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Self-Reported Ecstasy/MDMA/"Molly" Use in a Sample of Nightclub and Dance Festival Attendees in New York City

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Abstract

Background—Ecstasy (MDMA) use has regained popularity in the United States, particularly in the form of "Molly," which is often marketed as pure MDMA. Surveys have generally not included "Molly" in the definition of ecstasy, so rates of use may be underestimated. As popularity of ecstasy increases, research is needed to examine use among those at highest risk for use—nightlife attendees.

Methods—We surveyed 679 young adults (age 18–25) entering nightclubs and festivals holding electronic dance music (EDM) parties in New York City in 2015. A variation of time-space sampling was utilized. We examined prevalence and correlates of self-reported lifetime ecstasy use.

Results—Self-reported lifetime ecstasy use was common (42.8%, 95% CI: 32.8, 52.7). Use was most common among older participants, frequent party attendees, and those reporting higher levels of exposure to users. Those surveyed outside of festivals were less likely to report use compared to those surveyed outside of nightclubs (AOR=0.37, $p = .015$). Over a third of ecstasy users (36.8%) reported use in pill, powder, and crystal form. Ecstasy users were also more likely to report use of other drugs, including novel psychoactive substances (e.g., 2C series drugs, synthetic cathinones ["bath salts"]). Half (50.4%) reported suspecting (21.9%) or finding out (28.5%) that their ecstasy had ever contained a drug other than MDMA.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Conclusion—A large percentage of nightlife attendees in NYC report lifetime ecstasy use. Findings should inform prevention and harm reduction programming. Further research is needed as ecstasy continues to change (e.g., in form, purity, and name).

Keywords

Ecstasy; MDMA; nightclub and festival attendees; young adults

The popularity of electronic dance music (EDM) has increased in recent years throughout the US and much of the world, and according to a recent EDM industry report, so too has the popularity of EDM parties at nightclubs and dance festivals (Watson, 2015). This increasing popularity may be of public health concern because rates of drug use are particularly high among nightclub and festival attendees in comparison to the general population (Palamar, Griffin-Tomas & Ompad, 2015; Lim, Hellard, Hocking, & Aitken, 2008). Results from Monitoring the Future (MTF), a nationally representative study of high school seniors (modal age: 18) in the US, found that compared to non-attendees, those who reported ever attending “raves” reported both higher rates and higher frequency of drug use (Palamar, Griffin-Tomas, et al., 2015). Nightlife attendees are at particular risk for use of “club drugs” (or “party drugs”) which typically includes ecstasy (3,4-methylenedioxymethamphetamine [MDMA], “Molly”), *gamma*-hydroxybutrate (GHB), ketamine, powder cocaine, and methamphetamine (Halkitis, Palamar, & Mukherjee, 2007; Kelly, Parsons, & Wells, 2006). However, ecstasy in particular has become an increasing concern as popularity and poisonings related to use appear to be increasing in the US and in the UK.

According to results from a nationally representative sample of young adults (age 18–25) in the US, self-reported prevalence of lifetime ecstasy use in 2013 was 12.8% (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014). According to MTF, 5.6% of high school seniors in the US reported lifetime use in 2014 (Miech et al., 2015). An MTF survey of young adults in the US (age 19–28) found that 11.4% reported lifetime use (Miech et al., 2015). However, results from non-nationally representative samples suggest that ecstasy use is higher in the nightclub-attending population. Targeted surveys of nightclub attendees in the US have reported high rates of self-reported ecstasy use (e.g., Kelly et al., 2006; Ross, Mattison, & Franklin, 2003). To our knowledge, no recent studies in the US have utilized probability-based sampling techniques to survey about self-reported ecstasy use among those at highest risk—nightclub and dance festival attendees. In addition, there are currently no published survey data that consider the new American street name for ecstasy—Molly.

Molly (short for “molecular”) is a name that now commonly refers to (what is thought to be) MDMA. Unlike traditional ecstasy pills, Molly tends to be purchased and used in powder or crystalline form. Although Molly is often marketed as being pure MDMA, just like traditional ecstasy pills (Baggott et al., 2000; Parrott, 2004; Tanner, 2006), it can often contain adulterants such as synthetic cathinones (also known as “bath salts”; Palamar, Salomone, Vincenti, & Cleland, 2016). Given that recent studies suggest somewhat high prevalence of adulteration in the US, the ecstasy situation in the US appears to be much

different in recent years compared to the UK, where purity has generally increased (Brunt et al., 2016). While decades of research have documented the potential health risks associated with ecstasy/MDMA use (Parrott, 2013), it is unknown whether adulterants such as "bath salts" are more dangerous than MDMA. Despite this lack of information, user reports of confirmed or suspected adulteration can inform future research regarding potential dangers associated with adulteration. This is particularly important since Molly usually comes in powder form and this may increase the likelihood of dealers adulterating the products they sell.

Despite the recent increase in popularity of Molly in the US, national surveys in the US generally do not include Molly in the definition of ecstasy so reported prevalence may be underestimated, especially considering that emergency department visits (SAMHSA, 2013), reported poisonings related to use (Bronstein et al., 2010; Mowry, Spyker, Cantilena, McMillan, & Ford, 2014), and deaths and poisonings at large EDM festivals related to use (Ridpath et al., 2014; Centers for Disease Control and Prevention [CDC], 2010) have increased—despite self-reported prevalence decreasing in nationally representative samples over the last 10–15 years (Miech et al., 2015; SAMHSA, 2014). We recently also found that lifetime prevalence of self-reported ecstasy use in 2014 increased to 8% among high school seniors when "Molly" was included in the definition of ecstasy (compared to 5.5% among those surveyed without "Molly" in the definition) (Palamar, Keyes, & Cleland, 2016).

Because little is known about ecstasy (or Molly) use among the youngest cohort of nightclub and dance festival attendees in the US, we surveyed a sample of young adult nightlife attendees in New York City (NYC) to describe self-reported prevalence of ecstasy use—with Molly included in the definition—and factors associated with use. We also describe users' perceptions of purity of the ecstasy they have taken, as adulteration appears to be increasingly problematic in the EDM scene. Since this population is known to be a high-risk group, results can inform prevention and harm reduction programming.

Method

Participants and procedure

We surveyed 679 nightclub and festival attendees in NYC from July through early September of 2015 using a variation of time-space sampling. Each week we created a time-venue sample space for random selection that included a list of EDM venues and/or specific parties planned for that week (generally Thursday through Saturday). We included specific venues that hold EDM parties on consistent nights each week in the sample space and we also added multiple parties that were: (1) recommended by key informants, and/or (2) listed on a popular EDM ticket website as having at least 15 advanced tickets purchased a week in advance for that party. This included "secret location" warehouse parties.

Unlike time-space sampling described in much of the previous literature, the state of the current EDM scene did not allow us to first randomly select venues and then randomly select times. Many venues do consistently have EDM parties (on the same day[s] each week), but promoters and DJs today also throw parties at various venues throughout the city, and sometimes in "secret" warehouse locations. There are also numerous one-time (or annual)

EDM parties at various venues, as well as daytime (e.g., rooftop) parties, boat cruise parties, and large dance festivals. Therefore, we randomly selected parties from a sample which combined party and day (e.g., “Party 1, Thursday”, “Party 2, Thursday”…“Party 20, Saturday”). However, during the first nights of pilot testing, we discovered some parties have a large proportion of attendees who were not eligible (i.e., age 26 or older). Since some parties (i.e., two pairs of parties/nightclubs) were in close proximity to one another (sometimes as close as a single block away), for random selection, we linked these pairs in our randomization, which allowed recruiters to walk to the other nearby jointly-selected parties in case (1) most attendees were not eligible, or (2) very few individuals attended. This allowed us to utilize our resources efficiently while maintaining some elements of random selection. In addition, we aimed to approach all individuals who appeared eligible, unlike some other traditional studies where every *n*th passerby is approached. Previous studies have found that eliminating this additional level of random selection does not lead to significantly different participant characteristics and it also allows for full utilization of resources (Parsons et al., 2008). Random selection was conducted using version 3.1 of the R statistical computing environment (R Core Team, 2015).

Participants were eligible if they identified as (1) ages 18–25, and (2) were about to attend the randomly selected party. Trained recruiters approached passersby (who were alone or in groups) who looked ages 16–27 and asked if they were going to the randomly selected party. The extended age range was to ensure that no one ages 18–25 were skipped. Those who replied affirmatively were asked their age and if they would like to take a survey asking about drug use. After providing informed consent, participants completed the survey on tablets. Those who completed the survey were compensated $10 cash. Recruiters surveyed participants on 21 different nights, and on average, the response rate of those approached who were believed to be eligible was 63%. This study was approved by the New York University Langone Medical Center Institutional Review Board.

Measures

Sociodemographic characteristics and nightlife attendance—Participants were asked their age, sex, race/ethnicity, and level of educational attainment. To assess socioeconomic status, we asked about parent educational attainment and self-reported weekly income. Specifically, participants were asked about educational attainment of each parent and we computed a mean score for both parents (or a raw score if only one parent), categorizing scores into tertiles representing low, medium, and high educational attainment. Participants were asked how much money they earn (after taxes) per week from a job or other sources (on average), and we coded responses into tertiles representing <$200, $201–$499 and ≥$500 per week. Parent education and income items were taken from the MTF national survey (Miech et al., 2015) and recoding was guided by previous studies (Palamar, 2014; Palamar & Kamboukos, 2014). We utilized these sociodemographic covariates as these have been found to be significant correlates of ecstasy use in previous national studies (e.g., Martins & Alexandre, 2009; Palamar & Kamboukos, 2014; Wu et al., 2010). We also examined possible associations with regard to sexual orientation as most other studies in NYC focusing on ecstasy use consisted solely of gay, bisexual, and lesbian samples (Grov, Kelly, & Parsons, 2009; Halkitis et al., 2007; Kelly et al., 2006).

We altered the rave attendance survey item from MTF (Miech et al., 2015; Palamar, Griffin-Tomas, et al., 2015) to ask, “How often do you go to rave/nightclub/festival/dance parties?” with answer options never, a few times a year, once or twice a month, at least once a week, and almost every day. We recoded answers into three categories: (1) attend never or once or twice a year, (2) attend once or twice a month, and (3) attend at least once a week. We also created a variable indicating whether the participant was surveyed outside of a nightclub or a dance festival. In addition, we assessed participants’ level of perceived exposure to ecstasy users (Palamar, Kiang, & Halkitis, 2011) via seven items asking about whether the participant has (or has had) friends, coworkers, classmates, family members, housemates, neighbors, or other individuals who use ecstasy. We computed a composite score (α = .84) and computed a median-split for analysis.

Drug use—Participants were asked: “Have you ever (knowingly) used ecstasy/MDMA/Molly?” Those who answered affirmatively were then asked to check off which type(s) of ecstasy they had used and answer options included MDMA pills, MDMA powder/Molly, and MDMA crystals. They were also asked to check off the route(s) of administration by which they had used ecstasy, and answer options included oral (“swallowed”), nasal (“sniffed”), and other routes. Ecstasy users were also asked if they had (1) ever found out their ecstasy/Molly contained a drug other than MDMA, and if they (2) ever suspected their ecstasy/Molly contained a drug other than MDMA. Answer options for both questions were “no”, “yes”, and “not sure” and we created a variable indicating whether they (1) never suspected or found out that their ecstasy was adulterated, (2) suspected, but did not find out whether their ecstasy was adulterated, and (3) found out that their ecstasy had been adulterated.

Participants were also asked whether they had ever used 20 other specific drugs or drug classes (including unknown pills, powders and liquids). This list included some drugs that are normally prescribed (i.e., opioids, benzodiazepines, amphetamine), and for these they were asked only about nonmedical use, which was defined as use without a prescription or use in a manner in which it was not prescribed. Participants were also provided with lists of drugs (along with “street” names) belonging to specific novel psychoactive substance (NPS) classes and asked whether they had ever knowingly used. Specifically, subjects were asked whether they had ever used any of six NBOMe series (e.g., 25i-NBOMe [“Cimbi-5”]) and eighteen 2C series (e.g., 2C-B [“Nexus”], 2C-I, 2C-T-7 [“Blue Mystic”]) psychedelic phenethylamine drugs. We coded that the subject answered affirmatively (i.e., NBOMe or 2C use) if he or she answered that any drug in these classes was used. Similarly, participants were asked whether they had ever knowingly used any of 35 listed “bath salts” (synthetic cathinones; e.g., alpha-PVP [“Flakka”], methylone [“M1”, “bk-MDMA”], mephedrone [“MCAT”, “Meow Meow”]) and they were also asked whether they had ever used any of 18 dissociative NPS (e.g., methoxetamine [MXE], 2-MeO-PCP). If they checked off that they had used any of these NPS, we categorized them into “bath salt” and/or dissociative NPS users accordingly. This survey served as a pilot study to test methods of assessing dozens of NPS to inform a future survey; thus, a large portion of this survey focused on self-reported NPS.

Analyses

Since more frequent nightlife attendees and attendees at parties with a higher proportion of suspected eligible individuals approached had a higher probability of being surveyed, we calculated each subject's selection probability (Mackellar et al., 2007) and weighted prevalence estimates by the inverse of that probability (Jenness et al., 2011). We first examined descriptive statistics for sociodemographic characteristics. We also examined descriptive statistics for self-reported type (i.e., pill, powder, and/or crystal) of ecstasy taken, route of administration, and whether ecstasy was believed or suspected to contain other drugs (adulterants). We then examined prevalence of self-reported lifetime ecstasy use, and estimated associations between lifetime use and sociodemographics. We computed both unadjusted and adjusted estimates of associations between each covariate and self-reported lifetime use. Specifically, using logistic regression, we computed unadjusted odds ratios (ORs) for each covariate and then we included all covariates in a single multivariable logistic regression model, which produced adjusted ORs (AORs), controlling for all other variables in the model. We then examined whether lifetime ecstasy use was related to self-reported lifetime use of 25 different drugs using chi-square. Since multidrug use was common, we utilized a more conservative alpha (.05/25 [for 25 drugs] = .002) to avoid inflation of Type I Error.

Since a variation of time-space sampling was utilized, analyses of ecstasy use prevalence and correlates took into account clustering of participants by party and differential probability of selection, with Taylor series estimation methods for accurate standard errors (Heeringa et al., 2010). The complex sampling design specified party as the primary sampling unit and probability weights for individual participants. Probability weights incorporated frequency of attendance at nightclubs and EDM festivals as well as the proportion of potentially eligible participants approached outside the party the participant attended.

Weights were utilized for all analyses other than attendance. Because frequency of attendance was incorporated in probability weights, we estimated the association between frequency of attendance and lifetime use with the unweighted data. We then estimated the median odds ratio (Merlo et al., 2006) to quantify the degree of clustering in self-reported lifetime ecstasy use by party. All statistics were computed using Stata SE 13 (StataCorp, 2013).

Results

Lifetime ecstasy use was reported by 42.8% (95% CI: 32.8, 52.7) of the sample. Table 1 presents demographic characteristics of the full sample, and comparisons between lifetime ecstasy users and non-users. In bivariable models, older participants, those with more education, and those reporting higher exposure to ecstasy users had increased odds for reporting lifetime ecstasy use. Hispanic participants and those recruited at EDM festivals had decreased odds of reporting lifetime ecstasy use. In the multivariable model, older participants and those reporting higher levels of exposure to ecstasy users had increased odds of lifetime ecstasy use while participants recruited at EDM festivals had decreased odds of reporting use.

Lifetime ecstasy use was most commonly used in pill, powder, and crystal form (36.8%). Using powder only (18.9%) was next most common, followed by pills only (18.2%), then both pills and powder (but not crystals, 13.6%), and crystals (alone or in combination with pills or powder, but not both; 12.5%) was least common. With regard to route of administration, the majority of users (55.7%) reported they had only ingested (swallowed) ecstasy. About a third reported they had both ingested and sniffed ecstasy (34.4%), 1.4% only sniffed, 5.1% used an "other" route of administration, and 3.4% reported a combination of sniffing, swallowing, and an "other" route of administration.

Use of other drugs was common in this sample (Table 2). Even with the conservative correction for multiple testing, compared to non-users, ecstasy users were significantly more likely to report lifetime use of marijuana, powder cocaine, LSD, amphetamine (nonmedical use), 2C series psychedelic phenethylamines, "bath salts" (synthetic cathinones), dissociative NPS, and unknown liquids (all ps < .0025).

Regarding perceived purity of ecstasy, half (49.6%) of ecstasy users reported that they have never suspected or found out that their ecstasy was adulterated; 28.5% reported that they had found out that their ecstasy contained a drug other than MDMA, and 21.9% of ecstasy users reported that they suspected that their ecstasy contained a drug other than MDMA.

Finally, we examined the association between frequency of nightclub and EDM festival attendance and self-reported lifetime ecstasy use with the unweighted data. Almost half (46.6%) of those attending once or twice a month and 30.6% of those attending weekly or more often reported ecstasy use, while only 22.8% of those who never attended or attended once or twice a year reported use. Participants attending once or twice per month (OR = 1.98, 95% CI: 1.38, 2.86, $p < .001$) and weekly or more often (OR = 2.04, 95% CI: 1.36, 3.06, p=.001) were at twice the odds of reporting lifetime ecstasy use than participants attending less than once per month. While differences in prevalence across parties were statistically significant ($\chi^2(1) = 11.13$, $p < .001$), the degree of clustering by party was modest (median OR=1.45), indicating most of the variation in use was between participants and not between parties.

Discussion

As the popularity of EDM dance parties at nightclubs and festivals continues to increase, research is needed to investigate use and correlates of use of one of the most popular party drugs—ecstasy. In the US, ecstasy has changed in recent years, as it is now commonly used in powder or crystalline form and commonly referred to as "Molly." This was among the first epidemiology surveys to specifically ask about Molly use.

Self-reported lifetime prevalence of ecstasy use in our sample of young nightclub or festival attending adults was 42.8%. An older study that surveyed nightclub attendees (age 18–29) in NYC using time-space sampling found a similar (unweighted) prevalence of self-reported lifetime ecstasy use (45.2%; Kelly et al., 2006). However, a recent study using non-probability venue-based sampling of nightclub attendees in London found that 78.7% of respondents reported lifetime ecstasy use, but respondents on average were older (mean age

= 31.6, range: 18–60) and recruitment focused on gay venues (Chan, Wood, & Dargan, 2015). Older studies conducted in NYC found high prevalence of self-reported ecstasy use in the last four months (53.5–74.7%), but being a club drug user was an inclusion criterion (Grov et al., 2009; Halkitis et al., 2007). It should also be noted that even though some of these studies did utilize time-space sampling methodology, sample weights were not constructed based on level of attendance, thus leading to potential overestimates of prevalence as more frequent attendees were more likely to be selected (Jenness et al., 2011).

As mentioned above, most previous studies assessing self-reported ecstasy use among nightclub attendees included respondents older than our age range (18–25) and some studies surveyed respondents as old as 60. Lifetime drug use tends to increase with age (Miech et al., 2015) so higher prevalence is expected in such studies. The mean age in our sample was 21.9 and our results suggest that older participants were at increased odds for reporting use. Many previous studies have focused on gay venues or participants who identified as gay or bisexual, or stratification was utilized to include a modest number of lesbian, gay, or bisexual (LGB) participants. Less than a fifth (17%) of our sample self-reported sexual minority status and no associations regarding sexual orientation were significant. It should be noted that we did not design the sampling plan to specifically include “gay” parties or venues, so individuals who attend these parties might be underrepresented. Other studies have found LGB individuals to be at increased risk for ecstasy use (Boyd, McCabe, & d’Arcy, 2003; Fendrich, Wislar, Johnson, & Hubbell, 2003; Parsons, Halkitis, David, & Bimbi, 2006).

This study was not limited to nightclub attendees as we also surveyed individuals entering dance festivals, so generalizability extends beyond the EDM nightclub scene. We found that those recruited outside festivals had less than half the odds of reporting ecstasy use as compared to those recruited outside of nightclubs. Therefore, we estimate that compared to nightclub attendees, fewer festival attendees are experienced with ecstasy use (although we must keep in mind overlap between nightclub and festival scenes). Even though we found that those surveyed outside of festivals were at lower risk for ecstasy use, research is needed to determine whether festival attendees are at higher risk for adverse outcomes as, for example, attendees of large dance festivals in the US are often exposed to extreme environmental conditions which include large crowds (e.g., tens of thousands of patrons per day) and hot temperatures (e.g., ≥90°F) (Ridpath et al., 2014).

Many investigations have found that females are at lower risk for ecstasy use than males (Fendrich et al., 2003; Palamar, Kiang, & Halkitis, 2012; Parsons et al., 2006; Van Havere, Vanderplasschen, Lammertyn, Broekaert, & Bellis, 2011); however, while fewer females in our sample reported ecstasy use, this difference was not significant. Many other studies have also found that white individuals are more likely to report ecstasy use than racial minorities (Fendrich et al., 2003; Kelly et al., 2006; Ompad, Galea, Fuller, Phelan, & Vlahov, 2004; Palamar & Kamboukos, 2014; Parsons et al., 2006; Van Havere et al., 2011), and whites have been found to report higher exposure to ecstasy users than racial minorities (Palamar et al., 2011). We found that Hispanics were had lower odds of reporting ecstasy use (compared to whites), but this association was not significant after controlling for all other covariates.

Compared to non-users, ecstasy users in our sample were more likely to report lifetime use of a variety of illicit drugs. Even after utilizing a conservative statistical correction, compared to non-users, ecstasy users were more likely to report use of marijuana, powder cocaine, LSD, amphetamine, 2C drugs, “bath salts”, dissociative NPS, and unknown liquids. Many other studies also suggest that polydrug use is common among ecstasy users (Boyd et al., 2003; Degenhardt, Barker, Topp, 2004;Grov et al., 2009; Halkitis et al., 2007; Kelly et al., 2014; Moore, Dargan, Wood, & Measham, 2013), and Grov and colleagues (2009) found that ecstasy was combined with other drugs more than any other club drug.

We also found that ecstasy users were more likely to report use of NPS (e.g., 2C drugs, “bath salts”) or unknown drugs (e.g., unknown powders or liquids). A recent nationally representative study in the United States found that NPS users report high prevalence (79.4%) of lifetime ecstasy use, with 87.7% of users of psychedelic phenethylamines (e.g., 2C or NBOMe series) reporting lifetime ecstasy use (Palamar, Martins, Su, & Ompad, 2015). A recent Australian study of ecstasy users found that 44% of their sample reported NPS use, with 2C-I and 2C-B being the most prevalent NPS (Burns et al., 2014). There is also evidence that some individuals use “bath salts” such as mephedrone to supplement ecstasy use (Moore et al., 2013), and reported poisonings in NYC (calls to Poison Control reporting an adverse effect possibly related to use) involving NPS such as 25i-NBOMe, benzylpiperazine (BZP), dimethyltryptamine (DMT), and “bath salts” were linked to concomitant ecstasy use (Palamar, Su, & Hoffman, 2015). Since ecstasy users are at high risk for NPS use, prevention and harm reduction programming should target ecstasy users in order to prevent future NPS-related poisonings.

While intentional use of other drugs among ecstasy users is common, ecstasy can contain a variety of adulterants (Baggott et al., 2000; Parrott, 2004; Tanner, 2006), and half of ecstasy users in our sample reported that they had found out their ecstasy contained a drug other than MDMA or reported suspecting that their ecstasy has contained another drug. It is unknown, however, whether any of these participants tested their ecstasy with a reagent kit to determine content of their drug. A recent study of EDM festival attendees found that among those who had reported using ecstasy within the last week, a number of their urine samples tested positive for “bath salts” such as alpha-PVP (“Flakka”) (12.5%), butylone (5.8%), ethylone (8.7%), dimethylone (9.6%), or methylone (22.1%) (Mohr et al., 2015). A more recent study of nightclub and dance festival attending young adults reporting lifetime ecstasy/MDMA/Molly use (and no use of “bath salts”), found that four out of ten who provided a hair sample for analysis tested positive for “bath salts” or other NPS (Palamar, Salomone, et al., 2016). Therefore, a number of ecstasy users in the US may in fact be unintentionally or unknowingly using potentially more dangerous NPS with—or in replacement of—ecstasy.

Results also suggest that higher frequency of nightclub/festival attendance was associated with increased odds of reporting lifetime ecstasy use. Attending once a month or more was associated with double the odds for reporting use as compared to those attending less than once per month. A similar association was found in an analysis of national data exploring the links between “rave” attendance and drug use. Specifically, among high school seniors in the MTF study, any attendance was related to increased risk of using 18 different drugs, and

more frequent attendance was associated with even higher prevalence of use of each drug (Palamar, Griffin-Tomas, et al., 2015). Other studies have found an association between higher frequency of EDM event attendance and ecstasy use (Abrahamsson & Hakansson, 2013), and a recent study found that regular EDM attendance was associated with three times the odds for high levels of use, and that knowing more than ten ecstasy users was associated with more than double the odds for high levels of use (Smirnov, Najman, Hayatbakhsh, Plotnikova, et al., 2013). Increased risk may be due, in part, to stronger affiliation with drug scenes as previous research has found that ecstasy use is associated with peers and close friends who also use, and offers to try the drug (Ter Bogt & Engels, 2005; Martins, Storr, Alexandre, & Chilcoat, 2008a, 2008b; Smirnov, Najman, Legosz, Wells, & Kemp, 2013; Smirnov, Najman, Hayatbakhsh, Wells, et al., 2013; Vervaeke, Benschop, van den Brink, & Korf, 2008; Vervaeke, van Deursen, & Korf, 2008). Our findings add to these previous studies as we confirmed that high levels of reported exposure to ecstasy users are positively and robustly associated with reporting ecstasy use in these nightclub and festival scenes, even when controlling for all other covariates.

This study is not without limitations. Data were derived from a pilot study that tested an electronic survey method to assess prevalence of use of ~200 NPS so since most focus was on the testing of NPS questions, there was only space to include a few questions about ecstasy use. We could only focus on lifetime use and we were not able to systematically assess recent use or frequency of use, and we were also not able to assess adverse outcomes associated with use. Participants had to be age 18–25 to participate and therefore older individuals were excluded and this possibly led to lower lifetime prevalence in the sample. As participants were all young adults and surveyed entering nightclubs or festivals, results may not be generalizable to those outside of these party scenes. The study was cross-sectional so temporality of associations could not be determined. We also did not set out to select parties specifically catered to gay patrons. Participants only reported on what they believed to be ecstasy/MDMA/Molly and we do not know whether or how they tested their ecstasy if they reported suspecting or finding out their ecstasy was adulterated. Finally, we did not utilize a true random sample, which is generally not feasible to recruit nightlife attendees. We instead utilized a version of time-space sampling, in which we surveyed outside of randomly selected venues/parties. This was a probability-based approach and we thus weighted according to frequency of attendance (Jenness et al., 2011; Mackellar et al., 2007). While multiple sources were utilized to inform randomization (e.g., party listings on EDM ticket websites, key informants in the scene), it is possible that some parties were unintentionally omitted from the sample space for random selection and it is unknown whether our findings derived from random selection adequately represent the NYC EDM scene as a whole.

In conclusion, at least four out of ten young adults who attend nightclubs or festivals in NYC are estimated to have used ecstasy. In the US, ecstasy is now commonly used in pill, powder, and in crystal form, the drug is now commonly sniffed, and we found that half of the users we surveyed suspect or report having confirmed that their ecstasy has been adulterated with other drugs. As ecstasy continues to change in the US (e.g., in form, purity, and name), researchers, educators and policymakers need to remain informed about current trends in use, and also about new street names (e.g., Molly) and about the potential purity of the drug.

Since ecstasy is now commonly sold and used in powder or crystalline form in the US, research is needed to determine whether this affects drug-taking behavior and associated risk (e.g., unmeasured dosing in crowded nightclubs or festivals). Powder ecstasy may also be easily adulterated by dealers or peers, potentially leaving users at higher risk for unknowingly using other drugs such as “bath salts.” Decades of research have documented the potential health risks associated with ecstasy/MDMA use (Parrott, 2013); however, research is needed to determine whether adulterants (e.g., “bath salts”) or combinations of adulterants and MDMA are more dangerous than MDMA alone. More specifically, research is needed to determine how various NPS compare to MDMA with regard to adverse effects (and severity of effects). This will help determine whether poisonings related to “ecstasy” use result more from (or are more severe from) various NPS (e.g., adulterants) or MDMA. Further research is also needed to examine characteristics of NPS users (who use intentionally) and according to whether or not they use ecstasy. While we have begun to investigate characteristics of NPS-using nightclub attendees (Palamar, Acosta, Sherman, Ompad, & Cleland, 2016), further investigation is needed to determine distinguishing factors among users.

Continued surveillance is needed in the United States and elsewhere to monitor trends in ecstasy use among nightclub and festival attendees as they are at high risk for use, and monitoring is also needed to track purity of ecstasy as well as its association with potential adverse outcomes related to use. To our knowledge, there is very little recent data on the purity of ecstasy consumed in the US and these data are needed to inform policy, and to support users and potential users in making safer choices and reducing their exposure to harm.

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Table 1

Sample characteristics and binary logistic models delineating correlates of lifetime ecstasy use.

	Raw percentages (Weighted)			Unadjusted estimates		Adjusted estimates	
	Full sample (%)	**No ecstasy use (%)**	**Ecstasy use (%)**	**OR**	**95% CI**	**AOR**	**95% CI**
Age, years, *M*(SE)	21.9 (0.2)	21.4 (0.2)	22.6 (0.3)	1.28**	(1.10, 1.50)	1.43*	(1.09, 1.88)
Sex							
Male	54.6	52.8	56.9	1.00		1.00	
Female	45.4	47.2	43.1	0.85	(0.54, 1.19)	0.70	(0.39, 1.27)
Race/ethnicity							
White	57.2	49.6	67.3	1.00		1.00	
Black	5.8	7.0	4.3	0.45	(0.10, 1.93)	0.40	(0.07, 2.24)
Hispanic	20.5	26.8	12.2	0.34**	(0.16, 0.70)	0.44	(0.17, 1.15)
Asian	9.7	10.4	8.9	0.63	(0.18, 2.22)	0.68	(0.25, 1.85)
Other	6.8	6.3	7.4	0.86	(0.35, 2.12)	0.89	(0.23, 3.47)
Educational attainment							
High School/GED or less	23.4	27.6	17.7	1.00		1.00	
Some College	32.0	33.2	30.5	1.42	(0.81, 2.50)	0.63	(0.30, 1.32)
Bachelor's Degree	37.5	35.1	40.7	1.80*	(1.06, 3.06)	0.52	(0.20, 1.35)
Graduate School	7.1	4.1	11.1	4.26*	(1.11, 16.31)	2.65	(0.46, 15.42)
Parent educational attainment							
Low	31.8	35.0	27.4	1.00		1.00	
Moderate	43.2	44.9	41.0	1.17	(0.37, 3.70)	1.18	(0.31, 4.61)
High	25.0	20.0	31.7	2.02	(0.70, 5.85)	2.96	(0.87, 10.08)
Weekly income							
≤$200	30.0	33.5	25.4	1.00		1.00	
$201–$499	37.8	34.2	42.6	1.63	(0.84, 3.20)	1.64	(0.91, 2.96)
≥$500	32.2	32.3	32.0	1.30	(0.66, 2.57)	0.44	(0.18, 1.09)
Sexual orientation							
Heterosexual	83.1	85.0	80.4	1.00		1.00	
Gay/Lesbian	5.1	4.5	6.0	1.42	(0.42, 4.77)	2.17	(0.53, 8.89)
Bisexual	11.8	10.5	13.6	1.37	(0.49, 3.86)	1.69	(0.35, 8.12)

	Raw percentages (Weighted)			Unadjusted estimates		Adjusted estimates	
	Full sample (%)	**No ecstasy use (%)**	**Ecstasy use (%)**	**OR**	**95% CI**	**AOR**	**95% CI**
Recruitment venue							
Nightclub	52.1	43.5	63.5	1.00		1.00	
Festival	47.9	56.5	36.5	0.44*	(0.24, 0.81)	0.37*	(0.17, 0.80)
Perceived exposure to ecstasy users							
Low Exposure	52.6	67.1	34.4	1.00		1.00	
High Exposure	47.4	32.9	65.6	3.90**	(1.94, 7.83)	4.76**	(1.84, 12.34)

Note. Percentages are weighted so they do not always add up exactly to 100%. M = mean, SE = standard error, OR = (unadjusted) odds ratio, AOR = adjusted OR, controlling for all variables in the logistic regression model, CI = confidence interval. The weighted lifetime prevalence of ecstasy use (the dependent variable) was 42.8% (weighted $n = 356$).

* $p < .05$

** $p < .01$.

Table 2

Lifetime prevalence of self-reported use of other drugs by lifetime ecstasy use.

	Full sample (%)	Non-ecstasy users (%)	Ecstasy users (%)
Alcohol	76.2	70.0	84.6
Marijuana	72.2	61.5	86.6*
Powder Cocaine	26.0	11.7	45.0*
LSD	19.7	9.5	33.2*
Ketamine	17.6	14.0	22.4
Psilocybin	17.4	9.8	27.6
Synthetic Cannabinoids	16.0	10.8	22.9
Amphetamine (nonmedical use)	14.0	9.2	20.4*
2C Series	10.4	5.2	17.3*
GHB	9.1	9.8	8.2
NBOMe Series	9.0	7.7	10.8
Methamphetamine	8.0	7.2	9.0
Bath Salts	6.5	1.3	13.5*
Heroin	6.1	5.8	6.6
Unknown Pills	5.4	2.7	8.9
Benzodiazepines (nonmedical use)	5.2	1.9	9.4
Opioid Painkillers (nonmedical use)	4.6	2.0	8.1
Dissociative NPS	4.4	0.1	10.1*
Unknown Powders	2.5	0.9	4.5
Unknown Liquids	1.9	0.1	4.3*

Note. NPS = novel psychoactive substances. Since multidrug use was common, we utilized a Bonferroni correction to minimize Type I Error (.05/20)=

*$p < .0025$.