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Association of MDMA/ecstasy and other substance use with self-reported sexually transmitted diseases among college-aged adults: a national study

L-T. Wu[a,*], **C.L. Ringwalt**[b], **A.A. Patkara**[a], **R.L. Hubbard**[a,c], and **D.G. Blazer**[a]

[a]Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, Duke Clinical Research Institute, Box 3419, Durham, NC 27710, USA

[b]Pacific Institute for Research and Evaluation, Chapel Hill Center, Chapel Hill, NC, USA

[c]National Development and Research Institutes, Raleigh Center, Raleigh, NC, USA

SUMMARY

Objectives—MDMA/ecstasy use among college students has increased and reportedly leads to risky sexual behaviours. However, little is known about its association with sexually transmitted diseases (STDs). To evaluate this public health concern, this study examined the association between substance use (particularly MDMA) and self-reported STDs (chlamydia, gonorrhoea, herpes and syphilis) among college students and non-students aged 18–22 years (*n*=20,858).

Study design—A cross-sectional data analysis of a national survey.

Methods—Data were drawn from the 2005–2006 National Surveys on Drug Use and Health; a nationally representative survey of non-institutionalized Americans. Self-reported STDs and substance use were assessed by the audio computer-assisted self-interviewing method. The association between MDMA use and STDs was determined while taking into account young adults' use of other substances, healthcare utilization and sociodemographic characteristics.

Results—Overall, 2.1% of college students and 2.5% of non-students reported contracting an STD in the past year. MDMA use in the past year was not associated with STDs. Among non-students, onset of MDMA use before 18 years of age increased the odds of past-year STDs. In both groups, alcohol use, marijuana use, female gender and African American race increased the odds of both past-year and lifetime STDs. Additional analyses indicated that, regardless of college-attending status, greater odds of past-year STDs were noted among users of alcohol and drugs, and users of alcohol alone, but not among users of drugs alone.

*Corresponding author. Tel.: +1 919 668 6067; fax: +1 919 668 5418. litzy.wu@duke.edu, litzywu@yahoo.com (L-T. Wu).

Ethical approval

The study was exempt from Duke Institutional Review Board Review due to the data being available in the public domain without any identification of personal information.

Competing interests

A.A. Patkar has received grant support from Pfizer, Forest Laboratories, Cephalon and Titan Pharmaceuticals, and is on the speakers bureaus of Cephalon and Reckitt-Benckiser.

Conclusions—Alcohol use is a robust correlate of STDs. Irrespective of college-attending status, young women and African Americans have a higher rate of STDs than young men and Whites.

Keywords

Alcohol use; College students; Epidemiology; MDMA; Sexually transmitted diseases

Introduction

In the USA, approximately 18.9 million new cases of sexually transmitted diseases (STDs) occur each year; of these, 9.1 million (48%) comprise young people aged 15–24 years.[1] The estimated direct medical cost associated with new cases of STDs among this group is US$6.5 billion.[2] Of particular concern is the readily transmissible nature of STDs, as well as the fact that untreated STDs can lead to pelvic inflammatory disease, infertility and co-infection with other STDs.[3] Unfortunately, STDs are often asymptomatic and thus substantially underdiagnosed and undertreated.[1,3–5] Studies suggest that young adults, including college students, are at high risk for acquiring and transmitting STDs because of their increased rates of substance use and substance-related risky sexual behaviours.[6–8]

Surveys of students[9] and household residents[10] report that the use of MDMA (3,4-methylenedioxymethamphetamine; ecstasy) has increased substantially among young people in general, and college students in particular.[7,8,11] MDMA is the second most commonly used illicit drug among college students;[7,12] in this group, past-year MDMA use was associated with excessive partying, having multiple sexual partners, and use of alcohol and drugs.[7,8] Additionally, results from a study of a community sample indicated a relatively high prevalence of past-year MDMA use among non-students and young adults aged 18–21 years.[13] Similar to results from studies of college students,[7,8,11] more than 80% of these MDMA users had consumed at least three other drug classes.[13] These studies suggest that MDMA use among college-aged young adults is of particular concern due to the strength of its association with other substance use and involvement with multiple sexual partners.[7,8,11] Little, however, is presently known about whether MDMA use increases the likelihood of STDs among college-aged young adults. College students are considered to be a high-risk group for acquiring STDs because of elevated rates of substance use, sexual activity, inconsistent condom use and sex with multiple partners.[12–15] On the other hand, their non-student peers are more likely to use MDMA and other substances,[13,16] and are thus also at risk for contracting STDs, although this group is excluded from school-based studies.[7,8,15] It is therefore important to investigate the extent of STDs and MDMA use within the context of a general population of young adults that includes both students and non-students.

Prior studies of college students have focused mainly on risky sexual behaviours but not on STDs.[7,8,14] This study adds to these earlier studies[7,8,11] by investigating previously unaddressed questions regarding the association between STDs and MDMA use in a nationally representative sample. Given that MDMA users are at risk for using other substances[7,8,11,13] and that healthcare utilization is likely to increase opportunities for STD screening, this study examined whether MDMA use is associated with STDs, irrespective of use of other substances and access to health care. Further, due to a lack of research on non-students, and the likely differences in socio-economic characteristics (e.g. family income and race/ethnicity), substance use and health status between students and non-students, this study determined the relationship between MDMA use and STDs in students and non-students separately. Finally, this study examined whether the two groups differ in STDs when holding constant their potential differences in sociodemographic characteristics, substance use and healthcare utilization. This study addressed the following questions: (1) is there an association between

MDMA use and past-year STDs; (2) does early onset of substance use increase the odds of lifetime STDs; and (3) are college students more likely to have an STD than non-students?

Methods

Data source

This study was based on data from the public use file of the 2005–2006 National Surveys on Drug Use and Health (NSDUH).[10,17] The annual survey provides population estimates of substance use and health status of the civilian, non-institutionalized population aged 12 years and older. Target participants selected using multistage area probability sampling methods included household residents; residents of shelters, rooming houses, college dormitories, migratory workers' camps, and halfway houses; and civilians residing on military bases.

Participants were interviewed in private at their places of residence. Confidentiality was stressed in all written and oral communications with potential respondents, and their names were not collected. Data collection methods involved a combination of computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) to increase the validity of respondents' reports of drug use behaviours.[18] Sociodemographic items were administered by field interviewers via CAPI. The interview then transitioned to ACASI mode, which provided respondents with a private and confidential setting in which to answer sensitive questions (substance use and STD status). Specifically, questions were either displayed on a computer screen or read through headphones to respondents who entered answers directly into the interviewers' computers.

Approximately 68,000 respondents complete the survey each year. Weighted response rates for completed interviews among young adults aged 18–25 years were 83% in 2005 and 81% in 2006. The study sample of each annual, independent survey is considered to be representative of the US general population aged 12 years or older. NSDUH designs are reported in detail elsewhere.[10,17]

Study variables

Sexually transmitted diseases—Self-reported STDs were assessed by ACASI methods to increase the validity of self-reports.[10,18] Respondents' lifetime and past-year history of STDs were assessed by two questions: 'Has a doctor or other medical professional *ever* told you that you had a sexually transmitted disease? (STDs include chlamydia, gonorrhoea, herpes and syphilis)' and 'Has a doctor or other medical professional told you that you had a sexually transmitted disease *in the past year*?'[19] Self-reported human immunodeficiency virus (HIV) status was assessed by a separate question: 'Has a doctor or other medical professional ever told you that you had HIV/AIDS?' As there were no cases of HIV among college students, and only 0.03% (n=4) of non-students reported having a diagnosis of HIV/acquired immunodeficiency syndrome (AIDS), HIV/AIDS was not examined.

Social characteristics and demographics—Respondents' age group, gender, race/ethnicity, college-attending status (college students vs non-students) and total annual family income were examined. The NSDUH defined 'college age' as 18–22 years.[10] A categorical survey-year variable was created to examine possible variations in sociodemographic characteristics, STDs and MDMA use across the two survey years.

Substance use—Based on prior research, respondents' MDMA use, age at onset of MDMA use, alcohol use, marijuana use, cocaine/crack use, methamphetamine use, age at onset of alcohol use, and age at onset of any drug use were examined as potential correlates for STDs.[6–8,20–22] The NSDUH employs separate questions to assess lifetime use of MDMA, alcohol,

marijuana, cocaine/crack and methamphetamine.[13,16] For example, MDMA use was assessed by the question: 'Have you ever used ecstasy (also called MDMA)?' The survey also assessed use of each substance in the past year and age at first use (onset). Age at first use was categorized into prior to 15 years (early adolescence), 15–17 years (mid-adolescence) and 18 years or older (adulthood). As only a small number of MDMA users reported first use before 15 years of age (*n*=94), the first two categories were combined. Onset of any drug use referred to age at first use (illicit or non-medical use) of any of nine drug classes assessed by the survey: marijuana, inhalants, cocaine/crack, hallucinogens (including MDMA), heroin, prescription pain relievers, sedatives, tranquilizers or stimulants (including methamphetamine).

Healthcare utilization—As STD diagnosis was likely to be influenced by healthcare use, past-year utilization of medical care and history of substance abuse treatment were also examined. Utilization of medical care included treatment in an emergency department or inpatient hospitalization for any health-related conditions during the past 12 months; the NSDUH does not distinguish between treatment for general health and for substance-use-related conditions. Data on lifetime medical care utilization was not collected. History of substance abuse treatment included lifetime treatment or counselling for problems related to alcohol or drug use at any service location (e.g. hospital, addiction or mental health facility, doctor's office or jail).

Data analysis

Data analysis was based on college students and non-students aged 18–22 years. All analyses were conducted with SUDAAN – software designed specifically for statistical analyses of data from complex surveys.[23] Sociodemographic characteristics and STD prevalence were initially compared by survey year and college-attending status (*n*=10,473 in 2005; *n*=10,385 in 2006). There was little yearly variation in these characteristics; next, the prevalence of substance use and STDs were examined by key sociodemographic characteristics in the combined data (*n*=20,858). Logistic regression procedures were conducted to estimate the associations between MDMA use variables and past-year STDs while adjusting for the influences of the other study variables. For lifetime STDs, the association of early onset of alcohol and any drug use with a history of STDs was examined. Finally, the odds of STDs between college students and non-students were compared while holding constant their potential variations in sociodemographic characteristics, substance use and healthcare utilization. For ease of interpretation, 95% confidence intervals (CI) of odds ratios (OR) are reported, taking into account the complex survey design of the NSDUH.

Results

Respondent characteristics

Compared with non-students, college students were more likely to be aged 18–20 years (64% vs 50%), female (53% vs 45%), White (68% vs 58%), Asian (7.4% vs 2.5%), and in the higher family income group (≥$40,000: 43% vs 39%), but were less likely to be Hispanic (12% vs 23%) (χ^2, $P<0.01$ for each comparison).

Prevalence of substance use (Table 1)

Compared with non-students, college students were more likely to have consumed alcohol in the past year (81% vs 74%); equally likely to have used marijuana in the past year (31% in each group); and less likely to have used MDMA (3.2% vs 4.7%), cocaine/crack (5.9% vs 8.5%) and methamphetamine (1.0% vs 2.0%) in the past year.

Prevalence of STDs (Table 2)

Among the combined sample (*n*=20,858), 2.3% (95% CI 2.0–2.6%) reported a past-year STD, and 3.9% (95% CI 3.5–4.2%) reported a lifetime STD. There were no differences in prevalence of past-year STDs between students and non-students. However, non-students were more likely than college students to report a lifetime STD (4.4% among non-students vs 3.3% among college students; χ^2=8.37, df=1, *P*=0.005). Regardless of college-attending status, women had a higher prevalence of past-year and lifetime STDs than men: 3.4% vs 0.6%, and 5.3% vs 1.0%, respectively, among students; and 4.1% vs 1.3%, and 7.4% vs 2.0% among non-students. African Americans had a higher prevalence of lifetime STDs than Whites: 6.4% vs 2.8% among students, and 7.4% vs 4.1% among non-students.

Logistic regression of past-year STDs (Table 3)

College students—Past-year MDMA use was not associated with past-year STDs. Early onset of MDMA use (>18 years) was associated with STDs in the unadjusted model; after the model included the use of alcohol, marijuana or cocaine/crack, this association became non-significant. The adjusted model revealed that students aged 21–22 years [adjusted OR (AOR) =1.6], women (AOR=6.1), African Americans (relative to Whites: AOR=2.3), past-year alcohol users (AOR=3.3) and past-year marijuana users (AOR=2.4) had increased odds of having a past-year STD. For example, female college students were 6.1 times as likely as their male counterparts to report an STD in the past year, which was independent of the influence of sociodemographic, substance use and healthcare use variables included in the model.

Non-students—In contrast to students, early onset of MDMA use (>18 years) in non-students was associated with past-year STDs (AOR=1.8), and this association persisted even after adjusting for sociodemographic, various substance use and healthcare use variables. Additionally, women (AOR=3.5), African Americans (AOR=2.1), past-year alcohol users (AOR=2.0) and past-year marijuana users (AOR=1.7) had an increased likelihood of having an STD in the past year.

Logistic regression of lifetime STDs (Table 4)

College students—The analysis of lifetime STDs examined the association with early use of alcohol and any drug because it measured a cumulative probability for STDs. The adjusted model indicated that students aged 21–22 years (AOR=2.1), women (AOR=6.6), African Americans (AOR=3.4) and lifetime users of alcohol (AOR=3.1–3.7) or any drug (AOR=1.9–5.5), regardless of their age at first substance use, had an increased likelihood of having an STD in their lifetime.

Non-students—Non-students aged 21–22 years (AOR=1.6), women (AOR=4.1), African Americans (AOR=2.4), other non-Hispanic minority groups (AOR=1.8), lifetime alcohol users (AOR=2.2–3.7) (regardless of their age at first alcohol use) and lifetime drug users who initiated their drug use before 18 years of age (AOR=2.0–2.4) had an increased likelihood of having an STD in their lifetime.

Gender, race/ethnicity and STDs

Due to robust associations of gender and race/ethnicity with STDs, their interaction effects on STDs were explored by examining an interaction term for gender and race/ethnicity in the adjusted logistic regression models among college students and non-students, respectively. This interaction term was not significant.

Alcohol use and STDs (Table 5)

In order to explore whether respondents who used both alcohol and drugs were more likely to have an STD than those who used either alcohol or drugs alone, the association of the four mutually exclusive groups of lifetime substance use (both alcohol and any drug, alcohol alone, drug alone, none) with STDs was examined in adjusted logistic regression models controlling for age, gender, race/ethnicity, family income, past-year healthcare use and history of substance abuse treatment. Among students, users of both alcohol and drugs (AOR =11.6) and users of alcohol alone (AOR=3.7) were more likely to have a past-year STD than never users of both substances. Users of drugs alone manifested no significant increase in odds of a past-year STD. A similar pattern was noted among non-students.

College-attending status and STDs

The analyses were concluded by conducting two adjusted logistic regression models of the combined sample of students and non-students to examine differences in the odds of STDs between the two groups. For past-year STDs, the analyses controlled for all variables listed in the first column of Table 3; for lifetime STDs, the analyses controlled for all variables listed in the first column of Table 4. No differences were found in the odds of past-year STDs and lifetime STDs by college-attending status.

Discussion

Within this nationally representative sample of college-aged young adults, approximately 2% and 4% reported a past-year and lifetime STD, respectively. Adjusted logistic regression analyses revealed that: (1) students are as likely as non-students to have had an STD in the past year or in their lifetimes; (2) non-students who initiated MDMA use before 18 years of age are more likely than never users of MDMA to have had an STD in their lifetime; (3) regardless of college-attending status, a history of alcohol use, female gender and African American race are strongly associated with past-year and lifetime STDs; and (4) past-year marijuana users are more likely than non-marijuana users to have had an STD in the past year.

Prevalence of STDs

The overall prevalence of self-reported STDs suggested by this study appears comparable to rates from other national studies of self-reported STDs, but variations in study design inhibit meaningful comparisons. For instance, results from the National Survey of Adolescent Males indicated that 2.7% of men aged 18–19 years and 1.6% of men aged 22–26 years reported an STD in the past year;[24] however, the investigators did not report the definition of an STD. In another national survey conducted in 1992, Ellen et al.[25] indicated that 7% of respondents aged 14–21 years reported a history of STDs (genital herpes, genital warts, chlamydia, gonorrhoea, syphilis and HIV/AIDS). The younger age of their sample (relative to that in the present study) and the relatively broad definition of STDs may account, in part, for the higher rate of STDs reported. Chlamydia, the most commonly reported infectious STD in the USA, is more prevalent among adolescents than young adults,[3] and genital warts are not included in the NSDUH's assessment.

This study not only confirms the relatively high prevalence of STDs among young women and African Americans,[3,4,25,26] but also shows that this finding is not influenced by use of a variety of substances. For example, in 2006, the rate of chlamydia cases for females reported to the Centers for Disease Control and Prevention (CDC) was three times higher than that for males, and the rate for African American females was more than seven times that of White females.[3] Additionally, rates of reported cases of gonorrhoea and syphilis among African Americans were 18 times and six times greater, respectively, than those for Whites.[3] The elevated risk for STDs for some African American youth may be related to a relatively high prevalence of STDs

among their sexual partners,[25,26] and the higher rate of STDs among females may be related to higher rates of STD screening than among males.[3] Additionally, young females are more biologically vulnerable (e.g. immature cervix in adolescents) and socially vulnerable (e.g. unable to make a decision about condom use) than males to acquiring STDs.[4]

MDMA use and STDs

Although MDMA use reportedly increases sexual arousal and promotes unprotected/risky sexual behaviours,[27] these findings suggest that past-year use of MDMA is only weakly associated with self-reported STDs. Instead, the probability of having an STD appears to be influenced by alcohol and marijuana use, and by initiation of any drug use (including MDMA) before 18 years of age. Similarly, other studies have reported that onset of alcohol or drug use in adolescence predicts early initiation of sexual activity and sexual risk-taking behaviours.[6,28] The observed association between marijuana use and STDs is consistent with previous results suggesting an association between marijuana use and risky sexual behaviours/STDs.[26,29] Alcohol or marijuana use may affect users' cognitive judgment, promote unplanned or other sexual risk taking, and reduce use of protective behaviours (e.g. condom use).[29–32] It is also possible that young adults at risk for STDs constitute a subgroup of adolescent-onset substance users characterized by a tendency to engage in a variety of risk-taking activities, including early drug use and unprotected sexual activity, with STDs reflecting one of several health-compromising consequences of these behaviours.[6,33]

Non-students vs college students in STDs

While college students are considered to be a high-risk group for contracting and transmitting STDs due to a reported lifestyle of substance use, frequent partying, and active or risky sexual behaviours,[12–15,34] very little is known about STD risk in a community-based sample of non-students. This national study shows that non-students are more likely than college students to be members of minority groups and to use illicit drugs (MDMA, cocaine and methamphetamine), but are less likely to have consumed alcohol in the past year. By applying multiple logistic regression procedures to adjust for the potentially confounding effects of several sociodemographic, substance use and healthcare use variables on college-attending status, this study found that college students do not necessarily constitute a higher-risk group for STDs compared with non-students.

Taken together, these findings have important implications for preventing substance use and STDs. First, non-students represent about one half of this national sample, yet they are excluded from school-based programmes aimed at preventing or reducing substance use or STDs.[35] Given that non-students are more likely than students to be of minority race and to have fewer resources for health care, substance use and STDs among this group of young adults warrant further study in order to better characterize at-risk groups for appropriate intervention. Second, the connection between STD risk and substance use indicates the need to combine prevention or intervention efforts to address both areas, such as including substance use interventions as part of routine care in STD clinics and providing STD testing to patients manifesting substance use problems in primary care settings. Finally, public health educational programmes can also incorporate messages to address links between substance use and sexual health.

Study limitations and strengths

These findings should be interpreted with caution. First, the cross-sectional nature of the data precludes drawing causal inferences related to the reported associations. Second, substance use behaviours and STDs are obtained from respondents' self-reports and are therefore subject to memory errors and under-reporting.[36] Like other studies relying on either self-reported information[25] or national surveillance data,[3] the prevalence of STDs in this study is likely to be underestimated due to under-reporting because of social stigma or because respondents are

unaware that they have STDs.[1,37] A third potential limitation is the aggregate question of a self-reported STD specified in the NSDUH, which does not allow specific STDs to be examined. Nonetheless, the NSDUH question covers all three nationally reportable STDs from the CDC (chlamydia, gonorrhoea, and syphilis), as well as the most prevalent viral STD (herpes).[4] Human papilloma virus, trichomoniasis and chancroid are not assessed by the NSDUH or by the national surveillance system.[38] In addition, the NSDUH does not collect information about sexual and contraceptive behaviours, thus preventing the analysis of these characteristics. Last, individuals who were institutionalized or homeless on the date of the survey, as well as active military personnel, are not covered by the NSDUH sampling. The findings of the present study are not applicable to these groups.

Despite these limitations, the NSDUH design has many strengths. It uses the most advanced ACASI technology available to assess respondents' STDs and substance use behaviours; such technology has been found to increase reporting of sexual and drug use behaviours among youth.[18] It should also be noted that self-reporting of STDs avoids the biases inherent to surveillance data,[25,38] which are based on cases of STDs reported to state and local health departments, and reporting from public sources is more complete than reporting from private settings.[38] They thus may undercount STDs among individuals with the resources to seek care from private care settings.[25,37] Nonetheless, the findings of this study are consistent with both surveillance and other data that reveal marked STD disparities across gender and racial/ethnic groups.[3,4,25,26]

Conclusions

This study examined the association between self-reported STDs and substance use (particularly MDMA) in a large, national sample of college-aged students and non-students. The results suggest that alcohol use, marijuana use, African American race and female gender increase the risk of STDs. Initiating MDMA use before 18 years of age also appears to increase STD risk for non-students. Future studies employing finer-grained assessments of contextual factors and sexual behaviours are needed to elucidate how the use of alcohol and MDMA influence safe sex practices. It is particularly problematic that the majority of new cases of STDs are adolescents and young adults, and they are often asymptomatic.[1,3] Routine screening of young, sexually active individuals who are substance users, female and African American is thus recommended to improve early detection and treatment of STDs in order to reduce adverse long-term consequences of these infections.

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Table 1

Prevalence of substance use among young adults aged 18–22 years in 2005–2006 (*n*=20,858)

Substance use **Column % (SE)**	**College students** ***n*=10,473**	**Non-students** ***n*=10,385**
Substance use in the past year		
MDMA	3.2 (0.24)	4.7 (0.29)[b]
Alcohol	80.9 (0.53)	74.4 (0.70)[b]
Marijuana	31.0 (0.61)	30.6 (0.57)
Cocaine/crack	5.9 (0.33)	8.5 (0.38)[b]
Methamphetamine	1.0 (0.14)	2.0 (0.21)[b]
Age at onset of MDMA use, lifetime		
≤17 years	4.6 (0.28)	8.1 (0.34)[b]
≥18 years	4.1 (0.29)	7.3 (0.36)
Age at onset of any drug use, lifetime[c]		
≤17 years	41.5 (0.61)	51.5 (0.56)[b]
≥18 years	14.0 (0.44)	10.7 (0.36)
Age at onset of alcohol use, lifetime		
≤17 years	64.4 (0.71)	63.2 (0.67)[a]
≥18 years	21.8 (0.60)	20.2 (0.43)

SE, standard error.

Sample sizes are unweighted numbers; proportions are weighted figures.

[a] χ^2 test by college-attending status: $P \leq 0.01$

[b] χ^2 test by college-attending status: $P \leq 0.001$.

[c] Age at first use of marijuana, inhalants, cocaine/crack, hallucinogens, heroin or first non-medical use of prescription pain relievers, sedatives, tranquilizers or stimulants.

Table 2

Prevalence of sexually transmitted diseases (STDs) among young adults aged 18–22 years in 2005–2006 by social and demographic characteristics (*n*=20,858)

Characteristics	Past-year STDs		Lifetime STDs	
Prevalence of STDs, row % (SE)	**College students**	**Non-students**	**College students**	**Non-students**
Overall prevalence	2.1 (0.21)	2.5 (0.20)	3.3 (0.27)	4.4 (0.25)[a]
Age (years)				
18–20	1.7 (0.23)[b]	2.2 (0.23)	2.4 (0.29)[c]	3.6 (0.31)[b]
21–22	2.7 (0.35)	2.9 (0.34)	4.8 (0.50)	5.3 (0.39)
Gender				
Male	0.6 (0.15)[c]	1.3 (0.18)[c]	1.0 (0.19)[c]	2.0 (0.20)[c]
Female	3.4 (0.37)	4.1 (0.36)	5.3 (0.46)	7.4 (0.44)
Race/ethnicity				
White	1.9 (0.23)	2.4 (0.29)	2.8 (0.30)[c]	4.1 (0.35)[c]
African American	3.3 (0.50)	3.9 (0.54)	6.4 (0.70)	7.4 (0.81)
American Indian or Alaska Native	7.1 (3.73)	3.7 (1.58)	8.1 (3.83)	9.1 (3.20)
Asian, Pacific Islander or Native	1.1 (0.80)	4.5 (2.01)	2.4 (1.33)	5.3 (2.15)
Hawaiian				
Multiple race	2.5 (1.01)	2.7 (1.30)	4.0 (1.57)	6.5 (2.15)
Hispanic	2.5 (0.73)	1.8 (0.40)	3.8 (0.88)	2.9 (0.45)
Total annual family income (US$)				
0–19,999	2.0 (0.41)	3.4 (0.41)	3.2 (0.48)	5.8 (0.52)[b]
20,000–39,999	2.2 (0.45)	2.2 (0.27)	3.6 (0.58)	3.9 (0.37)
40,000–74,000	2.2 (0.30)	2.6 (0.48)	3.0 (0.59)	4.5 (0.74)
≥75,000	2.2 (0.43)	1.4 (0.60)	3.3 (0.55)	2.6 (0.67)
Survey year				
2005	2.0 (0.24)	2.2 (0.22)	3.1 (0.29)	4.3 (0.33)
2006	2.2 (0.35)	2.9 (0.34)	3.5 (0.40)	4.6 (0.36)

SE, standard error.

Sample sizes are unweighted numbers; proportions are weighted figures.

[a] χ^2 test for differences between college students vs non-students: $P<0.01$.

[b] χ^2 test for differences between STD status and sociodemographic characteristics: $P\leq0.01$.

[c] χ^2 test for differences between STD status and sociodemographic characteristics: $P\leq0.001$.

Table 3

Odds ratios (OR) and 95% confidence intervals (CI) of past-year sexually transmitted diseases (STDs) among young adults aged 18–22 years in 2005–2006 (*n*=20,858)

Logistic regression model	**College students OR (95% CI)**		**Non-students OR (95% CI)**	
	Crude	**Adjusted**[b]	**Crude**	**Adjusted**[b]
Age (vs 18–20 years)				
21–22 years	**1.6 (1.12–2.28)**	**1.6 (1.13–2.32)**	1.4 (0.97–1.88)	1.4 (0.94–1.94)
Gender (vs male)				
Female	**5.6 (3.30–9.54)**	**6.1 (3.55–10.49)**	**3.3 (2.41–4.54)**	**3.5 (2.50–5.00)**
Race/ethnicity (vs White)				
African American	**1.8 (1.16–2.69)**	**2.3 (1.44–3.80)**	**1.7 (1.11–2.60)**	**2.1 (1.36–3.12)**
Hispanic	1.3 (0.70–2.56)	1.4 (0.73–2.65)	0.8 (0.46–1.29)	1.1 (0.64–1.87)
Other[a]	0.8 (0.34–1.87)	1.1 (0.45–2.66)	1.9 (0.89–3.19)	1.9 (0.95–3.70)
Family income (US$) (vs ≥ 75,000)				
0–19,999	0.9 (0.50–1.66)	0.8 (0.41–1.51)	2.5 (0.99–6.37)	2.0 (0.80–4.99)
20,000–39,999	1.0 (0.52–1.90)	0.9 (0.46–1.70)	1.6 (0.62–4.21)	1.5 (0.56–3.85)
40,000–74,999	1.0 (0.61–1.54)	1.0 (0.61–1.58)	1.9 (0.71–5.03)	1.7 (0.64–4.53)
Past-year alcohol use (vs no)				
Yes	**4.3 (2.37–7.75)**	**3.3 (1.71–6.34)**	**2.4 (1.36–4.13)**	**2.0 (1.06–3.64)**
Past-year MDMA use (vs no)				
Yes	0.9 (0.36–2.31)	……	**2.8 (1.74–4.47)**	……[c]
Past-year marijuana use (vs no)				
Yes	**2.5 (1.62–3.8)**	**2.4 (1.50–3.67)**	**2.2 (1.59–2.98)**	**1.7 (1.24–2.42)**
Past-year cocaine/crack use (vs no)				
Yes	**1.9 (1.11–3.17)**	1.2 (0.67–2.21)	**2.1 (1.43–3.14)**	1.2 (0.80–1.85)
Past-year methamphetamine use (vs no)				
Yes	**3.1 (1.12–8.63)**	2.0 (0.63–6.13)	**2.0 (1.06–3.76)**	1.0 (0.50–2.00)
Age at onset of MDMA use (vs no)				
≤17 years	**2.2 (1.16–4.09)**	1.1 (0.57–2.19)	**2.6 (1.57–4.48)**	**1.8 (1.03–3.11)**

Logistic regression model	College students OR (95% CI)		Non-students OR (95% CI)	
	Crude	Adjusted[b]	Crude	Adjusted[b]
≥18 years	1.1 (0.51–2.38)	0.6 (0.27–1.56)	**2.3 (1.52–3.56)**	1.4 (0.92–2.24)
Past-year emergency department or inpatient treatment (vs no)				
Yes	**1.6 (1.06–2.45)**	1.3 (0.88–1.92)	1.4 (0.95–2.04)	1.0 (0.70–1.52)
History of substance abuse treatment (vs no)				
Yes	1.7 (0.84–3.56)	1.5 (0.74–3.18)	**2.0 (1.17–3.40)**	1.6 (0.90–2.69)

[a] Due to a small sample size of STDs among Asians, Pacific Islanders, American Indians, Alaska Natives and those reporting multiple race, these categories are combined into one group.

[b] The adjusted model included all variables listed in the first column.

[c] Past-year MDMA use was not significant after age at onset of MDMA use was considered; to avoid colinearity, it was excluded from the model.

Bold: $P<0.05$.

Table 4

Odds ratios (OR) and 95% confidence intervals (CI) of lifetime sexually transmitted diseases among young adults aged 18–22 years in 2005–2006

Logistic regression model	**College students OR (95% CI)**		**Non-students OR (95% CI)**	
	Crude	**Adjusted[3]**	**Crude**	**Adjusted[c]**
Age (vs 18–20 years)				
21–22 years	**2.0 (1.47–2.81)**	**2.1 (1.53–2.94)**	**1.5 (1.18–1.92)**	**1.6 (1.24–2.00)**
Gender (vs male)				
Female	**5.5 (3.77–8.14)**	**6.6 (4.39–9.87)**	**3.9 (3.10–4.90)**	**4.1 (3.15–5.22)**
Race/ethnicity (vs White)				
African American	**2.4 (1.69–3.38)**	**3.4 (2.29–5.11)**	**1.9 (1.33–2.60)**	**2.4 (1.73–3.40)**
Hispanic	1.4 (0.84–2.34)	1.5 (0.90–2.50)	**0.7 (0.49–0.99)**	1.0 (0.70–1.48)
Other[a]	1.0 (0.45–2.26)	1.4 (0.60–3.20)	1.6 (0.95–2.55)	**1.8 (1.09–2.97)**
Family income (US$) (vs ≥ 75,000)				
0–19,999	1.0 (0.63–1.65)	0.9 (0.53–1.39)	**2.3 (1.28–4.16)**	1.7 (0.93–3.10)
20,000–39,999	1.1 (0.66–1.89)	0.8 (0.47–1.40)	1.5 (0.86–2.64)	1.3 (0.73–2.40)
40,000–74,999	0.9 (0.64–1.34)	0.9 (0.59–1.25)	1.8 (0.91–3.44)	1.6 (0.80–3.24)
Age at onset of alcohol use (vs no)				
≤14 years	**7.8 (4.12–14.8)**	**3.7 (1.68–8.17)**	**5.6 (3.46–9.15)**	**3.7 (2.16–6.49)**
15–17 years	**4.9 (2.43–9.78)**	**3.1 (1.42–6.83)**	**4.1 (2.36–7.01)**	**2.9 (1.70–5.03)**
≥18 years	**4.1 (2.18–7.72)**	**3.3 (1.64–6.47)**	**3.0 (1.76–5.01)**	**2.2 (1.32–3.85)**
Age at onset of any drug use[2] (vs no)				
≤14 years	**5.7 (3.55–9.03)**	**5.5 (2.65–11.49)**	**3.2 (2.27–4.43)**	**2.4 (1.60–3.64)**
15–17 years	**3.5 (2.49–5.03)**	**3.6 (2.28–5.65)**	**2.6 (1.78–3.66)**	**2.0 (1.40–2.84)**
≥18 years	**2.5 (1.66–3.78)**	**1.9 (1.21–3.11)**	**1.7 (1.02–2.68)**	1.2 (0.74–1.97)
Past-year emergency department or inpatient treatment (vs no)				
Yes	**1.5 (1.10–2.14)**	1.1 (0.81–1.57)	**1.5 (1.10–1.91)**	1.0 (0.78–1.38)
History of substance abuse treatment (vs no)				
Yes	**1.9 (1.14–3.28)**	1.4 (0.78–2.62)	**1.5 (1.02–2.32)**	1.3 (0.85–1.89)

[a] Due to a small sample size of STDs among Asians, Pacific Islanders, American Indians, Alaska Natives and those reporting multiple race, these categories are combined into one group.

[b] Age at first use of marijuana, inhalants, cocaine/crack, hallucinogens, heroin or first non-medical use of prescription pain relievers, sedatives, tranquilizers or stimulants.

[c] The adjusted model included all variables listed in the first column.

Bold: $P<0.05$.

Table 5

Adjusted odds ratios (AOR) and 95% confidence intervals (CI) of sexually transmitted diseases (STDs) by alcohol and drug use status among young adults aged 18–22 years in 2005–2006 (*n*=20,858)

Logistic regression	**Past-year STDs**[a]				**Lifetime STDs**[a]			
History of use	**College students**		**Non-students**		**College students**		**Non-students**	
	Prevalence %[b] **(SE)**	**AOR (95% CI)**	**Prevalence %**[b] **(SE)**	**AOR (95% CI)**	**Prevalence %**[b] **(SE)**	**AOR (95% CI)**	**Prevalence %**[b] **(SE)**	**AOR (95% CI)**
Alcohol and drugs	3.1 (0.32)	**11.6 (3.91–34.42)**	3.4 (0.30)	**5.8 (2.96–11.26)**	5.0 (0.45)	**12.5 (5.75–28.24)**	5.9 (0.37)	**5.5 (3.15–9.67)**
Alcohol alone	1.1 (0.24)	**3.7 (1.20–11.25)**	1.7 (0.37)	**2.9 (1.35–6.18)**	1.6 (0.27)	**3.6 (1.58–8.45)**	2.9 (0.43)	**2.4 (1.35–4.26)**
Drugs alone	0.9 (0.62)	2.9 (0.52–16.24)	1.1 (0.67)	1.8 (0.40–8.07)	2.2 (1.03)	**4.7 (1.43–15.50)**	1.5 (0.71)	1.3 (0.42–4.09)
Never use	0.3 (0.16)	1.0	0.6 (0.20)	1.0	0.5 (0.19)	1.0	1.2 (0.31)	1.0

SE, standard error.

[a]Each model adjusted age, gender, race/ethnicity, family income, past-year emergency department or inpatient treatment, and history of substance abuse treatment.

[b]χ^2 test of the STD status by the four categories of alcohol and drug use: df=3, $P<0.001$.

Bold: $P<0.05$.