 29

Characteristic	Unplanned pregnancy	Abortion
Race/ethnicity		
White	ref	ref
Black	0.31 (0.15)*	0.44 (0.17)**
Hispanic	0.60 (0.16)***	0.51 (0.16)**
Asian	-0.13 (0.14)	0.21 (0.15)
Other	0.24 (0.25)	0.40 (0.26)
Two-parent household‡	-0.32 (0.09)***	-0.31 (0.09)***
Parental education‡	-0.17 (0.04)***	-0.11 (0.04)*
Substance use§		
None	ref	ref
Alcohol only	0.13 (0.14)	-0.12 (0.14)
Cigarettes, no illicit substances	0.39 (0.14)**	0.25 (0.16)
Marijuana, no other illicit substances	0.41 (0.14)**	0.52 (0.15)***
Hard drugs	0.58 (0.14)***	0.44 (0.15)**
Unconventionality§		
Low religiosity	0.06 (0.04)	0.12 (0.05)*
Rebelliousness	0.19 (0.06)**	0.24 (0.07)***
Deviance	0.86 (0.14)***	0.67 (0.17)***
Low parental bonding	0.31 (0.06)***	0.21 (0.07)**
Low academic orientation	0.37 (0.07)***	0.21 (0.07)**
High school dropout	0.18 (0.16)	0.31 (0.17)†
Unplanned pregnancy	na	1.96 (0.13)***

*p<.05. **p<.01. ***p<.001. †p<.10. ‡At grade seven. §At grade 12. Notes: ref=reference group. na=not applicable. Two-parent household was measured dichotomously. Parental education was an ordered categorical variable. All unconventionality measures were continuous except for high school dropout, which was dichotomous.

Analytic Strategy

We began our analyses by using logistic regression to examine the longitudinal bivariate associations between each predictor variable and, in turn, the likelihood that a woman had an unplanned pregnancy between ages 18 and 29 and the likelihood that she had an abortion during that period (not conditioned on unplanned pregnancy). Next, we used path analysis to test two multivariate models of the association between substance use at age 18 and the likelihood of abortion between ages 18 and 29. In the first model, we estimated the multivariate associations between abortion and the four categories of substance use (participants who reported no recent substance use at Wave 7 were the reference group), controlling for seventh-grade demographic characteristics. In this model, we estimated direct paths from each predictor to abortion, as well as indirect paths that went through unplanned pregnancy. This allowed us to test whether all or some of any association between prior substance use and abortion could be attributed to a relationship between substance use and unplanned pregnancy.

In the second model, we added the indicators of unconventionality (low religiosity, rebelliousness, deviance, low parental bonding, low academic orientation and high school dropout status), estimating paths between each indicator and both unplanned pregnancy and abortion. If direct or indirect associations between substance use and abortion were observed in the first model but not in the second, we would conclude that the effect of substance use on abortion is wholly attributable to the association between sub-

stance use and unconventionality. If all associations between substance use and abortion that emerged in the first model remained in the second, we would conclude that substance use has an association with abortion that is independent of its relationship with unconventionality.

Changes observed in the second model would also allow us to specify the point in the process where substance use or unconventionality plays a role in abortion. For example, unconventionality might explain a direct relationship between substance use and abortion, but not an indirect one between substance use and unplanned pregnancy. Such a result would suggest that pregnancy resolution is a function of unconventionality, whereas unplanned pregnancy is a function of substance use.

RESULTS

Sample Description

Of the 1,224 women in our analytic sample, 69% were white, 9% Hispanic, 10% black, 8% Asian and 4% of other races or ethnicities. About half reported yearly earnings of less than \$45,000 at Wave 9. The mean level of education was 13.5 years at Wave 9; approximately 92% of respondents had earned a high school degree. Forty-three percent of the sample had at least one unplanned pregnancy between ages 18 and 29. Of these women, 54% had an abortion.

Bivariate Associations

Black and Hispanic women were more likely than white women to have an unplanned pregnancy and to have an abortion (Table 2). Women raised in a two-parent household prior to age 13 and those with more highly educated parents had a reduced likelihood of unplanned pregnancy and a reduced likelihood of abortion.

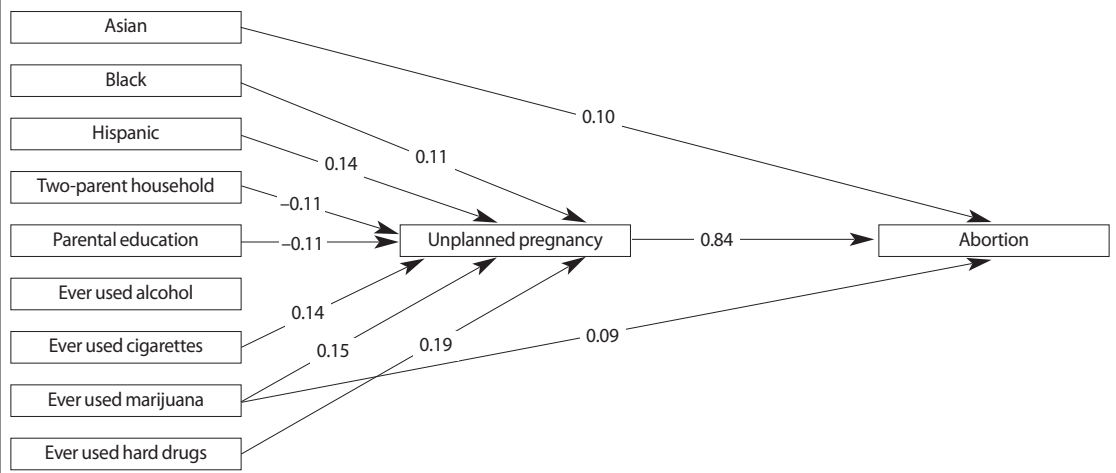
Women who reported at Wave 7 that they had used marijuana or hard drugs in the past year were more likely than their peers who had not used substances to have had an unplanned pregnancy and to have had an abortion between ages 18 and 29. Women who had smoked cigarettes during late adolescence had an increased likelihood of having a subsequent unplanned pregnancy but not an abortion. Alcohol use was not associated with either outcome.

Increased rebelliousness and deviance at grade 12 were associated with an elevated likelihood of unplanned pregnancy and abortion between ages 18 and 29, as were low levels of parental bonding and academic orientation. Women with low religiosity at grade 12 had an increased likelihood of abortion but not of unplanned pregnancy. Being a high school dropout was marginally associated with a greater likelihood of abortion but was not associated with unplanned pregnancy. Finally, there was a strong association between having an unplanned pregnancy between ages 18 and 29 and having an abortion during that same time period.

Path Analyses

The first model tested the associations between demographic characteristics and substance use at grade 12 and subsequent abortion. Recent use of cigarettes, marijuana and hard

FIGURE 1. Path model of the relationships between substance use at age 18 and unplanned pregnancy and abortion at age 29, controlling for baseline demographic characteristics



Notes: Values shown are standardized path coefficients. Paths were estimated from all substance use and demographic variables to both unplanned pregnancy and abortion. Only statistically significant paths ($p < .05$) are shown.

drugs at grade 12 were each independently associated with an elevated likelihood of having an unplanned pregnancy, which in turn was associated with an increased likelihood of abortion (Figure 1). However, only marijuana use at age 18 had a direct association with abortion. There were no associations—either direct or indirect—between alcohol use and abortion.

In this model, Asian women were more likely than white women to have an abortion, independent of unplanned pregnancy rates in these groups. Black and Hispanic women were more likely than white women to have an unplanned pregnancy (and thus an abortion). Finally, women who were raised in a two-parent household and women with more highly educated parents were less likely to have an unplanned pregnancy, and as a result, less likely to have an abortion, than were women who were raised in single-parent households and women with less educated parents, respectively.

The addition of unconventionality to the model eliminated two of the three indirect associations between substance use and abortion; only the indirect association between cigarette use and abortion remained significant (Figure 2, page 72). In addition, although the direct association between marijuana use and abortion became only marginally significant ($p = .07$), the coefficient representing it was unchanged; hence, the loss of significance was most likely due to a loss of statistical power, rather than to the effects of controlling for unconventionality. This conclusion is supported by the observation that the overall indirect effect of cigarette use on abortion (0.086)* is nearly identical in magnitude to the independent, direct effect of marijuana use on abortion (0.09).

Consistent with the changes in the substance use findings across models, all of the unconventionality variables were related to unplanned pregnancy, abortion or both. Women who were more deviant and those who were less bonded to their

parents were more likely to have abortions than women who were less deviant or had stronger bonds with their parents, respectively, but only because they had elevated rates of unplanned pregnancies. Low academic orientation was associated with abortion both directly and indirectly, but these associations were in opposite directions: Although being less academically oriented increased the likelihood that a woman would subsequently have an unplanned pregnancy, it decreased the likelihood that, given such a pregnancy, she would have an abortion. In contrast, being a high school dropout was marginally associated ($p = .06$) with a lower likelihood of having an unplanned pregnancy and, controlling for this, a higher likelihood of having an abortion. Finally, women who were less religious and more rebellious at age 18 were more likely to have an abortion, independent of rates of unplanned pregnancy, than were women with higher levels of religiosity and low levels of rebelliousness, respectively. The direct and indirect effects of the demographic variables in the first model remained significant in the second model.

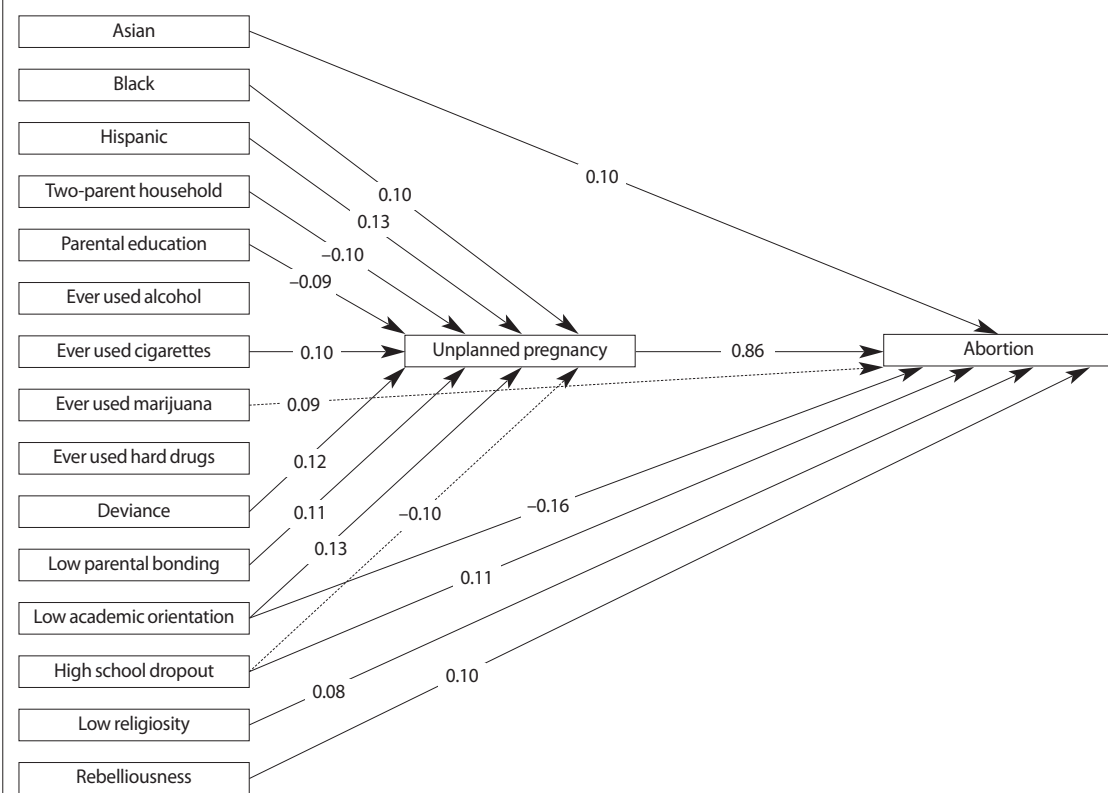
DISCUSSION

Prior to controlling for unconventionality, we found several associations between a woman's substance use at age 18 and the likelihood that she subsequently had an abortion. Cigarette, marijuana and hard drug use were each indirectly associated with abortion via their association with higher rates of unplanned pregnancy. Marijuana use was also directly associated with abortion.

In our final model, unconventionality was a strong predictor of both abortion and unplanned pregnancy. Moreover, it explained all of the indirect association between hard drug use and abortion, as well as the portion of the associ-

*This value represents the product of the coefficient for the association between cigarette use and unplanned pregnancy (0.1) and the coefficient for the association between unplanned pregnancy and abortion (0.86).

FIGURE 2. Path model of the relationships between substance use at age 18 and unplanned pregnancy and abortion at age 29, controlling for baseline demographic characteristics and unconventionality at age 18



Notes: Values shown are standardized path coefficients. Paths were estimated from all substance use, demographic and unconventionality variables to both unplanned pregnancy and abortion. Paths represented by solid lines are statistically significant ($p < .05$). Paths represented by dashed lines are marginally significant ($p < .10$). Nonsignificant paths ($p \geq .10$) are omitted.

ation between marijuana use and abortion that operated through unplanned pregnancy. These findings strongly support the notion that unconventional women are more likely to engage in risky behaviors, including use of marijuana and hard drugs, that put them at risk for unplanned pregnancy, and this in part explains the higher prevalence of abortion among users of these substances. Thus, our results partially support Newcomb and Bentler’s assertion that deviance or lack of social conformity underlies the relationship between substance use and abortion. However, our findings more clearly specify the point at which this process occurs. We find that unconventionality explains only the indirect role of substance use in abortion (i.e., the association between such use and unplanned pregnancy).

Moreover, unconventionality did not explain the indirect association between cigarette use and abortion. Our finding that cigarette smoking is related to an increased likelihood of unplanned pregnancy (and thus abortion) is consistent with previous findings,³⁶ including results of prior work using data from this same sample.³⁷ In that prior study, we found that use of cigarettes, but not other substances, predicted teenage pregnancy and, indirectly, early marriage. We explained this association by suggesting that cigarette use may reflect a particularly strong indifference to conventional norms and values; yet, in the present study, cig-

arette use remained an important predictor of unplanned pregnancy even after we controlled for several indicators of unconventionality. The association may instead be driven by cigarette users’ lack of concern for their own well-being and health, which may be reflected in poorer mental health.³⁸ To test this possibility, research is needed that examines the association between cigarette use and unplanned pregnancy and that controls for mental health.

Unconventionality also did not appear to explain the direct association between marijuana use and abortion. Although the association was only marginally significant after we controlled for unconventionality, the coefficient representing the magnitude of the association did not change. If this finding is reliable, it indicates that marijuana use is associated with pregnancy resolution decisions and that this association is independent of any relationship between marijuana use and unconventionality. One possible explanation for the association is that marijuana users may be more likely than nonusers to have abortions because of their fears about the effects of marijuana on fetal development. Another is that marijuana users are more likely than nonusers to judge themselves unable, or are unwilling, to take on the responsibilities of pregnancy or parenting. Role socialization/role incompatibility theory suggests that during the ages examined in the present study, substance users must choose between

taking on the adult roles of marriage and parenthood and continuing to use substances. This hypothesis has been applied particularly to the use of illicit substances, which is theorized to be especially incompatible with these adult roles.³⁹ It also is consistent with studies showing that marijuana users tend to be less accepting of personal and social responsibility than nonusers.⁴⁰ Further research is required to more clearly determine whether pregnancy resolution decisions are independent of unconventional and, if so, to evaluate the feasibility of these explanations.

The results of our study must be considered in light of some potential limitations. First, slightly more than half of the original sample of women was lost to attrition by Wave 9. We weighted the data to correct for the potential bias caused by attrition. Although these weights may not fully correct for attrition bias (we cannot directly correct for unmeasured characteristics), the weighted sample closely approximated the original sample in the proportion of respondents who had engaged in nonconforming behavior (used alcohol, cigarettes or marijuana by grade seven) and in the proportions of white, black, Hispanic and Asian women. Moreover, the present and prior analyses of the data collected at young adulthood⁴¹ indicate fertility and sexual behavior patterns similar to those from national estimates.⁴² Nevertheless, any uncorrected bias from the loss of unconventional adolescents may have attenuated the results.

Another limitation of our study is that it relies on self-reported information regarding abortion, pregnancy and substance use. Underreporting of abortion is common in surveys of women in the general population and is known to be related to several variables used as predictors in our study, including race, religiosity and education.⁴³ That we found relationships between these predictors and abortion gives us some confidence in our data, and the inclusion of these factors as covariates should correct any bias. However, we cannot be certain that misreporting did not affect our results. Although research suggests that the quality of self-report data on alcohol, marijuana and cigarette use is generally reliable,⁴⁴ and our tests to validate self-reported tobacco use in this sample showed the reports to be highly accurate,⁴⁵ women in our sample may have underreported other types of substance use. Previous analyses, however, have shown that prevalence rates for substance use in this cohort are within the range typically found in national studies.⁴⁶

These limitations notwithstanding, our study represents the most comprehensive analysis to date of the association between substance use and abortion, providing important insight into the nature of this relationship. Our results suggest that there are several pathways by which substance use is associated with abortion. First, the relationship between hard drug use and abortion in our sample was driven by hard drug users' increased risk of unplanned pregnancy, which appeared to be a function of their nonconforming personalities and lifestyles. This explanation applies to the indirect relationship between marijuana use and abortion as well. We also found evidence suggesting that women who

use marijuana have an elevated likelihood of terminating pregnancies, perhaps reflecting a desire to avoid parental responsibility. Finally, the relationship between cigarette use and abortion was entirely due to an association with unplanned pregnancy, indicating that smoking is not related to pregnancy resolution but rather to pregnancy occurrence. We suggest that cigarette users may lack concern for their well-being and health, and that this unwariness may lead them to engage in risky sexual behavior that then results in unplanned pregnancy. The last two explanations, however, need formal assessment.

Given our findings, it seems unlikely that reducing substance use will, by itself, result in fewer unplanned pregnancies or abortions. More empirical attention should be directed toward understanding the personality features that drive the associations that we uncovered and how those personality features operate. Our study suggests that unconventional adolescents foster abortion by increasing the likelihood of unplanned pregnancy—perhaps because unconventional adolescents have more sexual experience, use birth control less consistently or use less effective methods than conventional adolescents—and by influencing pregnancy resolution decisions. In addition to further clarifying the role of unconventional adolescents in abortion, future research should examine the degree to which characteristics such as poor mental health, lack of concern for one's health and lack of responsibility affect women's reproductive choices.

REFERENCES

1. Finer LB and Henshaw SK, Disparities in rates of unintended pregnancy in the United States, 1994 and 2001, *Perspectives on Sexual and Reproductive Health*, 2006, 38(2):90–96.
2. Costa F, Jessor R and Donovan JE, Psychosocial correlates and antecedents of abortion: an exploratory study, *Population and Environment*, 1987, 9(1):3–22; Mensch BS and Kandel DB, Drug use as a risk factor for premarital teen pregnancy and abortion in a national sample of young white women, *Demography*, 1992, 29(3): 409–429; and Newcomb MD and Bentler PM, *Consequences of Adolescent Drug Use: Impact on the Lives of Young Adults*, Newbury Park, CA: Sage, 1988.
3. Newcomb and Bentler, 1989, op. cit. (see reference 2).
4. Duncan SC, Strycker LA and Duncan TE, Exploring associations in developmental trends of adolescent substance use and risky sexual behavior in a high-risk population, *Journal of Behavioral Medicine*, 1999, 22(1):21–34; Fortenberry JD, Adolescent substance use and sexually transmitted diseases risk: a review, *Journal of Adolescent Health*, 1995, 16(4):304–308; and Lowry R et al., Substance use and HIV-related sexual behaviors among U.S. high school students: are they related? *American Journal of Public Health*, 1994, 84(7):1116–1120.
5. Curtin JJ et al., Alcohol affects emotion through cognition, *Psychological Science*, 2001, 12(6):527–531; and MacDonald TK, Zanna MP and Fong GT, Why common sense goes out the window: effects of alcohol on intentions to use condoms, *Personality and Social Psychology Bulletin*, 1996, 22(8):763–775.
6. Steele CM and Josephs RA, Alcohol myopia: its prized and dangerous effects, *American Psychologist*, 1990, 45(8):921–933.
7. Ary DV et al., Development of adolescent problem behavior, *Journal of Abnormal Child Psychology*, 1999, 27(2):141–150; and Donovan JE and Jessor R, Structure of problem behavior in adolescence and young adulthood, *Journal of Consulting and Clinical Psychology*, 1985, 53(6):890–904.
8. Donovan JE, Jessor R and Costa FM, Adolescent health behavior

and conventionality-unconventionality: an extension of problem-behavior theory, *Health Psychology*, 1991, 10(1):52–61.

9. Jessor R, Turbin MS and Costa FM, Protective factors in adolescent health behavior, *Journal of Personality and Social Psychology*, 1998, 75(3):788–800.

10. Bracken MB, Klerman LV and Bracken M, Abortion, adoption, or motherhood: an empirical study of decision-making during pregnancy, *American Journal of Obstetrics and Gynecology*, 1978, 130(3):251–261; Cooksey EC, Factors in the resolution of adolescent premarital pregnancies, *Demography*, 1990, 27(2):207–218; Costa F, Jessor R and Donovan JE, 1987, op. cit. (see reference 2); Jones RK, Darroch JE and Henshaw SK, Patterns in the socioeconomic characteristics of women obtaining abortions in 2000–2001, *Perspectives on Sexual and Reproductive Health*, 2002, 34(5):226–235; Newcomb MD and Bentler PM, 1988, op. cit. (see reference 2); Olson L, Social and psychological correlates of pregnancy resolution among adolescent women: a review, *American Journal of Orthopsychiatry*, 1980, 50(3):432–445; and Teachman J and Polonko KA, Timing of the transition to parenthood: a multidimensional birth-interval approach, *Journal of Marriage and the Family*, 1985, 47(4):867–879.

11. Donovan JE, Jessor R and Costa FM, 1991, op. cit. (see reference 8).

12. Newcomb MD and Bentler PM, 1988, op. cit. (see reference 2).

13. Yamaguchi K and Kandel D, Drug use and other determinants of premarital pregnancy and its outcome: a dynamic analysis of competing life events, *Journal of Marriage and the Family*, 1987, 49(2):257–270.

14. Brown NR, Rips LJ and Shevell SK, The subjective dates of natural events in very-long-term memory, *Cognitive Psychology*, 1985, 17(2):139–177.

15. Henshaw SK, Unintended pregnancy in the United States, *Family Planning Perspectives*, 1998, 30(1):24–29 & 46.

16. National Campaign to Prevent Teen Pregnancy, *America's Adults and Teens Sound Off About Teen Pregnancy*, Washington, DC: National Campaign to Prevent Teen Pregnancy, 2003.

17. Mensch BS and Kandel DB, 1992, op. cit. (see reference 2).

18. Johnston LD et al., *Monitoring the Future National Survey Results on Drug Use, 1975–2003. Vol. I: Secondary School Students*, Washington, DC: U.S. Government Printing Office, 2004.

19. Aloise-Young PA and Hennigan KM, Self-image, the smoker stereotype and cigarette smoking: developmental patterns, *Journal of Adolescence*, 1996, 19(2):163–177; Barton J et al., Social image factors as motivators of smoking initiation in early and middle adolescence, *Child Development*, 1982, 53(6):1499–1511; Gorman DM and Derzon JH, Behavioral traits and marijuana use and abuse: a meta-analysis of longitudinal studies, *Addictive Behaviors*, 2002, 27(2):193–206; and Roberts BW and Bogg T, A longitudinal study of the relationships between conscientiousness and the social-environmental factors and substance-use behaviors that influence health, *Journal of Personality*, 2004, 72(2):325–353.

20. Jones RK, Darroch JE and Henshaw SK, 2002, op. cit. (see reference 10).

21. Henshaw SK, 1998, op. cit. (see reference 15); and Jones RK, Darroch JE and Henshaw SK, 2002, op. cit. (see reference 10).

22. Henshaw SK, 1998, op. cit. (see reference 15); and Jones RK, Darroch JE and Henshaw SK, 2002, op. cit. (see reference 10).

23. Johnston LD, O'Malley PM and Bachma JG, *Monitoring the Future National Survey Results on Drug Use, 1975–1999. Vol. II: College Students and Young Adults*, Washington, DC: U.S. Government Printing Office, 2000.

24. Kadushin C et al., The substance use system: social and neighborhood environments associated with substance use and misuse, *Substance Use and Misuse*, 1998, 33(8):1681–1710; and Winkleby MA et al., Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease,

American Journal of Public Health, 1992, 82(6):816–820.

25. Henshaw SK, 1998, op. cit. (see reference 15); and Robbins C, Kaplan HB and Martin SS, Antecedents of pregnancy among unmarried adolescents, *Journal of Marriage and the Family*, 1985, 47(3):567–583.

26. Cooksey EC, 1990, op. cit. (see reference 10); Mensch BS and Kandel DB, 1992, op. cit. (see reference 2); South SJ and Baumer EP, Community effects on the resolution of adolescent premarital pregnancy, *Journal of Family Issues*, 2001, 22(8):1025–1043; and Udry JR, Kovenock J and Morris NM, Early predictors of nonmarital first pregnancy and abortion, *Family Planning Perspectives*, 1996, 28(3):113–116.

27. Ellickson PL and Bell RM, Drug prevention in junior high: a multi-site longitudinal test, *Science*, 1990, 247(4948):1299–1304.

28. Bell RM, Garelick C and Ellickson PL, *Baseline Nonresponse in Project ALERT: Does It Matter?* Santa Monica, CA: RAND, 1990.

29. Freier ME, Bell RM and Ellickson PL, *Do Teens Tell the Truth? The Validity of Self-Reported Tobacco Use by Adolescents*, Santa Monica, CA: RAND, 1991.

30. Reinisch EJ, Bell RM and Ellickson PL, *How Accurate Are Adolescent Reports of Drug Use?* Santa Monica, CA: RAND, 1991.

31. Mosher WD, Design and operation of the 1995 National Survey of Family Growth, *Family Planning Perspectives*, 1998, 30(1):43–46.

32. Kandel DB and Jessor R, The gateway hypothesis revisited, in: Kandel DB, ed., *Stages and Pathways of Drug Involvement: Examining the Gateway Hypothesis*, Cambridge, UK: Cambridge University Press, 2002, pp. 365–372.

33. Ary DV et al., 1999, op. cit. (see reference 7); Donovan JE, Jessor R and Costa FM, 1991, op. cit. (see reference 8); and Jessor R, Turbin MS and Costa FM, 1998, op. cit. (see reference 9).

34. Schafer JL and Graham JW, Missing data: our view of the state of the art, *Psychological Methods*, 2002, 7(2):147–177.

35. Little RJA, Regression with missing x's: a review, *Journal of the American Statistical Association*, 1992, 87(420):1227–1237.

36. Biglan A et al., Social and behavioral factors associated with high-risk sexual behavior among adolescents, *Journal of Behavioral Medicine*, 1990, 13(3):245–261.

37. Martino SC, Collins RL and Ellickson PL, Adolescent substance use and early marriage, *Journal of Marriage and Family*, 2004, 66(1):244–257.

38. Orlando M, Ellickson PL and Jinnett K, The temporal relationship between emotional distress and cigarette smoking during adolescence and young adulthood, *Journal of Consulting and Clinical Psychology*, 2001, 69(6):959–970.

39. Yamaguchi K and Kandel DB, On the resolution of role incompatibility: a life event analysis of family roles and marijuana use, *American Journal of Sociology*, 1985, 90(6):1284–1325.

40. Mayer JE and Ligman JD, Personality characteristics of adolescent marijuana users, *Adolescence*, 1989, 24(96):965–975.

41. Collins RL et al., Isolating the nexus of substance use, violence and sexual risk for HIV infection among young adults in the United States, *AIDS and Behavior*, 2005, 9(1):73–87; and Martino SC, Collins RL and Ellickson PL, 2004, op. cit. (see reference 37).

42. Henshaw SK, 1998, op. cit. (see reference 15).

43. Fu H et al., Measuring the extent of abortion underreporting in the 1995 National Survey of Family Growth, *Family Planning Perspectives*, 1998, 30(3):128–133 & 138.

44. Mensch BS and Kandel DB, Underreporting of substance use in a national longitudinal youth cohort: individual and interviewer effects, *Public Opinion Quarterly*, 1988, 52(1):100–124; and O'Malley PM, Bachman JG and Johnston LD, Reliability and consistency in self-reports of drug use, *International Journal of Addiction*, 1983, 18(6):805–824.

45. Freier ME, Bell RM and Ellickson PL, 1991, op. cit. (see reference 29).

46. Ellickson PL et al., Teenagers and alcohol misuse in the United States: by any definition, it's a big problem, *Addiction*, 1996, 91(10):1489–1503; and Ellickson PL, Saner H and McGuigan KA, Profiles of violent youth: substance use and other concurrent problems, *American Journal of Public Health*, 1997, 87(6):985–991.

Acknowledgment

This research was supported by National Institute on Drug Abuse grant R01 DA13515.

Author contact: martino@rand.org

CORRECTION

In “Asian American Adolescents’ First Sexual Intercourse: Gender and Acculturation Differences,” by Hyeouk Chris Hahm, Maureen Lahiff and Rose M. Barreto [2006, 38(1):28–36], reference 4 should be Eng TR and Butler WT, eds., *The Hidden Epidemic: Confronting Sexually Transmitted Diseases*, Washington, DC: National Academy Press, 1997; reference 5 should be Ventura SJ et al., Revised pregnancy rates, 1990–1997, and new rates for 1998–1999: United States, *National Vital Statistics Report*, 2003, Vol. 52, No. 7.