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An Examination of Sociodemographic Correlates of Ecstasy Use Among High School Seniors in the United States

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Abstract

Background—Although ecstasy (MDMA) use is not as prevalent in the United States (US) as it was in the early 2000s, use remains popular among adolescents and young adults. Few recent studies have examined ecstasy use in national samples among those at particularly high risk for use—adolescents approaching adulthood. Research is needed to delineate sociodemographic correlates of use in this group.

Methods—Data were examined from a nationally representative sample of high school seniors in the US (modal age = 18) from the Monitoring the Future study (years 2007–2012; weighted $N = 26,504$). Data from all cohorts were aggregated and correlates of recent (last 12-month) use of ecstasy were examined.

Results—Roughly 4.4% of high school seniors reported use of ecstasy within the last year. Females and religious students were consistently at lower odds for use. Black and Hispanic students, and students residing with two parents, were at lower odds for ecstasy use, until controlling for other drug use. Odds of use were consistently increased for those residing in a city, students with weekly income of $>\$50$ from a job, and students earning $>\$10$ weekly from other sources. Lifetime use of alcohol, cigarettes, marijuana, and other illicit drugs each robustly increased odds of ecstasy use.

Conclusion—Subgroups of high school seniors, defined by specific sociodemographic factors, and those who have used other drugs, are currently at high risk for ecstasy initiation and use. Since ecstasy is regaining popularity in the US, prevention efforts should consider these factors.

Keywords

MDMA; ecstasy; club drugs; adolescents; socioeconomic status

INTRODUCTION

Ecstasy (MDMA, “Molly,” “E,” “X”) is an illicit drug that is commonly taken at nightclubs and dance parties. Although not limited to nightlife scenes (Horyniak et al., 2013), ecstasy is popular at dance parties, as it tends to enhance the party experience (e.g., perceptions of

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Declaration of Interest

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lights and music, nightlife socialization) (Lyttle & Montagne, 1992; Parks & Kennedy, 2004). While ecstasy use in the United States (US) is not as prevalent as in the late 1990s and early 2000s, use has remained popular in recent years (Johnston, O'Malley, Bachman, & Schulenberg, 2013a, 2013b; Substance Abuse and Mental Health Services Administration [SAMHSA], 2013a; Wu et al, 2010a). Since trends in ecstasy use have changed in recent years and there is a lack of investigation of correlates of current use, especially in adolescents, research is needed to examine who is currently at high risk for use.

The most recent European survey of ecstasy use showed stable or slow declining patterns in prevalence rates from 2005 to 2010, with 2 million young adults in Europe reporting past year use of ecstasy; regardless, ecstasy remains one of the three most commonly used illicit stimulants in Europe (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2012). The European School Survey Project on Alcohol and Other Drugs (ESPAD; Hibell & Guttormsson, 2013), which monitors trends of substance use in over 100,000 15–16-year-old students across 36 European countries, reported lifetime prevalence rates of 1–4% in 15–16-year olds across countries in 2011, with rates of 4% for the United Kingdom and The Netherlands, among others. Further, according to the Australian Secondary Students' Alcohol and Drug Survey (ASSADS), a national school-based survey on 7th to 12th graders' illicit and licit drug use, ecstasy use increases with age; lifetime and last year ecstasy use peaked in adolescents in 1999 and was lower in 2011, compared to other years (Miller, Bridle, Goggin, & Christou, 2012). In 2011, however, 15.4% of 17-year olds surveyed reported positive expectancies if they would take ecstasy; 5.2% of 17-year olds reported ever using ecstasy, 2.1% indicated past-year use, and 1% reported using ecstasy in the past month. However, it should be noted that reported use in the last year was highest (3.4%) for 15-year olds (Miller et al., 2012).

In 2012, the National Survey on Drug Use and Health (NSDUH), which provides national data on tobacco, alcohol, and drug use in the US, indicated that 2% of 12–17-year olds and 12.9% of 18–25-year olds reported lifetime use of ecstasy, and 1.2% and 4.1%, respectively, had reported past year use (SAMHSA, 2013a). Additionally, data from the NSDUH suggest that females are more likely to use ecstasy compared to males (Wu et al, 2010a). Further, according to Monitoring the Future (MTF), an annual representative survey of high school seniors in the US (modal age = 18), rates of recent ecstasy use among seniors have fluctuated rather dramatically since the late 1990s, with a spike in annual prevalence in 2001 to 9.2%, and a steep decrease through 2005 to 3%; use has increased again in recent years (e.g., to 5.3% in 2011) (Johnston et al., 2013a). Similar trends over the years were also reported in the NSDUH and the Youth Risk Behavior Surveillance System (YRBSS) (Centers for Disease Control and Prevention [CDC], 2012; SAMHSA, 2013). Lifetime use of ecstasy among high school seniors also increased to 8% in 2011 according to MTF. Although rates of *lifetime* ecstasy use are higher in young adults (ages 19–28), and the average age of initiation is age 20 (e.g., 20.3 years in 2013 as per the NSDUH) (SAMHSA, 2013a), *recent* ecstasy use (annual prevalence) among high school seniors and 18-year olds tends to be higher than among older young adults (e.g., age 23 and older), placing high school seniors and/or 18-year olds at high risk for initiation and current use (Johnston et al., 2013a, 2013b).

The popularity of ecstasy can be attributed to its unique subjective effects, including feelings of empathy, intimacy, personal closeness, friendliness, and sensuality (Bedi, Hyman, & de Wit, 2010; Palamar, Kiang, Storholm, & Halkitis, 2012; Parrott, 2013; Verheyden, Maidment, & Curran, 2003). The immediate physical effects of ecstasy include tachycardia, increased blood pressure, increased body temperature, thermal stress and overheating, jaw clenching and tooth grinding, and feelings of dehydration (Liechti, Gamma, & Vollenwei, 2001; Parrott, 2013; Topp, Hando, Dillon, Roche, & Solowij, 1999). Short-and long-term effects include depression and anxiety, and memory impairments and problems in higher executive functioning (Liechti et al., 2001; Parrott, 2013; Parrott et al., 2011). Ecstasy is also often taken in a polydrug context (Halkitis, Palamar, & Mukherjee, 2007; Sindicich & Burns, 2012), which may increase the chances of adverse effects associated with use. Alarming, emergency department mentions in the US involving ecstasy have also risen in recent years, from 3.5 per 100,000 in 2004 to 7.2 per 100,000 in 2011 (Drug Abuse Warning Network, 2011). Emergency department visits increased in particular among individuals younger than 21 years of age between 2005 and 2011 by 128% (SAMHSA, 2013b).

Recent increases in prevalence have coincided with a rise in use of the new nickname for ecstasy, “Molly,” which is commonly used in popular culture and by users particularly in the US (Duterte, Jacinto, Sales, & Murphy, 2009; Kahn, Ferraro, & Benveniste, 2012; National Institute on Drug Abuse [NIDA], 2013). “Molly,” which is powder MDMA, named after the word “molecular,” is often perceived to be a purer and safer version of MDMA (Duterte et al., 2009; Kahn et al., 2012). The recent rise in prevalence of ecstasy may also be associated with increasing popularity of electronic dance music (EDM) events in the US. In addition, ecstasy has become associated with hip hop music, and many hip hop, rap, and mainstream music lyrics also refer to Molly use (Boeri, Sterk, & Elifson, 2004; Diamond, Bermudex, & Schensul, 2006; Lee, Battle, Soller, & Brandes, 2011), suggesting a potential recent shift in sociodemographic characteristics of users.

Few research studies have examined correlates of ecstasy use among representative samples of adolescents approaching young adulthood. Most studies of club drug use have focused on targeted samples of nightclub attendees, drug users, and gay and bisexual individuals. Research is needed to examine more recent sociodemographic predictors of use in representative samples, as smaller studies now suggest recent shifts in use of ecstasy; for example, a recent epidemiological report suggests increases in prevalence of use among Blacks in some US cities (Community Epidemiology Work Group [CEWG], 2012). This area of research will allow for targeted prevention efforts and focused attempts at preventing initiation of ecstasy in high-risk groups of adolescents. This study examines self-reported recent ecstasy use and associated correlates among a representative sample of high school seniors.

METHODS

Sample and Study Procedures

MTF is an annual cross-sectional survey of high school seniors in approximately 130 public and private schools throughout 48 states in the US. Roughly 15,000 high school seniors are assessed annually (Johnston et al., 2013a). Schools are selected through a multistage random

sampling procedure—geographic areas are selected, then schools within areas are selected, and then students within schools are selected. MTF protocols were approved by the University of Michigan Institutional Review Board. Since MTF assesses a variety of constructs, content is divided into six questionnaire forms, which are distributed randomly. All forms assess sociodemographic variables, and use of various other drugs; however, ecstasy is only assessed in survey forms 3 and 4. The current paper examines aggregated (and weighted) data from 26,504 high school seniors from years 2007–2012 as this time frame captures most recent trends of use.

Measures

Students were asked their sex, age (<18, 18 years) and race/ethnicity (i.e., black, white, Hispanic). Religiosity was determined by two ordinal items assessing level of religious attendance and importance. These items were computed into a mean religiosity composite (range: 1–4) and divided into tertiles indicating low (1.0–2.0), moderate (2.5–3.0), and high (3.5–4.0) religiosity (Palamar, 2013). Population density of students' residences was defined by MTF as metropolitan statistical area (MSA) vs. non-MSA. MSAs are defined as counties or groups of contiguous counties that contain at least one city of 50,000 inhabitants (Johnston et al., 2013a). To assess family composition, students were asked to indicate with which parent(s) they resided. Answer options were dichotomized into 0–1 parent vs. two parents. Parents' level of educational attainment (i.e., grade school, some high school, high school graduate, some college, college graduate, or graduate school) was assessed and a mean score for both parents (or raw score if only one parent) was coded into three groups: low (1.0–3.0), medium (3.5–4.0), and high (4.5–6.0) education. Students' weekly income was assessed by asking how much money students earned during the average week from a job or other work (i.e., none, \$1–5, \$6–10, \$11–20, \$21–35, \$36–50, \$51–75, \$76–125, \$126–175, or \$176+). Students were also asked how much money they earned from other sources and were provided with the same answer options. Responses for each item were recoded into \$10 or less, \$11–50, or \$51 or more. Coding of most sociodemographic variables was guided by the work of Wallace and colleagues (2009).

With respect to drug use, students were asked whether they had used a variety of different drugs within their lifetime. Lifetime use of 11 drugs was consistently assessed across MTF forms. Use of two “licit” (age-restricted) drugs was assessed: alcohol (“more than just a few sips”) and cigarettes. Lifetime use of marijuana (including hashish) was assessed, as well as use of eight other illicit drugs: cocaine (powder or crack), LSD, hallucinogens other than LSD, heroin, and nonmedical use of narcotics (other than heroin), amphetamine, sedatives, and tranquilizers. Lifetime use of alcohol, cigarettes, and marijuana were examined as dichotomous (yes/no) variables and lifetime use of any of the eight other illicit drugs was dichotomized into a single “use of other illicit drug” category. To maximize power, this variable was computed for anyone who provided data for at least four of the eight other illicit drugs. Finally, recent use (use within the last 12 months) of ecstasy was assessed. All drug variables were analyzed as dichotomous (yes/no) variables indicating whether or not the student reported use.

Analysis

We first computed descriptive statistics and examined whether 12-month prevalence of ecstasy use significantly changed over time. A Rao–Scott chi-square test (Rao & Scott, 1984) was computed to determine whether there were significant differences in ecstasy use over the six-year period (2007–2012) while correcting for the complex study design. While examining trends of use over time was not a main focus of this study, we wanted to ensure that no significant changes in trends over time were present as we aggregated all cohorts into a single cross-section.

Recent use (past year) of ecstasy served as the outcome variable in separate binary logistic regression models. First, each covariate was modeled separately in a bivariable manner to examine unconditional associations with ecstasy use. Therefore, each covariate was associated with an unadjusted odds ratio (OR). Then, two multivariable models were computed; the first model included only sociodemographic variables and the second model also included lifetime drug use variables. This was done to examine whether findings change in light of other drug use. Covariates were entered into each model simultaneously in order to delineate the conditional associations of each while controlling for all other variables in the model. Multivariable models produce adjusted odds ratios (AORs) for each covariate. Potential cohort effects/secular trends were controlled by entering indicators for each year (with 2007 as the comparison) in all models (Wray-Lake et al., 2012). In addition, in order to maximize data in this aggregated sample, all models utilized the full datasets including missing data indicators for each variable that had missing data (Terry-McElrath, O'Malley, & Johnston, 2013). These indicators were included to maximize power (in part, due to the low prevalence rates of the outcome variable) and to help prevent response bias from affecting results (e.g., 13.4% of the sample was missing race and 23.8% was missing religiosity). Removing cases with any missing data would have led to the deletion of nearly half the sample. Multivariable models were repeated using both case-complete and full datasets (including missing data indicators) to ensure that results were consistent, giving us confidence in reporting results from the full dataset. Data were weighted according to MTF's survey scheme to adjust for clustering and differential probability of selection of schools and students. All analyses were design-based for survey data (Heeringa, West & Berglund 2010) and conducted using SAS 9.3 software (SAS Institute Inc, Cary, NC).

RESULTS

Sample Characteristics

The majority of students were 18 years of age or White (Table 1). Lifetime use of alcohol, cigarettes, and marijuana was common. With regard to recent ecstasy use, as shown in Table 2, there was slight fluctuation in prevalence of recent (past year) ecstasy use between 2007 and 2012, with an increase in 2011 (to 5.29%) and a slight decrease in 2012 (to 3.77%). The change in prevalence over time only approached significance and use did not increase or decrease in a clear manner; as a result, we did not further investigate predictors of trends over time. The overall annual prevalence of use for the combined sample was 4.41%.

Logistic Regression Models

Results from the logistic regression models are presented in Table 3. The table presents ORs of each covariate—first, in an unadjusted manner (ORs) and then in a multivariable manner (AORs), controlling for all other variables in the model. The first multivariable model only examines sociodemographic covariates, and the second model includes an additional block with lifetime drug use variables. Age was not significant in any model; however, females were consistently at lower odds for ecstasy use (compared to males), even though the protective association diminished while controlling for all other covariates including other drug use (AOR = 0.83, 95% CI = 0.71–0.96, $p = .014$). Compared to Whites, Black students were protected against use in the unadjusted model and, in Model 1, controlling for sociodemographic covariates; however, this association was lost when controlling for other drug use in Model 2. Hispanic students were at lower odds for ecstasy use in Model 1, but similar to Black students, significance disappeared when controlling for use of other drugs in Model 2. Religiosity was a strong protective factor against ecstasy use in all models, with higher levels of religiosity being more protective than moderate levels (compared to low religiosity). Although associations diminished when controlling for all other variables (including other drug use), both moderate (AOR = 0.73, 95% CI = 0.59–0.89, $p = .003$) and high (AOR = 0.53, 95% CI = 0.40–0.69, $p < .001$) religiosity decreased the odds of use.

With regard to population density, residing in an MSA consistently increased the odds of use (AOR = 1.68, 95% CI = 1.37–2.05, $p < .001$). Level of parent education was not related to ecstasy use in any model, but family structure was significantly associated with ecstasy use. Specifically, residing with two parents decreased the odds of use in both the unadjusted model and in Model 1. However, this significant association was lost after controlling for drug use in Model 2. Earning more than \$50 per week from a job consistently and robustly increased the odds of use (AOR = 1.36, 95% CI = 1.15–1.62, $p < .001$), even though this association diminished when controlling for other drug use in Model 2. Student weekly income from other sources was more of a risk factor for use. Even though associations diminished when controlling for use of other drugs in Model 2, earning \$11–50 per week from other sources increased the odds of use (AOR = 1.20, 95% CI = 1.01–1.43, $p = .039$) and earning more than \$50 per week from other sources robustly increased odds of use (AOR = 1.60, 95% CI = 1.28–2.00, $p < .001$).

Finally, with respect to lifetime use of other drugs, use of alcohol, cigarettes, marijuana, or other illicit drugs all robustly increased the odds for recent ecstasy use. Odds ratios are particularly large and have wide 95% confidence intervals (CIs), especially in the unadjusted models, because very large percentages of students who used ecstasy used these drugs. Specifically, of recent ecstasy users, only 15 (1.3%) never drank alcohol, 123 (10.6%) never smoked cigarettes, 35 (3.0%) never used marijuana, and 109 (9.3%) never used another illicit drug. When controlling for all other covariates, odds were reduced, but still robust. Lifetime use of another illicit drug in particular was associated with a robust increase in odds of recent ecstasy use (AOR = 13.92, 95% CI = 10.96–17.67, $p < .001$).

DISCUSSION

Although ecstasy use in the US is less prevalent than a decade ago, use has remained popular in recent years. Little research has focused on use in the US in recent years, so research was needed to examine who is currently at risk for initiation and use. An understanding of the specific factors associated with initiation and use can inform efforts to target specific high-risk groups in order to prevent or delay initiation, decrease continued use, and reduce risk-related harm.

Recent rates of past year ecstasy use in high school seniors based on the MTF survey (4.4%) are similar or slightly higher than other national surveys (e.g., 4.1% in the NSDUH and 2.1% in the Australian ASSADS). Results suggest that females were consistently protected against ecstasy use. Lower rates of ecstasy use by female high school seniors in the US are consistent with other published MTF rates and with results of the YRBBS (CDC, 2012; Johnston et al., 2012). However, although an older club drug study conducted in New York City (NYC) found that females were not less likely to use ecstasy than males (Kelly, Parsons, & Wells, 2006), recent large-scale studies have found no sex differences with regard to age or rates of ecstasy initiation (Sindicich & Burns, 2012; Wu, Liu, & Fan, 2010b). Similarly, an older investigation of adolescents and young adults (age 16–23) from the 2002 NSDUH (Wu, Schlenger, & Galvin, 2006) found no sex differences with regard to recent ecstasy use. Wu and colleagues (2010a), however, found that younger female adolescents (age 12–17) were more likely to initiate ecstasy than male adolescents from 1999 through 2008. While most national studies have focused on initiation, this study adds to the literature in that male high school seniors are currently at higher risk for *recent, past year* ecstasy use. Males also tend to ingest ecstasy in larger amounts than females (Ogeil, Rajaratnam, & Broadbear, 2013), suggesting that prevention needs to focus on gender within this age group.

Wu and colleagues (2006) also found that in 2002, young adults (age 18–19) in the US were more likely to use ecstasy in the last year than older young adults (age 22–23). While MTF data only allowed for comparison of seniors who were younger than 18 to those who were 18 or older, no significant age associations were found in the current study. While underage parties do exist throughout the US (allowing entrance to individuals <18 years of age), the legal age for entrance to many nightclubs is 18 or 21. Ecstasy use can occur anywhere (e.g., private residences; Horyniak et al., 2013), but it is possible that many students are not exposed to ecstasy until they enter nightlife, festival, or party cultures (often at a later age); entry into these scenes likely places youth at higher risk for use. While this study did not find significant age associations (i.e., <18 vs. 18 years of age) within this national sample of high school seniors, lifetime prevalence increases with age (Johnston et al., 2013b) so many adolescents in this sample are expected to initiate use after high school. Since some high school seniors are reporting ecstasy use and are at particularly high risk for *recent* use compared to older young adults (e.g., >23 years of age) (Johnston et al., 2013b), prevention needs to focus on preventing or delaying use among this at-risk age group.

With regard to race/ethnicity, results of our models that did not control for other drug use are consistent with previous research which has found that Whites report higher rates of ecstasy

use than racial minorities (Kelly et al., 2006; Wu et al., 2006). Yet, this study highlights the importance of examining and controlling for sociodemographic factors in light of use of other drugs. Results suggest that both Black and Hispanic students were protected against ecstasy use, but this association disappeared when controlling for lifetime use of other drugs. It should also be noted that trends in ecstasy use across racial groups have been shifting. Although White students have the highest prevalence of ecstasy use overall, rates of use among Hispanics is now close to that of Whites, and rates in Blacks have increased over recent years (Johnston et al., 2012). However, the YRBSS survey of US adolescents found that Hispanics had the highest rates of lifetime use in 2011 (10.6%), compared to White (7.7%) and Black (6.0%) students (CDC, 2012). In addition, ecstasy use among blacks has increased in some cities and states in the US (e.g., Chicago, Texas, NYC) in the last decade (CEWG, 2012; Office of National Drug Control Policy, 2004; Ompad, Galea, Fuller, Phelan, & Vlahov, 2004; Pantalone, Bimbi, Holder, Golub, & Parsons, 2010), and compared to White students, Black high school seniors are now at lower odds for reporting disapproval toward ecstasy use (Palamar, 2013).

Religiosity has been shown to be a protective factor against drugs such as marijuana and cocaine (Bartkowski & Xu, 2007; Degenhardt, Chiu, Sampson, Kessler, & Anthony, 2007; Palamar & Ompad, 2014), but little is known about how religiosity relates to ecstasy use. A recent investigation of young adults in NYC found that religiosity was protective against lifetime ecstasy use, but not recent ecstasy use (Palamar, Halkitis, & Kiang, 2013; Palamar, Kiang, & Halkitis, 2013). Results of the current study suggest that religiosity is consistently protective against recent ecstasy use, and the more religious a student, the lower the odds of engaging in use. Parental education, conversely, does not appear to influence lifetime ecstasy use. However, results suggest that residing with two parents was protective against ecstasy use, until controlling for other drug use. Another large-scale US study of adolescents found that residing with two parents is protective against ecstasy initiation, but that study adjusted for drug use only prior to age 12 (Wu et al., 2010b). Residing in an MSA is a consistent risk factor for ecstasy use. Similarly, Wu and colleagues (2006) found that residing in nonmetropolitan areas was associated with reduced risk for use of ecstasy. Ecstasy use is most prevalent in MSAs; and more specifically, smaller MSAs have recently “caught up” to large MSAs with respect to rates of ecstasy use (Johnston et al., 2012). It is possible that these associations are due to cities having more nightlife (and thus higher exposure to users) and potentially more liberal-minded attitudes, but further research is needed.

While many studies have examined how parent or household income is associated with drug use (e.g., Wu et al., 2006), this is among the first studies to examine how student income is related to ecstasy use. Results suggest that students who earn >\$50 per week from a job or >\$10 per week from other sources are consistently at risk for ecstasy use. While family income and employment status (e.g., part-time vs. full-time work) have not been found to predict ecstasy use (Wu et al., 2006), student income is in fact a robust correlate of use. Similar student income findings were found for lifetime use of powder and crack cocaine in another study (Palamar & Ompad, 2014). While many illicit drugs are relatively cheap and can easily be shared among peers (e.g., marijuana joints), “club drugs” such as ecstasy tend to be relatively more expensive. For example, depending on the city, ecstasy can cost up to US\$40 per pill (CEWG, 2012). Research indicates that price (which is often dependent on

purity) impacts use (Goudie, Sumnall, Field, Clayton, & Cole, 2007); despite the relative higher cost, this research further suggests that high school seniors with higher incomes are at increased risk for buying drugs that are available to them, especially when income is derived from sources other than a job.

Use of alcohol, cigarettes, marijuana, and other illicit drugs were all robust risk factors for ecstasy use. In addition, reporting use of another illicit drug (other than marijuana) increased the odds of use by 14 times. Early initiation of alcohol, cigarettes, and marijuana has been found to increase the risk of ecstasy initiation among adolescents (Wu et al., 2006, 2010b). A key finding of this study was that other drug use tended to drown out significant sociodemographic predictors of ecstasy use. Results suggest that while there are many important sociodemographic factors associated with ecstasy use, prevention of other drug use may be the most important factor in preventing ecstasy use, in part, because use of other drugs appears to override protective effects of certain characteristics. Given the positive expectations of experiences many adolescents associate with ecstasy, prevention efforts should focus on educating adolescents and young adults at highest risk with regard to the potential harmful effects of ecstasy, and just as importantly, education needs to continue to focus on preventing use of drugs that normally precede ecstasy use. Ecstasy use also tends to precede use of other club drugs so preventing ecstasy use (e.g., among those who attend nightclubs and parties) may also prevent initiation and use of drugs such as ketamine and GHB (Halkitis & Palamar, 2008).

Harm reduction messages (e.g., steps to prevent health-related risks such as dehydration) disseminated as part of the nightclub and dance event scenes are needed for those who reject abstinence. However, prevention messages geared toward users who are not affiliated with nightlife scenes (e.g., because they are too young to attend clubs and may use ecstasy at home or parties) may be particularly challenging. While many public health messages about ecstasy use have been traditionally calibrated toward club attendees, perhaps drug education geared toward the general population can more fully educate those at risk for ecstasy use along with education of other more “traditional” drugs. In addition, harm reduction education is greatly needed, regardless of where and under what circumstances the drug is taken. As ecstasy becomes increasingly popularized and often contains adulterants, those who reject abstinence need to be able to make informed decisions about use in order to minimize potential harmful effects.

Limitations

Missing data (e.g., 13.4% missing race) was a limitation of this sample, but missing data indicators were included in analyses in order to maintain power. Multivariable models were also computed using the smaller case-complete sample and results were nearly identical, giving us confidence in using the full dataset including missing data indicators. Rates of use also most accurately matched published MTF rates when not deleting nearly half of the sample, listwise. Prevalence of ecstasy use was not completely stable across cohorts, but the changes in trends over time were not significant (although they approached significance); as a result, we did not examine trends (or correlates of trends) any further. We did, however, control for potential cohort effects/secular trends in all unadjusted and adjusted models.

Although data were derived from a representative sample, students who dropped out of school were not included and this might limit the generalizability of findings. However, even though dropouts and students who are frequently absent from school tend to have higher rates of drug use, trends in use between MTF and NSDUH are generally comparable and MTF rates even tend to be higher (SAMHSA, 2013a). Therefore, it is unlikely that this had a major effect on results.

Other common MTF variables of interest (e.g., attitudinal variables) could not be examined, as they were not assessed consistently through the forms that assessed ecstasy use. Given that rates of ecstasy use among 8th and 10th graders are much lower, analyses focused only on high school seniors. Finally, the reader should be reminded that while pills or powder are sold as ecstasy (usually thought to be MDMA), “ecstasy” may actually contain little or no MDMA and can contain other harmful drugs or adulterants (Brunt, Koeter, Niesink, & van den Brink, 2012). Therefore, it is possible that while respondents indicated that they had used ecstasy, they may have not always known what substance they were actually using. Finally, rates of ecstasy use might actually be higher than reported as some students may not know that “Molly” is the same drug as MDMA/ecstasy (as MTF does not ask about Molly specifically).

CONCLUSIONS

This study helped determine which high school seniors are at highest risk for current, past year, ecstasy use. Many important sociodemographic risk factors were delineated, but the most consistent and important risk factor is use of other drugs. Special attention needs to be paid to adolescents in this age group because they are at high risk for initiation and associated adverse outcomes. Results of this study can help inform prevention and harm reduction strategies as ecstasy use remains popular.

Biographies

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GLOSSARY

Molly	A common nickname for ecstasy or a particular form of ecstasy in the United States. "Molly," thought to be short for the word "molecular," is sold in powder form and is often perceived to be a purer and safer version of ecstasy.
Sociodemographic	A combination of social and demographic factors. Includes factors such as age, race/ethnicity, level of educational attainment, and income, and often used to indicate socioeconomic status

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TABLE 1Sample characteristics of combined sample (weighted $N = 26,504$)

Variable	<i>N</i>	%
Sex		
Male	12,355	46.6
Female	13,232	49.9
Missing	917	3.5
Age, years		
< 18 Years	11,384	42.9
18 Years	15,061	56.8
Missing	60	0.2
Race		
White	16,181	61.1
Black	2,926	11.0
Hispanic	3,843	14.5
Missing	3,554	13.4
Population Density		
Non-MSA	5,609	21.2
MSA	20,895	78.8
Religiosity		
Low	8,235	31.1
Moderate	5,714	21.6
High	6,252	23.6
Missing	6,303	23.8
Parent Education		
Low	7,797	29.4
Moderate	7,553	28.5
High	10,162	38.3
Missing	993	3.7
Family Composition		
0–1 Parents	8,635	32.6
2 Parents	17,675	66.7
Missing	194	0.7
Income from Job		
\$10 or less	10,865	41.0
\$11—50	2,971	11.2
\$51 or more	11,238	42.4
Missing	1,431	5.4
Income from Other Source		
\$10 or less	13,650	51.5
\$11—50	8,453	31.9
\$51 or more	2,632	9.9

Variable	N	%
Missing	1,770	6.7
Lifetime Drug Use ⁺		
Alcohol	18,636	70.3
Cigarettes	11,267	42.5
Marijuana	11,509	43.4
Another Illicit Drug	6,243	23.6

Note. The “another illicit drug” category indicates whether the subject indicated lifetime use of one of the following eight drugs: cocaine (powder or crack), LSD, hallucinogens (other than LSD), amphetamine (nonmedical use), sedatives (nonmedical use), tranquilizers (nonmedical use), heroin, or narcotics other than heroin (nonmedical use). This was computed if the subject had data for at least four drugs. MSA = metropolitan statistical area.

⁺Valid percentages are presented for alcohol, cigarettes and marijuana. All percentages are weighted so they might not add up exactly to 100%.

TABLE 2

Prevalence of annual ecstasy use from 2007–2012

	2007	2008	2009	2010	2011	2012	Combined
Ecstasy Use	$N = 4,625$ %	$N = 4,345$ %	$N = 4,307$ %	$N = 4,536$ %	$N = 4,380$ %	$N = 4,312$ %	$N = 26,504$ %
Last 12-Month Use	4.42	4.26	4.12	4.60	5.29	3.77	4.41
						10.58(5)	

Note. Rao–Scott Chi-squares (χ^2) are design-based to correct for the complex survey design. The test approached significance ($p = .06$).

TABLE 3

Sociodemographic and drug use variables explaining last 12-month use of ecstasy

	Multivariable					
	Bivariable			Model 1		
	OR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Sex						
Male	Ref		Ref		Ref	
Female	0.69	(0.60–0.79) ***	0.74	(0.64–0.85) ***	0.83	(0.71–0.96) *
Age, years						
<18	Ref		Ref		Ref	
>18	0.96	(0.83–1.09)	0.92	(0.80–1.05)	0.88	(0.76–1.02)
Race						
White	Ref		Ref		Ref	
Black	0.36	(0.25–0.52) ***	0.38	(0.26–0.56) ***	1.09	(0.71–1.66)
Hispanic	0.90	(0.74–1.09)	0.79	(0.63–0.98) *	1.16	(0.92–1.46)
Religiosity						
Low	Ref		Ref		Ref	
Moderate	0.57	(0.47–0.69) ***	0.61	(0.50–0.74) ***	0.73	(0.59–0.89) **
High	0.22	(0.17–0.28) ***	0.26	(0.20–0.34) ***	0.53	(0.40–0.69) ***
Population Density						
Non-MSA	Ref		Ref		Ref	
MSA	1.67	(1.39–2.01) ***	1.62	(1.33–1.96) ***	1.68	(1.37–2.05) ***
Family Structure						
0–1 Parents	Ref		Ref		Ref	
Both Parents	0.65	(0.57–0.75) ***	0.63	(0.54–0.73) ***	0.86	(0.74–1.01)
Parent Education						
Low	Ref		Ref		Ref	
Moderate	1.04	(0.87–1.24)	1.07	(0.90–1.29)	1.05	(0.86–1.28)
High	0.96	(0.82–1.14)	1.02	(0.86–1.21)	1.11	(0.92–1.35)
Weekly Income from Job						

	Multivariable					
	Bivariable		Model 1		Model 2	
	OR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
\$10 or Less	Ref		Ref		Ref	
\$11–50	1.04	(0.81–1.34)	1.13	(0.87–1.47)	0.94	(0.71–1.23)
\$51 or More	1.88	(1.62–2.19)***	1.99	(1.70–2.32)***	1.36	(1.15–1.62)***
Weekly Income from Other Source						
\$10 or Less	Ref		Ref		Ref	
\$11–50	1.34	(1.14–1.56)***	1.54	(1.32–1.81)***	1.20	(1.01–1.43)*
\$51 or More	2.24	(1.85–2.72)***	2.49	(2.04–3.04)***	1.60	(1.28–2.00)***
Lifetime Alcohol Use						
No	Ref				Ref	
Yes	35.48	(21.33–56.01)***			3.75	(2.16–6.50)***
Lifetime Cigarette Use						
No	Ref				Ref	
Yes	12.65	(10.16–15.73)***			1.97	(1.55–2.51)***
Lifetime Marijuana Use						
No	Ref				Ref	
Yes	46.67	(30.32–71.84)***			6.82	(4.30–10.82)***
Lifetime Use of Another Illicit Drug						
No	Ref				Ref	
Yes	37.99	(30.54–47.27)***			13.92	(10.96–17.67)***
Nagelkerke R ²						
Correct Classification Rate			8%		39%	
			96%		96%	

Note. All models included cohort and missing data indicators. OR = (unadjusted) odds ratio; AOR = adjusted odds ratio; CI = confidence interval. ORs are considered unadjusted even though they were adjusted by cohort and missing data indicator (if applicable). MSA = metropolitan statistical area.

* $p < .05$.

** $p < .01$.

*** $p < .001$.