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HIV/AIDS Risk Behaviors and Substance Use by Young Adults in the United States

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Abstract

The current research assessed the extent to which substance use behaviors (i.e., heavy episodic drinking, marijuana use, and use of illicit drugs other than marijuana) were associated with behaviors that confer risk for HIV infection (i.e., sex with multiple partners, inconsistent condom use, and injection drug use) in a nationally representative sample of young adults. Generalized estimating equations (GEEs) examined patterns in the data from U.S. young adults ($N=7,595$), ages 21 to 30, who participated in the Monitoring the Future (MTF) panel study between 2004 and 2009. Fifty-two percent of the participants were female and 70% were White. Time-varying effects indicated that more frequent heavy episodic drinking, marijuana use, and other illicit drug use were associated with a greater number of sex partners. Frequency of marijuana and other illicit drug use was associated with less frequent condom use, and marijuana use was associated with use of injection drugs. Younger individuals (i.e., 21–24 years old versus 25–30 years old) had fewer sexual partners, more frequent condom use, and a stronger association between heavy episodic drinking and number of sexual partners than did older individuals. These effects did not vary across gender. Findings highlight the covariation of substance use with HIV-related risk factors among recent cohorts of young adults in the U. S. and the particularly strong link between heavy episodic drinking and number of sexual partners among individuals aged 21 to 24. Prevention programs should acknowledge the co-occurring risks of substance use and HIV risk behaviors, especially among young adults in their early twenties.

Keywords

HIV; Alcohol; Marijuana; Drug use; Sexual behavior

In the United States, it is estimated that 1.2 million people are living with HIV, although 20% of these individuals are unaware of their infection (CDC 2011b). In addition, approximately 50,000 individuals are infected each year (CDC 2011b; Hall et al. 2008). After a decrease beginning in the 1990's, the trend in total number of HIV/AIDS cases and deaths remained relatively stable from 2002 to 2009 (CDC 2011b). Currently, risky sexual behaviors account for a large proportion of new HIV infections; 24% of American women and 34% of American men between the ages of 20 and 24 reported more than five lifetime sexual partners (Gavin et al. 2009). In addition, 55% of young adults between the ages of 21 and 30 who had sex in the past year reported that they “seldom” or “never” used condoms (Johnston et al. 2010).

The sharing of contaminated needles is a known mechanism for HIV transmission (CDC 2011b), and 2% of young adults between the ages of 21 and 30 report that they had ever injected an illicit drug (Johnston et al. 2010). In addition to the direct risks for HIV transmission posed by injection-related behaviors (e.g., using dirty needles), use of alcohol and other drugs has also been found to be significantly associated with a variety of increased sexual risk behaviors such as lower age of sexual initiation, increased number of sexual partners, and decreased condom use (Aicken et al. 2011; Cooper 2002, 2006; Graves and Leigh 1995; Kaiser Family Foundation 2002; Kotchick et al. 2001; Levy et al. 2009; Neal and Fromme 2007; Nkansah-Amankra et al. 2011; Patrick and Maggs 2009; Testa and Collins 1997). These findings have been obtained in both cross-sectional, nationally representative studies and convenience samples. Despite the high levels of risk behavior and clear public health relevance for young adults, the current study is the first national longitudinal examination of the covariation between substance use and HIV risk behaviors among young adults in the U.S. The present study used Dahlberg and Krug's (2002) public health approach, which identified four steps to prevention: (1) define the problem, (2) identify risk/protective factors, (3) develop and test prevention strategies, and (4) assure widespread adoption. The current analysis is designed to address the first two; namely, to examine the prevalence of HIV risk behaviors among young adults in the U.S. and identify the extent to which substance use is associated with behaviors that confer risk for HIV transmission.

Continued research attention is required to understand the correlates of risk behaviors for HIV (Gavin et al. 2009), and data obtained from nationally representative samples are essential for describing the scope of engagement in behaviors that place individuals at risk for HIV infection (Reinisch et al. 1988). Currently available data collection efforts that provide information on HIV risk behaviors on nationally representative samples of the general U.S. adult population include the Monitoring the Future study (MTF; ages 19–30), the National Health and Nutrition Examination Survey (NHANES; ages 14–69), the National Longitudinal Study of Adolescent Health (Add Health; ages 12–31), the National Survey on Drug Use and Health (NSDUH; ages 12 and over), and the National Survey of Family Growth (NSFG; ages 15–44). Although these surveys examine HIV risk behaviors among their target populations, MTF is the only survey to use a cohort-sequential design. The MTF design is particularly well-suited to examining the co-occurrence of substance use and other HIV risk behaviors among recent cohorts of young, American, high school graduates (Johnston et al. 2010). The present study is the first to use the MTF panel data collected from participants, ages 21–30, who were first assessed in 2004 to examine associations between heavy episodic drinking, marijuana use, and other illicit drug use with behaviors that confer risk for HIV infections (i.e., number of sexual partners, inconsistent condom use, and injection drug use) among young adults nationwide.

HIV-related risk behaviors and infections continue to vary across demographic subgroups. Men are more likely than women to engage in risk behaviors such as injecting drugs, sharing needles, and having multiple sex partners (Johnston et al. 2010). Individuals under age 30, compared to those age 30 or older, are more likely to engage in sexual risk behaviors (Brown et al. 2007; Williams and Snyder 1993). Married partners, on the other hand, are found to engage in fewer HIV-risk behaviors than are those not married (Bachman et al. 2002; Leonard and Homish 2005). In terms of HIV infection rates, men who have sex with men account for the majority of new infections (CDC 2011b). Black men account for about a third of all new infections in the U.S. (CDC 2006, CDC 2011b; Prejean et al. 2011). Black Americans aged 18 to 26 are at higher risk for HIV than are White Americans in this age range (Hallfors et al. 2007).

We used panel data from the national MTF study (Johnston et al. 2011) to examine the time-varying associations of substance use with HIV risk behaviors. In addition, we focused on the impact of demographic predictors and how the relation between substance use and HIV-related behaviors may differ by age (i.e., 21–24 years old vs. 25–30 years old) and gender. The present study used longitudinal data to investigate the following two research questions: (1) What is the association between substance use and HIV-relevant behaviors in a national sample? Specifically, to what extent is substance use associated with HIV risk behaviors (i.e., number of sexual partners, inconsistent condom use, and injection drug use) within-person, after controlling for major demographic variables (i.e., gender, race/ethnicity, marriage, college)? (2) Does the association between substance use and HIV risk behaviors vary by age group (i.e., 21–24 vs. 25–30) and gender?

Methods

Participants

MTF is a population-based, prospective study of drug use behaviors and related attitudes and beliefs that uses a cohort-sequential design. We provide a brief description here; detailed information about the study design is available elsewhere (Bachman et al. 2011; Johnston et al. 2011). MTF conducts annual, in-school surveys of 8th-, 10th-, and 12th-grade students. Questionnaires are administered in classrooms to nationally-representative samples of about 15,000 high school seniors each year. Beginning in 1976, approximately 2,400 graduating high school seniors have been selected from each class cohort to complete follow-up, mail surveys through age 30. Among these high school seniors, substance users are selected with a higher probability of selection. A random half (1,200) of each cohort is selected for follow-up surveys every 2 years beginning 1 year after graduation (at modal age 19), while the other half is surveyed every 2 years beginning 2 years after graduation (at modal age 20). In 2004, MTF added questions about HIV risk behaviors to the questionnaires that were sent to respondents aged 21 to 30 (Johnston et al. 2010, 2011). The added questions provide a unique opportunity for understanding the intersection of sexual and substance use behaviors in an ongoing study of nationally representative samples of young adults. Respondents in the current analyses were from the high school senior classes of 1992 to 2006. Seniors in the class of 2006 were 21 years old in 2009 and starting their follow-up assessments; seniors in the class of 1992 were 30 years old and ending their follow-up assessments. MTF has used multiple questionnaire forms, randomly assigned within classrooms to individuals at the first assessment, with the same form assigned to an individual in all follow-ups. Questions regarding HIV risk factors were added to two of six forms in 2004 (yielding data on a random 1/3 of the sample) and to a third form in 2007 (yielding data on a random 1/2 of the sample).

Because assessments were conducted every 2 years for each randomly selected half sample and the HIV-related items were added in 2004, MTF participants in the present study could complete one to three assessments that collected data on their substance use and their sexually-based, HIV-risk behaviors. For example, individuals in the senior class of 2001 could have participated in the biennial assessments when they were 21 (in 2004), 23 (in 2006), and 25 (in 2008). Of the 8,910 participants in the present analyses, 49% provided one wave of data, 31% provided two waves of data, and 20% provided three waves of data, based largely on their eligibility (i.e., how many times they were administered the HIV questions, based on their cohort and assigned questionnaire form). A total of 8,910 individuals (weighted $N_{individuals}=7,595$;¹ 51.9% female; 70.0% White, 10.6% African

¹A poststratification reweighting procedure was used to adjust for differential retention in the longitudinal panel by demographic variables (gender, race/ethnicity, high school GPA) and drug use variables (level of base-year drug use, initial oversampling of base year drug users) (Johnston et al. 2011).

American, 10.0% Hispanic, and 9.3% Other Race) provided 15,220 observations (weighted $N_{\text{observations}}=12,784$). Clustering of responses within individual is accounted for in the models (see Plan of Analysis for details). All procedures have been approved by the University of Michigan Institutional Review Board.

Measures—Dependent HIV-Related Behavior Variables (Time-Varying) The three dependent measures utilized in the current analyses were developed for the longitudinal MTF study with critical review from an expert panel. *Number of sexual partners.* Participants were asked, “During the last 12 months, how many sex partners have you had? (This includes vaginal, oral, or anal sex.)” Responses were coded as 0=*none*, 1=*one*, 2=*two*, 3=*three*, 4=*four*, 5=*5–10*, 6=*11–20*, 7=*21–100*, 8=*more than 100*. Participants with at least one sexual partner in the last 12 months reported on (male) *condom use*. Specifically, they were asked, “When you had sexual inter-course during the last 12 months, how often were condoms used? (This includes vaginal and anal sex, but not oral sex.)” Response options were 1=*never*, 2=*seldom*, 3=*sometimes*, 4=*most times*, 5=*always*. *Injection drug use* was assessed with the question, “On how many occasions (if any) have you taken any drugs by injection with a needle (like heroin, cocaine, amphetamines, or steroids) during the last 12 months? Do not include anything you took under a doctor's orders.” Response options were 1=0, 2=1–2, 3=3–5, 4=6–9, 5=10–19, 6=20–39, 7=40+ *occasions*.

Substance Use Predictors (Time-Varying) Three substance use measures were used in the present analyses. *Heavy episodic drinking* was assessed with the question, “Think back over the last 2 weeks. How many times (if any) have you had five or more drinks in a row?” Response options were 1=*none*, 2=*once*, 3=*twice*, 4=*three to five times*, 5=*six to nine times*, 6=*10 or more times*. *Marijuana use* was measured with the question, “On how many occasions (if any) have you used [marijuana, or hashish] ... during the last 30 days?” Response options were from 1=0 to 7=40+ *occasions*. *Illicit drug use* was coded dichotomously as any use of any illicit drug other than marijuana in the past 12 months (0=*none*, 1=*any*).

Demographic Variables Dummy variables used to code the three fixed demographic variables were *gender* (0=*female*, 1=*male*), *race/ethnicity* (White [reference group], African American, Hispanic, Other Race), and full-time *college attendance* (0=*no*, 1=*yes*²). A dichotomous *younger age* variable (1=21–24 *years old*, 0=25–30 *years old*) was examined as a main effect and moderator of substance use effects on HIV-related behaviors. Current *marital status* (1=*engaged or married*, 0=*not*) was a time-varying demographic predictor.

Plan of Analysis—The present analyses consisted of two main steps. First, SAS Proc Mixed was used to fit three unconditional means (i.e., intercept-only) models to estimate intraclass correlation coefficients (ICCs) for the three behaviors that confer risk for HIV infection. One of the main questions asked in the analyses focused on the extent to which substance use is associated with HIV risk behaviors *within* persons. To investigate this question, it was first important to examine how much of the observed variance in outcomes was within versus between individuals. ICCs reflect how much of the variance was within individuals. Second, generalized estimating equations (GEEs; Duncan et al. 1995; Lee et al. 2007) were used to address the research questions. The GEE approach was developed to analyze correlated data due to, for example, repeated assessments of individuals over time. The SAS 9.2 GENMOD procedure was used with a REPEATED SUBJECT statement (specifying unique individual ID numbers) and specifying an autoregressive correlation structure (TYPE=AR), normal distribution, and identity link function. Use of the

²Given that the data spanned ages 21 to 30 (i.e., largely after the normative years of college attendance), being an attender was used as a fixed predictor measured at ages 19–20 (prior to available data on HIV behaviors), rather than time-varying.

REPEATED SUBJECT statement results in responses between subjects being assumed to be statistically independent, while within-subject responses are assumed to be correlated (SAS Institute Inc. 2011). A poststratification reweighting procedure was used in the GEE models to adjust for differential retention in the longitudinal panel by demographic variables (gender, race/ethnicity, high school GPA) and drug use variables (level of base-year drug use, initial oversampling of base year drug users; Johnston et al. 2011). Outcome variables were number of partners, frequency of condom use (among those with at least one sexual partner), and frequency of injection drug use. Predictors included time-varying within-person variables (i.e., heavy episodic drinking, marijuana use, other illicit drug use, younger age, married, number of partners [for condom use only]) and between-person fixed variables (i.e., gender, race, whether attended college). In addition, interaction tests were conducted to determine whether the strength of the associations between substance use and HIV-related behaviors varied by age and gender.

Results

The proportion of variance that was within persons over time (i.e., the ICC) was 0.44 for number of sexual partners, 0.47 for condom use, and 0.36 for injection drug use, indicating that much of variation in the HIV-related variables was within persons over time rather than between persons. Means and standard deviations for the dependent variables show that the mean number of sexual partners in the past year was between 1 and 2 ($M=1.14$, $SD=1.18$; on a Likert scale). On average, participants used condoms between seldom (response value of 2) and sometimes (response value of 3; $M=2.56$, $SD=1.42$). Consistent condom use (i.e., “always”) was reported on 17.8% of occasions. Injection drug use was very infrequent, with a mean of about never (response value of 1 on scale; $M=1.02$, $SD=0.27$); any use was reported on 0.5% of occasions. The number of sexual partners in the past year was positively correlated with both more frequent condom use and with more frequent injection drug use. Descriptive statistics by demographic group are shown in Table 1.

The first research question examined how substance use and HIV behaviors were linked within persons and across time. The GEE model fit to the data on number of sexual partners in the past year suggested that number of partners was positively associated with the number of times individuals engaged in heavy episodic drinking in the past 2 weeks (see Table 2). That is, as the reported frequency of heavy drinking increased, there was a corresponding increase in the reported number of sexual partners. As participants' reports of the number of marijuana use occasions in the past month increased, their reports of the number of sexual partners in the past year increased, their reports of the frequency of condom use in the past year decreased, and their reports of the frequency of injection drug use in the past year increased. As participants' reports of the frequency of illicit drug (other than marijuana) use in the past year increased, their reports of the number of sexual partners in the past year increased and their reports of the frequency of condom use in the past year decreased.

In terms of time-varying demographic predictors, married participants reported fewer sexual partners and less frequent condom use in the past year than did unmarried participants. Participants who were younger; that is, between the ages of 21 and 24, reported fewer sexual partners and more frequent condom use in the past year than did participants aged 25 to 30. For condom use only, number of sexual partners was included as a predictor. As participants' reports of number of sexual partners in the past year increased, their reports of condom use frequency in the past year also increased.

In terms of the fixed demographic predictors, men reported more frequent condom use and more frequent injection drug use than did women. Compared to Whites, African Americans and Hispanics reported having a greater number of sexual partners in the past year; African

Americans also reported more frequent condom use and less frequent injection drug use than Whites. Individuals categorized as Other race also tended to report having fewer sexual partners in the past year, compared to Whites. Attending college predicted fewer sexual partners and more condom use.

Results pertaining to the second research question, incorporating interaction terms of age by each of the three measures of substance use, indicated that increased heavy episodic drinking was more strongly positively associated with number of sexual partners for participants aged 21 to 24 than it was during for participants aged 25 to 30. No other significant moderating effects of age on substance use were found. In addition, gender did not moderate the effect of substance use on HIV-related behaviors.

Discussion

The current research extends what is currently known about the associations between substance use behaviors (i.e., heavy episodic drinking, marijuana use, and use of illicit drugs other than marijuana) and behaviors that confer risk for HIV infection (i.e., sex with multiple partners, inconsistent condom use, and injection drug use) by using a national sample of young adults in the U.S. between the ages of 21 and 30. These longitudinal data allowed an examination of the associations between alcohol/drug use and HIV-risk behaviors, and of the question whether these associations exhibited systematic intra- and inter-individual variation. We confirmed in this sample the associations between substance use behaviors (heavy episodic drinking, marijuana use, and other illicit drug use) and HIV-risk behaviors. These results suggest that it is not just the injection drug users who place themselves at risk for HIV infection, but also those who drink heavily and use marijuana. The extent to which participants engaged in alcohol, marijuana, and other illicit drug use was associated with sexual and injection drug use behaviors that confer risk for HIV infection, after controlling for major demographic predictors (including gender, race, college attendance, marital status, and age). In particular, heavy episodic drinking, marijuana use, and other illicit drug use were associated with a greater number of sexual partners in the past year, and marijuana use and other illicit drug use were associated with less frequent condom use in the past year. The association between substance use and HIV-risk behaviors was not moderated by gender, but it was by age with the relationship between heavy episodic drinking and number of sexual partners being stronger among the younger (21–24) than older (25–30) participants.

Differences by race/ethnicity indicated that African Americans had a greater number of sexual partners than White Americans, which is consistent with previous research indicating that African Americans are at greater risk for HIV infection (CDC 2006, CDC 2011b; Hallfors et al. 2007; Prejean et al. 2011). However, we found that African Americans also used condoms more frequently and engaged in less injection drug use, qualifying the higher risk status. Hispanic Americans also had a significantly greater number of sexual partners than White Americans, which is consistent with their disproportionately high HIV infection rate in the U.S. population (CDC 2011a).

Despite the major strengths of a national study assessing HIV-related behaviors across time, there are also limitations. First, the MTF sample target population was high school graduates; therefore, high school dropouts are not included, although they may be a group with noteworthy patterns of substance use and HIV-related behaviors (e.g., Bauermeister et al. 2009, Bryant et al. 2000, Hallfors et al. 2007, Townsend 2007). Second, direct comparison for the same recall period was not possible because the recall periods differed for the measures of substance use and HIV-related behaviors.

The present results highlight the need for continued attempts to strengthen HIV prevention efforts among sexually active adults in their early twenties who use alcohol, marijuana, and other illicit substances. There are also particular groups for whom prevention is especially needed; for example, individuals in their early twenties may be an important intervention target. The association between heavy episodic drinking in the past 2 weeks and the reported number of sexual partners in the past year was stronger for young adults between the ages of 21 and 24, compared to young adults between the ages of 25 and 30. This suggests that prevention and intervention programs targeting those in their early twenties should acknowledge both substance use and HIV-related behavioral risks in efforts to promote public health.

Our findings highlight the covariation of substance use with HIV-related risk factors over time among current national cohorts of young adults. We extend the work of others who have documented this association for alcohol use (Cooper 2002, 2006; Kotchick et al. 2001; Neal and Fromme 2007; Patrick and Maggs 2009; Testa and Collins 1997) with largely cross-sectional or convenience samples. Using repeated measures data, ICCs demonstrated that there is a substantial portion of variance that is within person, such that an individual's reports of his/her HIV-related risk behaviors tend to vary across time. Therefore, it is especially important to understand situational and contextual predictors of HIV-related risk behaviors. Further research is also needed to understand the mechanisms by which substance use and HIV-related behaviors are associated concurrently, and the extent to which substance use has longitudinal effects on other risks for HIV among American young adults.

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Table 1
Mean level of HIV risk behaviors among young adults by demographic group

	Number Partners <i>M(SD)</i>	Condom Use <i>M(SD)</i>	Injection Drugs <i>M(SD)</i>
Gender			
Women	1.32(0.97)	2.41(1.31)	1.01(0.20)
Men	1.54(1.42)	2.73(1.55)	1.03(0.34)
Race/Ethnicity			
African American	1.67(1.61)	2.96(1.71)	1.00(0.00)
Hispanic	1.46(1.38)	2.64(1.67)	1.01(0.21)
White	1.39(1.08)	2.46(1.33)	1.02(0.27)
Other	1.22(1.24)	2.70(1.67)	1.02(0.33)
Age			
Younger (21–24)	1.51(1.31)	2.92(1.41)	1.02(0.26)
Older (25–30)	1.36(1.06)	2.32(1.38)	1.02(0.27)
College Attendance			
Attender	1.35(1.12)	2.66(1.40)	1.02(0.27)
Non-attender	1.42(1.18)	2.45(1.42)	1.02(0.28)
Marital Status			
Married	1.10(0.56)	2.01(1.25)	1.01(0.19)
Unmarried	1.63(1.42)	3.02(1.42)	1.02(0.30)

HIV risk behaviors in the last 12 months were coded on the scales of: Number of sexual partners in the last 12 months: 0=*none*, 1=*one*, 2=*two*, 3=*three*, 4=*four*, 5=*5-10*, 6=*11-20*, 7=*21-100*, 8=*more than 100*. Condom use: 1=*never*, 2=*seldom*, 3=*sometimes*, 4=*most times*, 5=*always*. Injection drug use: 1=0, 2=1-2, 3=3-5, 4=6-9, 5=10-19, 6=20-39, 7=40+ occasions

Table 2
Generalized estimating equations for concurrent associations between HIV/AIDS risk behaviors and substance use among individuals ages 21–30

	Number partners			Condom use			Injection drugs		
	Est	SE	p	Est	SE	p	Est	SE	p
Time-varying within-person									
Heavy episodic drinking (HED)	0.16	0.02	***	−0.01	0.02		0.000	0.005	
Marijuana (MJ)	0.09	0.01	***	−0.02	0.01	*	0.01	0.004	***
Other illicit drugs ^a	0.33	0.05	***	−0.23	0.05	***	−	−	−
Younger (21–24) ^b	−0.22	0.05	***	0.40	0.06	***	−0.004	0.01	
Married ^c	−0.32	0.03	***	−0.65	0.04	***	−0.005	0.01	
Number of partners	−	−	−	0.23	0.01	***	−	−	−
Younger × HED	0.11	0.03	***	−0.02	0.03		−0.001	0.01	
Fixed effects between-persons									
Male ^d	0.02	0.03		0.25	0.04	***	0.02	0.01	*
African American ^e	0.35	0.06	***	0.28	0.08	***	−0.02	0.004	***
Hispanic ^e	0.16	0.06	**	0.10	0.07		−0.001	0.01	
Other race ^e	−0.17	0.05	**	0.11	0.08		0.01	0.02	
College attender ^f	−0.10	0.03	***	0.20	0.04	***	−0.003	0.01	

^a Other illicit drug use was not included in the model for injection drug use because the variables are redundant.

Comparison group is

^b older (ages 25–30),

^c not married,

^d female,

^e White,

^f college non-attenders.

By outcome, weighted Ns of observations are: Number partners=12,522; Condom use (asked only if participant reported>0 partners)=10,661; Injection drugs=12,560.

 $p<.001$,
**
 $p<.01$,
*
 $p<.05$