

Family Planning Perspectives
Volume 33, Number 5, September/October 2001

Timing of Alcohol and Other Drug Use And Sexual Risk Behaviors Among Unmarried Adolescents and Young Adults

By John S. Santelli, Leah Robin, Nancy D. Brener and Richard Lowry

Context: Although alcohol and drug use by young people has been associated with sexual risk behavior in some research, detailed data are lacking on the timing of substance use in relationship to sexual risk-taking.

Methodology: Cross-sectional data on 7,441 unmarried young people aged 14-22 from the 1992 Youth Risk Behavior Survey (household supplement) were used in the analysis. Alcohol and other drug use at last sexual intercourse, substance use in the past 30 days (recent use), the number of different substances ever used (lifetime use) and age at initiation of alcohol use are examined here. The outcome variables assessed through multivariate regression analyses were condom use at last intercourse and more than one sexual partner in the past three months.

Results: Failure to use a condom was strongly associated with the lifetime substance-use scale or, alternatively, with age at initiation of alcohol. Once the number of substances ever used was controlled for, neither substance use at last sexual intercourse nor recent use was associated with the likelihood of using a condom at last coitus. Among young men and women, recent substance use and use of either alcohol or drugs at last intercourse were both strongly associated with having had more than one sexual partner in the past three months. For females only, lifetime use also increased the probability of recent multiple partners.

Conclusions: The relationships between alcohol and other drug use and two sexual behaviors—condom use and multiple partners—suggest distinct mechanisms of influence and the need for different prevention strategies.

Family Planning Perspectives, 2001, 33(5):200-205

- » [article in pdf](#)
- » [table of contents](#)
- » [search the FPP archive](#)
- » [guidelines for authors](#)

John S. Santelli is branch chief, Program Services and Development Branch, Division of Reproductive Health; and Leah Robin is a health scientist, Nancy D. Brener is a research psychologist and Richard Lowry is a medical epidemiologist with the Division of Adolescent and School Health, all at the Centers for Disease Control and Prevention (CDC), Atlanta. The research on which this article is based was funded by CDC. An institutional board at CDC reviewed and approved the collection of these data.

Of the estimated 12 million new cases of sexually transmitted diseases (STDs) diagnosed among Americans each year, three million involve people younger than age 20, and another four million occur among 20-25-year-olds.¹ Among adolescents, key behavioral risk factors for STD infection are initiating sexual intercourse, having multiple concurrent or sequential sexual partners, having a partner who has had multiple partners and failing to use barrier contraceptives.² Although condom use among adolescents increased dramatically in the 1980s and 1990s,³ many young people still do not use them correctly and consistently. In addition, adolescents tend to

have multiple sexual partners,⁴ since adolescent relationships are frequently brief; the median duration of a romantic relationship among male adolescents (including both the sexual and nonsexual relationships) is about 10 months.⁵

In some studies, adolescents' use of alcohol and other drugs has been associated with certain sexual risk behaviors. The relationship between alcohol and other drug use and first sexual intercourse is well established; longitudinal studies have shown that prior substance use increases the probability that an adolescent will initiate sexual activity.⁶ A reciprocal relationship is also found in these studies: Adolescents who have initiated intercourse are more likely to begin substance use. In addition, having multiple partners has been associated with both ever-use and current use of alcohol or other substances.⁷ Studies examining alcohol and other drug use among adolescents have found mixed evidence of an association with condom use.⁸

The association between substance use and sexual behavior may reflect situational factors such as disinhibiting effects, cognitive impairment, social modeling (i.e., learning from others by observing and copying their actions) or the fact that substance use and sexual risk-taking often occur in the same social venues.⁹ This association may also reflect individual or personality characteristics.¹⁰ Personality characteristics may include "unconventionality" (as described in problem behavior theory¹¹), a tendency toward "sensation-seeking" (as described by Zuckerman¹²) or normal developmental exploration. The mechanism by which alcohol and other drugs influence sexual risk-taking has important implications for STD and HIV prevention programs.

Previous studies of this relationship between alcohol and drug use and sexual risk-taking have not examined the impact of lifetime use and current use simultaneously. Using data from the 1992 Youth Risk Behavior Survey (YRBS), a follow-back supplement to the National Health Interview Survey (NHIS), we explored whether the timing of alcohol and other drug use (i.e., ever-use, current use within the past month and use at last intercourse) influenced condom use and multiple sexual partners among unmarried, sexually experienced youths. For respondents aged 18 and older, we also examined the association between age at initiation of the use of alcohol (a common drug for initiation of substance use) and the two sexual behavior outcomes.

METHODS

The NHIS, an annual household interview survey of the civilian, noninstitutionalized U.S. population, uses a multistage probability cluster sample design to obtain nationally representative data.¹³ Racial and ethnic minorities were oversampled in the 1992 NHIS.

The NHIS enumerated all youths aged 12-21 from sampled households, including those who were married or who lived away from their family. From this list, 12-21-year-olds were randomly selected, and youth who were no longer in school were oversampled.

The 1992 YRBS supplement was conducted as a follow-back survey to that year's NHIS; 12-21-year-olds enumerated in the NHIS were surveyed approximately two months after the NHIS. A weighting factor was applied to each YRBS record to adjust for oversampling and nonresponse. The final sample was weighted to be representative

of all 12-21-year-olds residing in U.S. households.

Respondents privately listened with headphones to a tape recording of the questionnaire and entered their responses onto a standardized answer sheet. This technique was used to address young people's concerns about the confidentiality of in-home interviewing. They reported most data themselves, but race, ethnicity, residence and marital status were reported by the adult who completed the NHIS interview.

Of the 13,789 young people selected who were aged 12-21 when the NHIS survey was conducted, 10,645 (77%) were successfully located and agreed to be interviewed. Of these, 5,253 were male and 5,392 were female. Our analysis excludes 12- and 13-year-olds ($N=2,385$), because the questionnaire for this age-group did not ask about sexual activity. We also excluded married young people (214 males and 542 females). Of those who remained, 63 had missing data on various demographic variables. Since the YRBS sample included 51 men and 50 women who were aged 21 at the time of the NHIS survey but had turned 22 by the time of the YRBS survey, the final sample thus included 7,441 14-22-year-olds—3,758 unmarried males and 3,683 unmarried females.

Of these young people, 2,338 males and 2,133 females had ever had sexual intercourse (i.e., defined as sexually experienced), and 1,744 males and 1,731 females had had sexual intercourse in the three months preceding the survey (i.e., defined as currently sexually active). Analyses involving condom use and multiple partners were limited to sexually active respondents. Respondents were asked to report whether they had used a condom at their last sexual intercourse. The multiple sexual partners variable was defined as having had two or more partners in the past three months.

Scales were created and tested for both lifetime use of alcohol and other drugs, and for recent use (within the past 30 days). Cronbach's alphas measuring the degree of internal consistency were .75 and .74 for males and females, respectively, for the lifetime use scale, and .77 and .72 for males and females, respectively, for the recent-use scale.

The six-point lifetime use scale (scores of 0-5) reflects a common sequence of drug use initiation¹⁴ distributed in the following way—zero points for never use, and then one point each for ever having used each additional substance (alcohol, cigarettes, marijuana, cocaine and other illicit drugs). The five-point recent-use scale (0-4) quantifying use within the past 30 days was calculated as zero points for no recent use and then one point each for any recent drink of alcohol, for binge drinking of five drinks in a row, for driving after drinking and for marijuana use. (Recent use of other drugs was relatively rare.)

The scores on the lifetime use scale were normally distributed, with a mean of 2.6, a median of 1.4 and a mode of two among both sexually active males and females. On the recent-use scale, scores were skewed toward zero, and sexually active males had a mean score of 1.7, a median of 1.2 and a mode of zero; among sexually active females, the corresponding values were 1.5, 1.1 and zero, respectively.

Among sexually active respondents, the correlation (R) between scores on the scales for recent use and lifetime use was .56 for males and .52 for females. The correlation between alcohol and other drug use at last intercourse and scores on the recent-use

scale was .41 for males and .36 for females. Finally, the correlation between scores on the lifetime-use scale and age at initiation of alcohol use was -.50 for males and -.52 for females.

Alcohol and other drug use at last intercourse was based on responses to a single question: "Did you drink alcohol or use drugs before you had sexual intercourse the last time?" For condom use at last intercourse, any association between condom use and substance use at last intercourse represents event-specific use only. If a respondent reported multiple partners over the past three months, we interpreted condom use at last intercourse to be a marker for use at other recent acts of intercourse.

For age at initiation of alcohol use, we created a five-part variable with "never used" as the reference category; age at initiation was grouped as 17 or older, 15-16, 11-14 and 10 or younger. Because the age at which young people initiate a behavior is correlated with age itself, analyses with this variable were conducted among 18-22-year-olds only.

We used logistic regression techniques to estimate the independent influence of each substance-use variable, while controlling for background demographic variables (age and race or ethnicity). Separate models were created for males and females. We retained age and race or ethnicity in each multivariate model because they were associated with both independent and dependent variables. Age was entered as a continuous variable; race or ethnicity was considered as a categorical variable (i.e., non-Hispanic white, non-Hispanic black, Hispanic and "other"). In the models, we first entered the following sexual risk behaviors simultaneously—recent-use score, lifetime-use score and alcohol or other drug use at last intercourse—while controlling for age and race or ethnicity. We then added age at initiation of alcohol use to each model, but limited the sample to older youths (i.e., those aged 18-22).

Regression analyses were performed using SUDAAN to account for the complex, weighted sampling design. We assessed interactions between race or ethnicity and each significant independent variable in each final logistic model. Logistic regression in SUDAAN was used to calculate odds ratios and 95% confidence intervals.

RESULTS

Analytic Approach

Our results section presents three types of analyses. In the first subsection, we provide some descriptive statistics about the sample, including the relationships among the independent variables. The second subsection examines the bivariate relationships (unadjusted for any differences in background variables) between the four measures of alcohol and other drug use and two types of sexual behavior. Finally, in the third subsection, we present the results of the logistic regression models, including some alternative models examining the influence of age at initiation of alcohol use.

Descriptive Data

Overall, 62% of males and 57% of females in this sample of unmarried 14-22-year-olds had ever had sexual intercourse. Among those with such experience, 74% of males and 81% of females were currently sexually active—i.e., they reported having had intercourse in the previous three months.

Among respondents who had had any sexual experience, 46% of males and 67% of females reported having had one partner in the past three months. Sizable proportions of these young men and women reported no partners in that time (26% and 19%, respectively). Among sexually active respondents, 38% of males and 18% of females indicated that they had had two or more (multiple) partners in the previous three months; and 57% and 41% of men and women, respectively, used a condom the last time they had intercourse.

Among sexually active males, the number of sexual partners was not related to condom use at last intercourse. For example, 56-58% of young men—whether they had had one, two or three or more partners—reported having used a condom at last intercourse. Among sexually active females, in contrast, the number of sexual partners was negatively associated with condom use at last intercourse: Forty-three percent of young women with just one partner reported condom use at last intercourse, but only 33% of those with two and 36% of those with three or more did so.

Consistent with findings from previous research on young people's use of alcohol and other drugs, there were several significant relationships between the independent variables.¹⁵ For example, among sexually active respondents, age was positively correlated with both lifetime use of alcohol and other drugs ($R=.24$ for males, $R=.14$ for females) and with recent use ($R=.14$ and $R=.11$, respectively). Race or ethnicity was also associated with both of these substance-use measures, with whites having relatively high scores, blacks having relatively low scores and Hispanics having intermediate scores. Adolescents and young adults who reported initiating alcohol use earlier were also more likely to score higher on the lifetime-use scale ($R=-.50$ for males and $-.52$ for females), and on the recent-use scale ($R=-.39$ and $-.38$ for males and females, respectively).

Bivariate Analyses

- *Males.* The unadjusted data for sexually active males show that condom use at last intercourse declined with age, from 77% among 14-15-year-olds to 45% among 20-22-year-olds ([Table 1](#)); the proportion of young men who had had more than one sexual partner did not differ by age. Condom use at last intercourse was higher among young black men and among those of other races (64% and 67%, respectively) than among whites or Hispanics (54% each). In addition, young black men and those of other races were more likely to report having had at least two partners (55% and 53%, respectively) than were young Hispanic (38%) and white men (30%).

Condom use at last intercourse declined with increasing scores on the recent alcohol and other drug behaviors scale (from 64% to 42%), and it declined even more markedly with increasing number of substances ever used (from 78% to 35%). The proportion of adolescents reporting two or more partners increased with increasing number of recent substance-use behaviors (from 26% to 56%) and of substances ever used (from 22% to 37%).

Use of alcohol and other drugs at last intercourse was not associated with condom use. However, substance use at last intercourse was strongly related to having had multiple partners: Among those who used a substance at last intercourse, 61% had had multiple

partners, compared with only 32% of those who did not use drugs or alcohol the last time they had sex.

Among 18-22-year-old men only,* an earlier age at initiation of alcohol use was negatively associated with condom use at last intercourse and was positively associated with having had multiple partners.

• *Females.* Condom use at last intercourse also declined with age among females, from 52% among 14-15-year-olds to 32% among 20-22-year-olds (see [Table 1](#)). The proportion of young women who had had more than one partner was highest at ages 14-15 (23%), and varied little among older females (16-18%). Condom use was highest among young black women (52%) and varied little between whites (39%) and Hispanics (35%). In contrast to the patterns found among young men, the proportion of young women who had had multiple partners did not differ by their race or ethnicity.

Condom use did not decline consistently with an increase in the recent alcohol and drug use score, although the proportion of young women who used a condom at last intercourse was lowest among those with the greatest number of recent-use behaviors (i.e., four). Condom use declined, however, with increasing number of different substances ever used (from 67% to 23%). The proportion of females with multiple partners in the past three months increased as the number of recent substance-use behaviors rose (from 8% to 48%) and as the number of different drugs ever used rose (from 6% to 35%).

Overall, substance use at last intercourse was not related to condom use at last intercourse among young women (i.e., 36% of those who had used drugs or alcohol used a condom versus 42% of those who had not). However, use at last intercourse was strongly associated with the likelihood of having had multiple partners in the past three months: Forty-four percent of young women who had taken drugs or alcohol at last intercourse had had two or more partners, compared with only 14% of those who had not used drugs or alcohol at last coitus.

Among young women aged 18-22, an earlier age at initiation of alcohol use was associated with the likelihood of having had multiple partners, but it was not clearly related to the likelihood of condom use at last coitus.

Multivariate Analyses

• *Males.* Once age and race or ethnicity were controlled for, the number of different substances ever used (lifetime use score) was strongly and negatively associated with condom use at last intercourse among young adult men (odds ratio, 0.8, [Table 2](#)). Neither the number of recent substance-use behaviors (recent-use score) nor the use of a substance at last intercourse was independently associated with condom use at last coitus, however.

On the other hand, both recent substance use and the use of drugs or alcohol at last intercourse independently increased the likelihood of having had multiple partners (odds ratios of 1.5 and 2.7, respectively). The number of substances ever used (lifetime use score) was not independently associated with having had multiple partners, however.

Further, in general we found no interactions between race or ethnicity and ever-use of

different substances in predicting condom use. In the model with multiple partners as the dependent variable, a single significant interaction was found between black race and substance use at last intercourse (not shown). When we explored this interaction term in separate models, however, we found that, among blacks, substance use at last intercourse was not independently associated with the likelihood of having had multiple partners.

Age at initiation of alcohol use was not significant when it was added to either model (not shown). We also constructed an alternative logistic model in which age at initiation of alcohol was substituted for the number of substances ever used; in that model, age at initiation of alcohol use was highly predictive of condom use at last coitus (not shown).

- *Females.* The influence of alcohol and other drug use on the two sexual behavior outcomes analyzed was mostly similar among young women. As among males, the number of different substances young women ever used in their lifetime significantly lowered their odds of condom use at last intercourse (0.7). However, recent substance-use behaviors and substance use at last intercourse did not independently affect the likelihood of condom use. Also as with males, the recent-use score and whether young women had used drugs or alcohol at last intercourse increased their odds of having had multiple partners (1.5 and 3.1, respectively).

Females differed from males, however, in that their lifetime substance-use score independently predicted the likelihood of having had multiple partners (1.2).

Moreover, among young women, we found no significant interactions between race or ethnicity and substance-use behaviors in predicting condom use or multiple partners.

As with the findings for males, the age at initiation of alcohol use was also not significant for females when it was added to models (not shown). However, when we substituted age at initiation of alcohol use for the ever-use scale, we found a significant association between age at initiation and condom use at last intercourse.

DISCUSSION

Review of Findings

Our data suggest that different aspects of the timing of substance use have distinct relationships with the likelihood of condom use and of multiple sexual partners. These different relationships, in turn, suggest distinct mechanisms of action. We found that recent substance use and use at last sexual intercourse were strongly associated with the likelihood of multiple sexual partners, and that the number of substances ever used was strongly associated with the likelihood of condom use at last intercourse. Despite the correlations among these three measures of the timing of substance use ($R=.36-.56$), the relationships between them and the two sexual behaviors seemed quite specific.

Possible mechanisms of action underlying this relationship include a pharmacological disinhibiting effect of alcohol, a disinhibitory response based upon psychological mechanisms, cognitive effects of specific substances, an individual's risk-taking tendencies or personality, social modeling, and the fact that substance use and sexual risk-taking often occur in the same social venues.¹⁶

The associations between having had at least two recent sexual partners and both recent alcohol and other drug use and use at last intercourse (after controlling for ever-use) suggest these substances exert a disinhibitory effect or that social situational mechanisms are at work in the selection of new sexual partners. Substance use before intercourse could directly impair judgment. For example, adolescents and young adults may also drink or use drugs to give themselves "permission" to engage in risk-taking.¹⁷ In addition, social environments that support the use of alcohol and other drugs may also support the meeting of new sexual partners. These processes could result in intercourse with new or casual sexual partners or could result in earlier initiation of intercourse within a relationship with a new romantic partner.

The strong relationship between the number of different substances ever used and condom use at last intercourse suggests alternative mechanisms. The lack of a relationship between condom use and either recent substance use or use at last intercourse suggests that disinhibition or social situational effects do not play prominent roles. On the contrary, it suggests a more general mechanism of taking risks, perhaps reflecting individual or personality characteristics of the adolescent or young adult,¹⁸ such as a desire for "unconventionality" (as described in problem behavior theory¹⁹) or a developmentally mediated tendency to explore one's sexuality.

Theories of sensation-seeking suggest that certain people have a biological predisposition to seek sensation, and are thus more likely than others to engage in a variety of risky behaviors.²⁰ The development of risk behaviors is a complex process, one that is influenced by a variety of biological, social, environmental, perceived environmental, personality and behavioral factors.²¹

Our data are consistent with a variety of recent studies that have found no, or only equivocal, effects of recent alcohol use on condom use,²² but a strong relationship between condom use and ever-use of substances.²³ Our data are also consistent with those from a study suggesting that in terms of HIV risk, alcohol and other drug use may pose less of a threat from their effect on condom use compared with their influence on the likelihood of having sex.²⁴

Researchers have questioned simplistic assumptions about the mechanism behind the relationship between alcohol use and sexual risk-taking.²⁵ Both condom use and selection of new partners are mediated by complex sets of social and individual factors; clearly, we need to know more about these factors.

Limitations

The YRBS provides little information about peer norms, personality factors or factors such as social context that may also influence sexual risk behaviors. In addition, the survey provides no information at all about same-sex sexual behaviors. As is true for all survey data, self-reports may underestimate or inflate true risk behaviors. The YRBS shows good test-retest reliability,²⁶ however, and the use of audiocassettes in surveys improves young people's comprehension and sense of privacy.²⁷ An important limitation of all cross-sectional studies is that they can suggest associations, but not prove causality.

A variety of methodological issues confront researchers who examine the relationship

between alcohol and other drug use and sexual risk-taking.²⁸ Clearly, there are limitations to examining associations between global measures of substance use and sexual risk behavior. Examining behaviors that occur at specific acts of coitus is one way to address this limitation. Although event-specific use data were available for substance use and condom use at last intercourse in the YRBS, event-specific use could not be obtained for sexual partners. Diary studies would provide a more specific way to measure alcohol and other drug use and the acquisition of new sexual partners,²⁹ although these measures are difficult to use with adolescents in national studies.

Implications

Health care practitioners and health educators need to build prevention messages that stress the specific relationships between substance use, multiple sexual partners, failure to use condoms, and STD and HIV infection. The distinct set of associations we found between different temporal aspects of substance use and these two sexual behaviors suggests that discrete prevention strategies may be needed to address them.

For example, if substance-induced disinhibition is causing sexual risk-taking, education and counseling should warn young people about the potential dangers of alcohol and other drugs on judgment, and should underline the connection between substance use and risky sexual behaviors in certain social contexts. Such education and counseling should help young people recognize the social cues involved and help them avoid the social situations that may lead to sexual risk behavior. If disinhibition is primarily influencing intercourse with new sexual partners, education and counseling should specifically stress this outcome and its relationship to the heightened risk of STD and HIV infection.

But if personality or individual factors are driving sexual risk-taking (e.g., failure to use a condom), we need to target adolescent risk-takers to design specific prevention messages for this group, and to channel potentially destructive risk-taking impulses into less-damaging activities. A variety of HIV prevention programs have shown success in targeting specific at-risk populations with tailored prevention messages.³⁰ Our data suggest that the prevention of sexual risk-taking via substance use risk-reduction will require a variety of strategies.

References

1. Kassler WJ and Cates W, Jr., The epidemiology and prevention of sexually transmitted diseases, *Urologic Clinics of North America*, 1992, 19(1):1-12.
2. Aral SO and Holmes KK, Epidemiology of sexual behavior and sexually transmitted diseases, in: Holmes KK et al., eds., *Sexually Transmitted Diseases*, 2nd edition, New York: McGraw Hill, 1990, pp. 19-36; and Cates W, Jr., The epidemiology and control of sexually transmitted diseases in adolescents, *Adolescent Medicine*, 1990, 1(3): 409-428.
3. Sonenstein FL et al., Changes in sexual behavior and condom use among teenage males: 1988 to 1995, *American Journal of Public Health*, 1998, 88(6):956-959; Abma JC et al., Fertility, family planning, and women's health: new data from the 1995 National Survey of Family Growth, *Vital and Health Statistics*, 1997, Series 23, No. 19; Forrest JD and Singh S, The sexual and reproductive behavior of American women, 1982-1988, *Family Planning Perspectives*, 1990, 22(5):206-214; and Santelli JS et al., Adolescent sexual behavior: estimates and trends from four nationally representative surveys, *Family Planning Perspectives*, 2000, 32(4):156-165 & 194.
4. Santelli JS et al., Multiple sexual partners among U.S. adolescents and young adults, *Family Planning Perspectives*, 1998, 30(6):271-275.

5. Udry JR and Bearman PS, New methods for adolescent sexual behavior, in: Jessor R, ed., *New Perspectives on Adolescent Risk Behavior*, New York: Cambridge University Press, 1998, pp. 241-269.

6. Rosenbaum E and Kandel DB, Early onset of adolescent sexual behavior and drug involvement, *Journal of Marriage and the Family*, 1990, 52(3):783-798; and Mott FL and Haurin RJ, Linkages between sexual activity and alcohol and drug use among American adolescents, *Family Planning Perspectives*, 1988, 20(3):128-136.

7. Santelli JS et al., 1998, op. cit. (see reference 4); and Lowry R et al., Substance use and HIV-related sexual behaviors among US high school students: are they related? *American Journal of Public Health*, 1994, 84(7): 1116-1120.

8. Lowry R et al., 1994, op. cit. (see reference 7); Fortenberry JD et al., Sex under the influence: a diary self-report study of substance use and sexual behavior among adolescent women, *Sexually Transmitted Diseases*, 1997, 24(6):313-319; Fergusson DM and Lynskey MT, Alcohol misuse and adolescent sexual behaviors and risk taking, *Pediatrics*, 1996, 98(1):91-96; Halpern-Felsher BL, Millstein SG and Ellen JM, Relationship of alcohol use and risky sexual behavior: a review and analysis of findings, *Journal of Adolescent Health*, 1996, 19(5):331-336; Fortenberry JD, Adolescent substance use and sexually transmitted diseases risk: a review, *Journal of Adolescent Health*, 1995, 16(4):304-308; and Leigh BC, Alcohol and unsafe sex: an overview of research and theory, in: Seminara D, Watson RR and Pawlowski A, eds., *Alcohol, Immunomodulation, and AIDS*, New York: Alan R. Liss, 1990.

9. Fergusson DM and Lynskey MT, 1996, op. cit. (see reference 8); and Leigh BC, 1990, op. cit. (see reference 8).

10. Fergusson DM and Lynskey MT, 1996, op. cit. (see reference 8); and Leigh BC, 1990, op. cit. (see reference 8).

11. 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.

12. Zuckerman M, Sensation seeking: a comparative approach to a human trait, *Behavioral and Brain Sciences*, 1984, 7(3):413-471; and Alexander CS et al., A measure of risk taking for young adolescents: reliability and validity assessments, *Journal of Youth and Adolescence*, 1990, 19(6):559-569.

13. Adams PF et al., Health risk behaviors among our nation's youth: United States, 1992, *Vital and Health Statistics*, 1995, No. 192.

14. Kandel D and Yamaguchi K, From beer to crack: developmental patterns of drug involvement, *American Journal of Public Health*, 1993, 83(6):851-855.

15. Rosenbaum E and Kandel DB, 1990, op. cit. (see reference 6); Mott FL and Haurin RJ, 1988, op. cit. (see reference 6); Lowry R et al., 1994, op. cit. (see reference 7); and Kandel DB and Logan JA, Patterns of drug use from adolescence to young adulthood: periods of risk for initiation, continued use, and discontinuation, *American Journal of Public Health*, 1984, 74(7):660-666.

16. Fergusson DM and Lynskey MT, 1996, op. cit. (see reference 8); and Leigh BC, 1990, op. cit. (see reference 8).

17. Leigh BC, 1990, op. cit. (see reference 8).

18. Fergusson DM and Lynskey MT, 1996, op. cit. (see reference 8); and Leigh BC, 1990, op. cit. (see reference 8).

19. Donovan JE and Jessor R, 1985, op. cit. (see reference 11).

20. Alexander CS et al., 1990, op. cit. (see reference 12); and Zuckerman M, 1984, op. cit. (see reference 12).

21. Jessor R, Risk behavior in adolescence: a psychosocial framework for understanding and action, *Journal of Adolescent Health*, 1991, 12(8):597-605.

22. Fortenberry JD et al., 1997, op. cit. (see reference 8); Fergusson DM and Lynskey MT, 1996, op. cit. (see reference 8); Halpern-Felsher BL, Millstein SG and Ellen JM, 1996, op. cit. (see reference 8); Fortenberry JD, 1995, op. cit. (see reference 8); and Leigh BC, 1990, op. cit. (see reference 8).

23. Lowry R et al., 1994, op. cit. (see reference 7).

24. Strunin L and Hingson R, Alcohol, drugs, and adolescent sexual behavior, *International Journal of the Addictions*, 1992, 27(2):129-146.

- [25.](#) Fortenberry JD et al., 1997, op. cit. (see reference 8); and Leigh BC, 1990, op. cit. (see reference 8).
- [26.](#) Brener ND et al., Reliability of the Youth Risk Behavior Survey Questionnaire, *American Journal of Epidemiology*, 1995, 141(6):575-580.
- [27.](#) Adams PF et al., 1995, op. cit. (see reference 13).
- [28.](#) Leigh BC, 1990, op. cit. (see reference 8).
- [29.](#) Fortenberry JD et al., 1997, op. cit. (see reference 8).
- [30.](#) Kim N et al., Effectiveness of the 40 adolescent AIDS-risk reduction interventions: quantitative review, *Journal of Adolescent Health*, 1997, 20(3):204-215.
-

*Because of the association between age and age at initiation of alcohol use, we limited the denominator in this part of the analysis to 18-22-year-olds.