Frequency of Alcohol Use in Adolescence as a Marker for Subsequent Sexual Risk Behavior in Adulthood

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Abstract

Purpose—Although a number of studies have demonstrated an association between alcohol use frequency and sexual risk behavior, few have used longitudinal data. This study examined alohol use frequency in adolescence as a predictor of HIV sexual risk behavior in adulthood.

Methods—We collected data among 1368 participants in Colorado. During adolescence (Time 1), respondents were asked about the frequency of using alcohol during the previous 12 months. In adulthood (Time 2), the same respondents were asked about their sexual risk behavior during the previous 12 months. Sexual risk behavior items were used to construct an index, which was categorized to indicate low, medium and high risk study participants. The relationship between alcohol use patterns and risky sexual behavior was modeled using ordinal regression.

Results—Compared to individuals who drank no alcohol in the past 12 months at Time 1, the odds of being in a higher risk group of sexual behavior as opposed to a lower one at Time 2 were 1.56 (95% CI, 1.04-2.35) among those who drank 6-19 times. Similarly, the odds of being in a higher risk group relative to a lower one among those who drank   20 times or were 1.78 (95% CI, 1.05-3.02).

Conclusion—Alcohol use patterns in adolescence may be useful markers for programs that aim to prevent risky sexual behavior. Based on alcohol intake patterns, it may be possible to identify

Implications and contribution
This is one of the few studies that longitudinally examine alcohol use frequency as a predictor of sexual risk behavior, and that assess the outcome in adulthood. Preventive health efforts could increase their effectiveness by taking into consideration behaviors such as frequency of underage alcohol intake when designing health promotion strategies.

frequent alcohol users that need to be targeted with appropriate alcohol use and HIV risk reduction messages.

Keywords

Alcohol; Frequency; Adolescence; Sexual risk behavior; Longitudinal

Introduction

As in other parts of the world, young people in the United States are disproportionately affected by HIV. According to 2009 data, those between the ages of 13 and 29 accounted for 39% of new HIV infections, the largest share of any age group [1]. It also is estimated that 8,300 young people aged 13-24 years in the 40 states reporting to the Centers for Disease Control and Prevention had HIV infection in 2009, representing about 20% of the persons diagnosed during that year [2]. At the same time, it is this young population that offers the greatest opportunity to change the course of the HIV epidemic, as changing behaviors and expectations early results in a lifetime of benefit in HIV prevention [3]. In light of this, efforts to understand and evaluate potentially modifiable behavioral patterns associated with the transmission of the HIV have assumed great importance.

Unprotected sexual contact with an infected person is the most frequent mode of transmission of HIV. However, there are specific behaviors that increase the likelihood of engaging in unprotected sexual intercourse, thereby enhancing the risk of infection. Having multiple sexual partners represents a major risk factor for HIV transmission [4], as greater numbers of sex partners increase the probability that any one random act of intercourse will result in infection [5]. In fact, in some parts of Africa, the decline in prevalence of HIV has mainly been attributed to reductions in the number of sexual partners [7]. Another behavior that has been consistently linked to HIV infection is exchanging sex for drugs or money [8], as this elevates the risk of HIV by increasing the likelihood of having a higher number of sexual partners, risky sexual partners or unprotected sex. The use of illicit substances and alcohol has also been implicated in the spread of HIV [9]. Indeed, alcohol use has received considerable attention as a contributing factor to risky sexual behavior. Although results vary, most global association studies largely demonstrate that individuals who use alcohol, particularly those who are heavy users, are more likely to engage in high-risk sexual behavior [10,11,12].

Although a considerable number of studies have been conducted on alcohol use and sexual risk behavior, few have focused on the frequency of alcohol use in relation to sexual risk behavior. A small number of cross-sectional investigations from the United States indicate that higher levels of alcohol use frequency are associated with higher levels of sexual risk behavior. For example, examining the relationship between lifetime marijuana and alcohol use frequency, and sexual behaviors, Floyd and Latimer [13] report that alcohol use frequency was associated with sexual activity initiation, although not with condom use at last sexual intercourse or with lifetime multiple sexual partners. In an investigation of the association between frequency of alcohol use and HIV-related sexual behavior, alcohol use frequency in the previous month was significantly associated with non-use of condoms and multiple sex partners during the same time period [14]. Similarly, in a study among HIV-positive persons, a higher number of days of alcohol use in the previous six months was associated with a higher probability of having sex without a condom [15]. Findings among high-risk groups in Africa (e.g., beer hall patrons, and bar and hotel workers) also reveal a significant relationship between frequency of alcohol use and high-risk sexual behavior [16]. However, some studies have found no association [17].

The above-mentioned studies all utilized cross-sectional data. The literature reveals a scarcity of longitudinal research that evaluates the relationship between frequency of alcohol use and risky sexual behavior. In one of the few longitudinal studies conducted to date, Dogan et al. [18] evaluated whether alcohol use preceded and predicted change in the number of sexual partners. Their results showed that the level of alcohol use at age 15 was significantly related to growth trajectories of the number of yearly number of sexual partners from adolescence to adulthood. The Dogan et al. study is important as it supports a temporal association using follow-up information on sexual risk behavior, and demonstrates that the association persists over an extended period of time. Although fewer studies have investigated frequency of alcohol use in relation to subsequent sexual risk behavior, frequency of use can be a useful measure in cases where data on measures such as quantity are unavailable. Furthermore, information on the longitudinal relationship between how frequently adolescents consume alcohol and their later sexual behavior can be useful in characterizing drinking patterns that are more likely to be associated with higher risk HIV-related sexual behavior. The aim of this study was to examine frequency of alcohol use in adolescence as a predictor of HIV-related sexual behavior in young adulthood. We hypothesized that higher frequency of alcohol use in adolescence would be associated with subsequent high-risk sexual behavior in adulthood. Findings from this study will add to the limited literature on the longitudinal relationship between frequency of alcohol use and subsequent sexual risk behavior.

Methods

Sample and procedures

The study comprised 1368 participants in the Center for Antisocial Drug Dependence (CADD), an ongoing, multi-component, collaborative study at the University of Colorado. The sample for the present study was drawn from the twin, adoption, and family study components of the CADD and was restricted to those who were aged between 15 and 18 years during the initial assessment. Twin participants were recruited from the Colorado Twin Registry [19], which consists of a community-based sample of twin families residing in Colorado. Non-twin participants were drawn from two community-based family samples: the Colorado Adoption Project [20], an ongoing, longitudinal study of the genetic and environmental influences on behavioral, cognitive, and emotional development; and the Colorado Adolescent Substance Abuse family study [21], which researches familial transmission of substance abuse and associated psychopathology, and recruits adolescents in treatment and matched community control subjects. Patients in substance abuse treatment were not used for the present study, but community controls, matched by sex, age, ethnicity and zip code, were included. The ethnicity distribution of the sample was 1.3% African American, 6.4% Hispanic, 88.8% white, 1.7% other and 1.8% unknown.

Participants of the CADD studies completed a series of questionnaires designed to obtain both genetic and phenotypic information. The present study included participants who completed assessments at two time-points, Times 1 and 2. At Time 1, subjects were interviewed regarding consumption of alcohol during the 12 months prior to the interview, using questions from the Monitoring the Future questionnaire [22]. At Time 2, information on sexual risk behavior was obtained using the modified Risk Behavior Questionnaire (mRBQ), an instrument developed for the CADD, which includes a series of questions on risky sexual and substance use-related HIV behaviors [23]. Items on substance use at Time 2 were from the Composite International Diagnostic Interview-Substance Abuse Module [24]. All 1368 participants interviewed at Time 1 were subsequently interviewed at Time 2. The duration between the two assessments varied among subjects, depending on how long it took to locate each subject for the Time 2 interviews. The mean time between assessments was 8.3 years (SD = 2.8; range = 4-16). The University of Colorado Institutional Review Board

approved all study protocols. Parental consent and adolescent assent were obtained before participation.

Measures

Sexual risk behavior—Reports of past 12-month and lifetime sexual activity were collected using the mRBQ. This 30-item questionnaire assesses male and female sexual activity, drug use, sexual partner characteristics, and sexual health and was developed by the CADD to assess HIV-risk related behaviors. An index of sexual risk behaviors was constructed using a subset of 11-items. Nine items assessed past-year sexual risk behaviors and included questions on whether participants had sex with someone other than a steady partner while still in a relationship; used alcohol or drugs to feel more comfortable with a sexual partner; had unprotected sex due to drinking or using drugs; had sexual partners who had other sexual partners; had sexual partners who were injection drug users; had sexual partners who were crack smokers; and had sexual partners who had hepatitis, gonorrhea or syphilis, hepatitis, genital warts or chlamydia. Two items were lifetime measures and assessed the number of times participants gave sex to get drugs and the number of times participants gave sex to get money. These questions are similar to those asked as part of the Comprehensive HIV Risk Assessment Protocol of the National HIV Behavioral Surveillance System, Centers for Disease Control and Prevention [25]. Responses on all 11 questions were dichotomized and summed to create an index of sexual risk behavior (range = 0-11). Based on the distribution of scores on this index, we collapsed the scores into three categories to represent "low risk" (0), "medium risk" (1-3), and "high risk" (>= 4) sexual behavior groups.

Alcohol use—The independent variable of interest was frequency of alcohol use in adolescence. Participants were asked the question, "On how many occasions did you have alcoholic beverages to drink during the previous 12 months?" The response had seven frequency levels: none, one to two, three to five, six to nine, 10 to 19, 20 to 39, and 40 or more occasions. Frequency of alcohol use was assessed as a categorical variable created by collapsing the seven levels into four categories: none, one to five, six to 19, and 20 or more occasions.

Covariates—Time 1 covariates were age, gender, quantity of alcohol use (how many drinks they have on a single occasion when they drink), whether or not the participant used marijuana in the previous 12 months, and whether or not the participant used illicit drugs (drugs other than marijuana) in the previous 12 months. At Time 1, participants were also asked minimal questions about their sexual behavior. We used information on age of first sexual intercourse and number of lifetime sexual partners to create a measure of risky sexual behavior at Time1. Adolescents reporting a young age at first sexual intercourse (< 16 years), or four or more lifetime sexual partners were coded as engaging in sexual risk behavior. At Time 2, we assessed age, frequency of alcohol use, quantity of alcohol use, whether or not the participant used marijuana in the previous 12 months, and whether or not the participant used other illicit drugs in the previous 12 months.

Statistical analysis

The outcome variable, which consisted of three categories, followed an ordinal distribution and satisfied the proportional odds assumption. We therefore used ordinal logistic regression to estimate the odds ratios (ORs) with 95% confidential intervals (CIs) of the relationship between adolescent frequency of alcohol use and adulthood high-risk sexual behavior. Under the proportional odds assumption in the ordinal regression model, the estimated OR applied to any of the two ORs being modeled; that is, we estimated the increased likelihood associated with being in the combined medium and high risk groups relative to being in the

low risk group, and with being in the high risk group versus the combined medium and low risk groups. We examined correlation of covariates using variance inflation factors (VIF). A common rule of thumb is to consider VIF values > 5 as cut off values for collinearity that is too high [26,27]. None of the VIF values in our analysis was so high as to indicate serious collinearity (range = 1.04-1.92). To account for potential familial correlations in this sample, we adopted a generalized linear model approach as implemented in SAS (proc glimmix). Traditional logistic regression analysis using SAS (proc logistic) yielded nearly identical point estimates, with only slight differences seen with respect to standard errors and p-values (data not shown). Nevertheless, the results shown for the relationship between frequency of alcohol use and high-risk sexual behavior are from the generalized linear model accounting for potential familial correlations. To evaluate the independent relationship between the two measures of interest, we created multivariable models by progressively adding covariates that might confound or alter the relationship. We also ran the analyses by gender to determine how results differed between females and males. All statistical analyses were conducted using SAS software (version 9.3; SAS Institute, Cary, NC).

RESULTS

Characteristics of study sample

Of the 1368 participants, 55.3% were female. At Time 1, the majority of the sample was aged 17 years old, with a mean of 16.7 years (SD = 0.98), a skewness of -0.4 and a kurtosis of -0.8. The mean age at Time 2 was 25.0 (SD = 2.6). Table 1 summarizes the descriptive characteristics of the sample at Time 1, by sexual risk group. Figure 1 displays the distribution of the scores of the sexual risk behavior index. The index did not follow a normal distribution, with the very few subjects scoring > 8. After collapsing the index, the low-risk, medium-risk and high-risk groups comprised 66.9%, 21.7% and 11.5% of the sample, respectively. The majority of these who reported using alcohol in the previous 12 months prior to the Time 1 assessment belonged to the low risk group of sexual behavior. Eighteen percent of adolescents were sexually active at Time 1, and of these, nearly half reported engaging in sexual risk behavior.

Figure 2 presents the reported frequency of alcohol use at Time 1. Over two-thirds of the sample reported having had used alcohol in the 12 months prior to the Time 1 assessment. Slightly more females than males reported using alcohol in the previous 12 months. Among those who used alcohol, the majority reported using alcohol on one to two occasions. Thirty one percent reported using alcohol on six or more occasions, while less than 5.0% of the sample reported using alcohol forty times or more (data not shown).

Associations of frequency of alcohol use and sexual risk behavior

In the unadjusted analysis, compared to individuals who drank no alcohol in the past 12 months at Time 1, those who drank 1-5 times were 1.46 (95% CI, 1.09-1.97) times more likely to be in a higher risk group of sexual behavior as opposed to a lower one (Table 2). Similarly, the odds of being in a higher risk group of sexual behavior among those who drank 6-19 times and those who drank 20 or more times were 2.54 (95% CI, 1.84-3.51) and 3.56 (95% CI, 2.40-5.28), respectively. After adjusting for alcohol and other drug use at Times 1 and 2, there were significant associations among those who drank 6-19 (OR, 1.50; 95% CI, 1.01-2.23) and 20 or more times (OR, 1.66; 95% CI, 1.00-2.74), but not among those who drank 1-5 times at Time 1. When all the covariates were added to the model, frequency of alcohol retained its significant relationship among those who drank 6-19 times (OR, 1.56; 95% CI, 1.04-2.35) and those who drank 20 or more times (OR, 1.78; 95% CI, 1.05-3.02). No other Time 1 variables were associated with Time 2 sexual risk behavior.

Time 2 variables associated with sexual risk behavior were having five drinks or more as opposed to none on a single occasion, marijuana use and other illicit drug use. When the data were analyzed by gender, results from the final model among males were similar to the main findings, where drinking 6-19 or 20 or more times relative to none independently predicted higher groups of sexual risk behavior (Table 3). No significant associations were found among females.

Discussion

This study examined frequency of alcohol use in adolescence as a predictor of HIV sexual risk behavior in adulthood. Consistent with our hypothesis, results showed that higher frequency of alcohol consumption in adolescence is associated with more risky sexual behavior in adulthood. Even after controlling for important covariates at Times 1 and 2, higher frequency of alcohol use emerged as a significant predictor of sexual risk behavior at Time 2. This is in line with the findings from the study by Dogan et al. [18], where higher levels of alcohol use predicted higher numbers of sexual partners. In the present study, when males and females were analyzed separately, the relationship was seen among males but not among females.

It is unlikely that frequent use of alcohol is a direct cause of sexual risk behavior; however, it can as serve as a potential marker for risk-taking behaviors, including those that increase the risk for HIV infection [28,29]. In our study, alcohol was the only substance in adolescence that predicted sexual risk behavior in adulthood. This strengthens the argument for alcohol as a sound indicator of the probability of later sexual risk behavior. Frequent users of alcohol among adolescents may comprise a population that HIV prevention efforts may need to target. By examining how frequently adolescents report drinking, it might be possible to differentiate between adolescents who are likely to engage in risky sexual behavior in later adolescence or adulthood and those who are not.

Few adolescents in this sample reported engaging in sexual risk behavior at Time 1. The literature shows that individuals who engage in sexual risk behavior in adolescence have a higher likelihood of engaging in that behavior in adulthood. For example, younger age at first intercourse has been associated with sexual risk behaviors such as having unprotected sex, having multiple sexual partners and the use of alcohol and drugs prior to sexual activity [30,31,32]. This can point to a continuation of behavior from adolescence to adulthood. However, our results were inconsistent with other research, as sexual risk behavior measured in adolescence did not predict adulthood sexual risk behavior. Our findings indicate that the high risk sexual behaviors that adolescents in this sample engaged in were likely not maintained in adulthood. The sexual behaviors, particularly young age at first sexual intercourse, could be attributed to the influence of peers [33] or simply adolescent experimentation.

Frequent underage drinking can be a function of a variety of individual and contextual factors. Having peers who drink has been found to be associated with how frequently adolescents drink [34]. Also, adolescents whose family members drink excessively [35] or whose parents are permissive about underage drinking [36] may think this behavior is acceptable, and may therefore be more likely to engage in heavy drinking or alcohol misuse. In addition, frequent drinking by adolescents can point to a lack of parental monitoring [37], where the parent does not know where or with whom the child is or what activities the child engages in. Frequent alcohol use in adolescence could also be attributed to underlying individual factors such as a propensity towards behavioral disinhibition, which is an inability to inhibit socially undesirable or restricted actions, including frequent alcohol consumption in adolescence [38]. Traits that are associated with behavioral disinhibition (e.g., sensation

seeking and impulsivity) have been linked to both alcohol use and sexual risk behavior [39]. Certainly, the fact that alcohol use frequency in adolescence predicted sexual risk behavior years later, in adulthood, supports this notion.

One of the strengths of this study lies in its use of longitudinal data. A number of cross-sectional studies have shown associations between frequency of alcohol use and sexual risk behavior [14,15,16], however, the longitudinal design of this study allowed us to demonstrate temporality in the relationship. Our study joins the body of research that examines frequency of alcohol use as a predictor in adolescence, a crucial period during which many habits are formed.

The results of this research have implications for the development and implementation of HIV intervention and prevention programs among adolescents. The findings can be integrated into already effective health promotion programs aimed at prevention efforts, which, in turn, could increase their effectiveness by taking into consideration behaviors such as underage alcohol intake as they design their health promotion strategies. In addition to other behaviors, drinking patterns can be used to characterize those who are more susceptible to HIV-related sexual behavior. Indeed, our findings underscore the importance of identifying young people early, as they first initiate risk-taking behavior, in order to foster better health outcomes.

This study had some limitations. First, the data on alcohol and sexual behaviors rely on retrospective self-reported data. There was a possibility of participants having difficulty recalling important information or providing socially desirable responses to the sensitive questions. Secondly, the sample was drawn from young people in Colorado, most of who were white. Thus, the results may have limited generalizability to other geographic regions and ethnic groups. Thirdly, we did not have a good measure of unprotected sexual intercourse and instead used whether or not the participant used alcohol during the last unprotected intercourse. Despite these limitations, our results join a growing body of evidence that implicates alcohol use as a risk factor for HIV-related sexual behavior.

Adolescent frequency of alcohol consumption may predict the likelihood of sexual risk behavior in adulthood. Although the alcohol use patterns in adolescence should not be interpreted as a cause of risky sexual behavior in later periods, it appears that they may be useful markers for programs that aim to prevent risky sexual behavior. Based on their alcohol intake patterns, it could be to identify adolescents who have a higher probability of engaging in HIV-related sexual behavior before or as they begin to engage in these behaviors.

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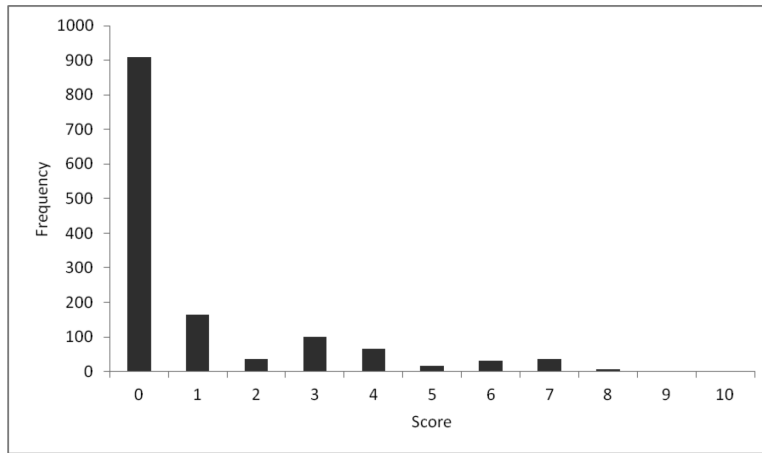
Figure 1.
Distribution of scores of sexual risk behavior index.
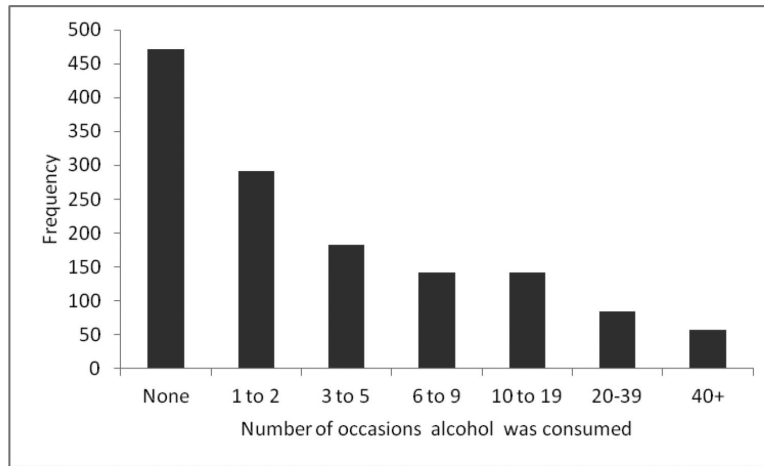
Figure 2.
Frequency of alcohol use in previous 12 months at Time 1.

Table 1

Characteristics of participants by sexual risk group at Time 1

Characteristic	Sexual risk group n (%)			Total n (%)
	Low	Medium	High	
Age				
15	134 (9.80)	52 (3.80)	22 (1.61)	208 (15.20)
16	190 (13.89)	55 (4.02)	33 (2.41)	278 (20.32)
17	369 (26.97)	131 (9.58)	69 (5.04)	569 (41.59)
18	216 (15.79)	63 (4.61)	34 (2.49)	313 (22.88)
Gender				
Male	379 (27.70)	152 (11.11)	81 (5.92)	612 (44.74)
Female	530 (38.74)	149 (10.89)	77 (5.63)	756 (55.26)
Sexual risk behavior				
No	826 (61.05)	273 (20.18)	131 (9.68)	1230 (90.91)
Yes	74 (5.47)	26 (1.92)	23 (1.70)	123 (9.09)
Used alcohol in past 12 months				
No	359 (26.24)	79 (5.77)	33 (2.41)	471 (34.43)
Yes	550 (40.20)	222 (16.23)	125 (9.14)	897 (65.57)
Used marijuana in past 12 months				
No	694 (50.99)	191 (14.03)	75 (5.51)	960 (70.54)
Yes	209 (15.36)	110 (8.08)	82 (6.02)	401 (29.46)
Used other illicit drugs in past 12 months				
No	830 (61.16)	257 (18.94)	120 (8.84)	1207 (88.95)
Yes	74 (5.45)	41 (3.02)	35 (2.58)	150 (11.05)

Frequencies might not add to the total sample size due to missing data

Table 2

Unadjusted and adjusted ordinal logistic regression analyses of frequency of alcohol use in adolescence and sexual risk behavior in adulthood

	OR (95% CI)[a]		
	Model 1	**Model 2**	**Model 3**
Number of times used alcohol in past 12 months at Time 1[b]			
0	Reference	Reference	Reference
1-5	1.46 (1.09-1.97)	1.14 (0.81-1.61)	1.08 (0.77-1.54)
6-19	2.54 (1.84-3.51)	1.50 (1.01-2.23)	1.56 (1.04-2.35)
20+	3.56 (2.40-5.28)	1.66 (1.00-2.74)	1.78 (1.05-3.02)
Number of drinks on a single occasion at Time 1[b]			
0		Reference	Reference
1-2		0.96 (0.71-1.29)	1.11 (0.80-1.54)
3-4		0.87 (0.56-1.31)	1.09 (0.68-1.76)
5+		0.93 (0.59-1.47)	1.22 (0.73-2.05)
Marijuana use at Time 1[b]		1.16 (0.84-1.61)	1.12 (0.80-1.56)
Other illicit drug use at Time 1[b]		1.45 (0.98-2.15)	1.48 (0.99-2.20)
Number of weeks used alcohol at Time 2[b]			
>1		Reference	Reference
12-23		1.46 (0.92- 2.30)	1.43 (0.90-2.28)
24-29		1.70 (1.07- 2.72)	1.61 (1.00-2.58)
30+		2.11 (1.41- 3.14)	2.14 (1.42-3.21)
Number of drinks on a single occasion at Time 2[b]			
0		Reference	Reference
1-2		0.63 (0.33-1.19)	0.61 (0.32-1.16)
3-4		1.33 (0.74-2.41)	1.29 (0.71-2.35)
5+		2.10 (1.22-3.60)	2.00 (1.16-3.45)
Marijuana use at Time 2[b]		1.69 (1.15-2.48)	1.64 (1.12-2.42)
Other illicit drug use at Time 2[b]		3.35 (2.09-5.38)	3.17 (1.96-5.14)
Gender (female)			1.06 (0.82-1.37)
Age at Time 1			0.89 (0.78-1.01)
Sexual risk behavior at Time 1			1.00 (0.63-1.59)
Age at Time 2			0.91 (0.86-0.97)

[a] Based on multivariable logistic regression models for the outcome of sexual risk behavior adulthood. Model 1 includes Time 1 frequency of alcohol use alone; model 2, Time 1 frequency of alcohol use plus other substance use at both Times 1 and 2; and model 3, Time 1 frequency of alcohol use plus all covariates.

[b] Based on past 12 months.

Table 3

Unadjusted and adjusted ordinal logistic regression analyses of frequency of alcohol use in adolescence and sexual risk behavior in adulthood for females and males

OR (95% CI)[a]

	Female			Male		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Number of times used alcohol at Time 1 [b]						
0	Reference	Reference	Reference	Reference	Reference	Reference
1-5	1.29 (0.86-1.95)	0.91 (0.56-1.47)	0.85 (0.52-1.40)	1.70 (1.10-2.64)	1.45 (0.86-2.45)	1.38 (0.81-2.35)
6-19	2.68 (1.68-4.29)	1.27 (0.71-2.27)	1.26 (0.68-2.31)	2.36 (1.48-3.74)	1.82 (1.02-3.25)	1.94 (1.07-3.52)
20+	2.86 (1.57-5.20)	0.98 (0.46-2.09)	1.01 (0.45-2.24)	4.16 (2.37-7.13)	2.73 (1.32-5.66)	2.87 (1.34-6.15)
Number of drinks on a single occasion at Time 1 [b]						
0		Reference	Reference		Reference	Reference
1-2		0.91 (0.59-1.41)	0.99 (0.62-1.60)		1.03 (0.65-1.61)	1.22 (0.76-1.98)
3-4		0.92 (0.49-1.70)	1.04 (0.52-2.11)		0.87 (0.46-1.64)	1.19 (0.60-2.40)
5+		0.98 (0.43-2.23)	1.14 (0.47-2.80)		0.92 (0.52-1.65)	1.27 (0.65-2.51)
Marijuana use at Time 1 [b]		1.36 (0.83-2.21)	1.20 (0.72-2.00)		0.90 (0.56-1.44)	0.92 (0.57-1.49)
Other illicit drug use at Time 1 [b]		1.50 (0.82-2.77)	1.52 (0.81-2.85)		1.48 (0.87-2.53)	1.54 (0.89-2.66)
Number of weeks used alcohol at Time 2 [b]						
>1		Reference	Reference		Reference	Reference
12-23		1.60 (0.87-2.95)	1.60 (0.86-2.98)		1.22 (0.66-2.25)	1.28 (0.60-2.72)
24-29		2.14 (1.12-4.09)	2.07 (1.07-4.02)		1.19 (0.58-2.44)	1.09 (0.52-2.28)
30+		3.39 (1.93-5.93)	3.57 (2.01-6.32)		1.28 (0.61-2.71)	1.22 (0.66-2.27)
Number of drinks on a single occasion at Time 2 [b]						
0		Reference	Reference		Reference	Reference
1-2		0.88 (0.39-2.01)	0.86 (0.37-1.98)		0.20 (0.05-0.84)	0.22 (0.05-0.91)
3-4		1.55 (0.68-3.51)	1.53 (0.67-3.50)		1.07 (0.42-2.73)	1.04 (0.40-2.68)
5+		2.26 (1.06-4.82)	2.18 (1.01-4.71)		1.92 (0.84-4.40)	1.88 (0.81-4.34)

| | OR (95% CI)[a] | | | | | |
| | Female | | | Male | | |
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Marijuana use at Time 2[b]		1.98 (1.09-3.58)	1.93 (1.06-3.51)		1.43 (0.84-2.44)	1.40 (0.82-2.39)
Other illicit drug use at Time 2[b]		4.73 (2.03-11.01)	4.61 (1.93-11.02)		3.06 (1.68-5.57)	2.89 (1.57-5.32)
Age at Time 1			0.98 (0.81-1.20)			0.81 (0.67-0.98)
Sexual risk behavior at Time 1			1.33 (0.68-1.04)			0.77 (0.40-1.51)
Age at Time 2			0.95 (0.88-1.04)			0.88 (0.81-0.96)

[a] Based on multivariable logistic regression models for the outcome of sexual risk behavior adulthood. Model 1 includes Time 1 frequency of alcohol use alone; model 2, Time 1 frequency of alcohol use plus other substance use at both Times 1 and 2; and model 3, Time 1 frequency of alcohol use plus all covariates.

[b] Based on past 12 months.