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Prevalence of reagent test-kit use and perceptions of purity among ecstasy users in an electronic dance music scene in New York City

Running title: Ecstasy testing in New York City

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Abstract

Introduction and Aims:

Ecstasy users in the electronic dance music (EDM) scene are at high risk for using ecstasy adulterated with new psychoactive substances and/or methamphetamine. We examined self-reported testing of ecstasy among users in this scene.

Design and Methods:

We surveyed individuals (aged 18–40) entering EDM parties in New York City in 2017. Past-year ecstasy users (n=351) were asked if they had tested their ecstasy in the past year. We estimated prevalence and correlates of having tested one's ecstasy.

Results:

23.1% reported having tested their ecstasy in the past year. Those with some college (aPR=0.49, p=.014) or a college degree (aPR=0.41, p=.025) were less likely to test their ecstasy than those with a high school diploma or less. Using ecstasy pills (aPR=1.89, p=.036) or crystals (aPR=1.90, p=.006) ≥ 3 times in the past year was associated with increased likelihood of testing one's ecstasy, and purchasing from an unknown or untrustworthy dealer was associated with decreased likelihood (aPR=0.63, p=.034) of testing one's ecstasy. Half (51.1%) of ecstasy users reported finding out or suspecting their ecstasy had contained a drug other than MDMA. Of these, 49.2% reported finding out their ecstasy contained methamphetamine or speed/amphetamine. Most ecstasy users reported that they would be less likely to use again upon learning their ecstasy contained "bath salts" (54.8%) or methamphetamine (54.3%).

Discussion and Conclusions:

Drug testing appears to help ecstasy users detect adulterants and results can help inform harm reduction efforts. Less frequent users in particular may require education about adulteration and drug-testing.

Keywords (MeSH): Drug Users, Designer Drugs, MDMA, Hallucinogens, Harm Reduction

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Introduction

Prohibited drugs are supplied through unregulated channels and thus tend to lack quality control. One specific drug that has historically been associated with adulteration is 3,4-methylenedioxyamphetamine (MDMA) (1), also known as ecstasy (2), or “Molly” when in powder or crystalline form (3). Its recreational use first occurred in the mid-1970s (4). According to Analysis Anonymous, a confidential drug-checking service in the 1970s and 1980s in the United States (US), through 1985, most submitted samples said to be MDMA tested positive for MDMA (and/or similar MDx substances such as MDA) (2). However, after its scheduling in 1985 in the US, adulteration of the drug appeared to increase. The proportion of samples that contain only MDx has varied over time and place, with notably more adulteration detected globally in the late 1990s and the late 2000s (5-10). In the last decade, the number of novel/new psychoactive substances (NPS) identified in purported MDMA has increased exponentially: by 2014 in Spain, over 30 adulterants were identified compared with less than 5 in 2000 (8). The most common adulterants detected in European ecstasy markets between 2008–2013 included: synthetic cathinones (e.g., mephedrone, methylone, ethylone), psychedelics (e.g., 2C-B), novel amphetamines (e.g., PMA, PMMA, 4-FA), dissociatives (e.g., DXM) and piperazines (e.g., mCPP) (11). The unwitting consumption of synthetic cathinones, or ‘bath salts’ among Americans in the electronic dance music (EDM) party scene appears to be particularly prevalent. Specifically, recent US studies found that around half of ‘ecstasy’-using EDM party attendees tested positive for novel substances they did not report using, most commonly synthetic cathinones, including ethylone, methylone, butylone, pentylone and alpha-PVP (12-14).

Decades of research has associated the consumption of pure MDMA with a range of health harms dependent on dose and context (potentiated by dancing in hot, crowded environments), including thermal stress and overheating, impaired thermoregulatory control and serotonin syndrome (15). But over and above the management of symptoms attributable to recreational consumption of *pure* MDMA, people who consume *adulterated* MDMA may experience psychoactive effects that are discrepant with their expectations. The unwitting use of a psychedelic adulterant (e.g. 2C or NBOMe series) may result in psychosis-like symptoms (16); the unwitting use of a substance with a delayed onset time may lead to re-dosing too soon and subsequent fatal or nonfatal overdose (e.g. PMA, PMMA) (17), and the unwitting use of any highly potent substance (e.g. fentanyl or its analogs) can lead to fatal or non-fatal overdose (18). Synthetic cathinones in particular have resulted in deaths attributed to

hyperthermia, hypertension and cardiac arrest (19), and use was associated with over 20,000 emergency room visits in the US in 2011 alone (20). Additionally, unintentionally using the synthetic cathinone mephedrone sold as ecstasy can more easily result in dependence as this drug has a quicker onset and shorter dose duration than MDMA which can lead to compulsive re-dosing (21).

Many people who consume ecstasy/Molly are aware that what they consume may not actually be entirely MDMA or contain any MDMA at all, and studies have found that most users desire to know the content and dose of their drug prior to consumption (22-26). In 2017, there were ‘drug checking’ or ‘pill testing’ services available in 20 countries, where drug consumers can provide samples of substances to be analyzed using laboratory equipment to determine content and/or purity (27). Field-ready analytical methods are also utilized on-site at some dance events by harm reduction organizations to provide this information directly to consumers to inform their drug consumption choices (27). However, the operating of ‘drug checking’ services is legally and politically fraught in many countries. In the US, promoters of dance events are discouraged from supporting drug checking services on-site due to legal liability issues, because official support for such services implies prior knowledge by promoters that prohibited drugs will be consumed at their event (28).

Therefore, in the US, ecstasy consumers rarely have access to laboratory-grade analysis of purported MDMA samples. The main option available at consumer level is the use of color reagent test kits or chemical spot tests. These are presumptive tests primarily used for forensic applications to determine the presence or absence of specific substances (29). A drop of reagent fluid is placed onto a shaving of the drug sample (or a pin-head-sized amount of the drug is added to the reagent mixture), then a color reaction (or lack thereof) is observed and compared with a chart. For example, with some reagents, if the reaction is black or dark purple this may indicate presence of MDMA or another MDx, but a yellow reaction may indicate presence of a synthetic cathinone such as methylone. Costs are low (e.g., often \leq \$100) compared to laboratory instruments which can cost thousands of dollars; training is simple, and the tests can easily be used in field settings, while many other drug tests require machinery (30). If test results are interpreted with their limitations in mind, they are considered accurate at detecting the presence or absence of specific psychoactive compounds (29,30). Popular with toxicologists and law enforcement agents, these tests have also been adopted by a significant minority of people who consume drugs, especially ecstasy (23-26,31).

A limitation of the existing literature focusing on prevalence and correlates of use of drug testing is that it has been conducted with convenience samples, and in many cases, the literature is now dated. Studies of representative samples of those at risk are needed in order to more accurately estimate more generalizable results. The increase in detections of novel substances in the US, especially synthetic cathinones among clubbers (12,13), suggests we need up-to-date and locally-relevant information about ecstasy misrepresentation, attempts by consumers to determine adulteration, and how they respond to discovering that their drugs are adulterated.

Aims

We aimed to determine (a) prevalence and correlates of testing ecstasy with reagent test-kits, (b) perceptions of ecstasy purity, and (c) intentions to use less ecstasy following hypothetical positive test results for other drugs among a representative sample of EDM attendees in New York City (NYC).

Method

Participants and procedure

We surveyed 943 individuals about to enter EDM parties at nightclubs and festivals in NYC from June through September of 2017. Time-space sampling (32) was utilized in which parties were randomly selected each week, as this allowed us to maintain elements of randomness to the selection process while surveying this targeted population. Individuals about to enter these parties were approached to be surveyed and they were eligible if they were ages 18–40 and were about to attend the randomly selected party. Trained recruiters approached passersby (who were alone or in groups) and confirmed they were about to enter the randomly selected party. Those confirmed eligible were asked if they would like to take a survey about drug use. Surveys were conducted on tablets and participants provided informed consent on the first page of the survey. The response rate was 74%. This study was approved by the institutional review board at New York University Langone Medical Center.

Measures

Participants first provided information regarding demographics, including gender, age, race/ethnicity, educational attainment, weekly income, and sexual orientation. Age was split into young adults (ages 18-24) and older adults (ages 25-40) and income was median-split

into $< \$500$ and $\geq \$500$ per week.

Participants were then asked about their use of various drugs with a focus on ecstasy. We asked whether they used ecstasy/MDMA/Molly in the past year. “Molly” was added to the definition of ecstasy in this American sample because previous research has found that not all users of this powder or crystalline form of the drug are aware that it is ecstasy (33,34). Those reporting past-year use were asked follow-up questions about use. Past-year users were asked whether they had used in the past 30 days, and they were also asked to check off which form(s) of ecstasy were used in the past year, which included pills, powder, and crystals. Those indicating use of a particular form of ecstasy were asked to report past-year frequency of use of that form of the drug via an ordinal item with the following response options: 1) 1–2 times, 3–5 times, 6–9 times, 10–19 times, 20–39 times, and ≥ 40 times. Frequency of use for each form was coded into tertiles: 0 times, 1–2 times, and ≥ 3 times for statistical models.

Past-year ecstasy users were then asked whether they had ever found out their ecstasy/Molly contained a drug other than MDMA and then they were asked if they had ever suspected that their ecstasy/Molly contained a drug other than MDMA. Answer options for these two questions were “yes”, “no”, and “not sure”, and those who answered “yes” were asked to type in which drug(s) they found out or suspected their ecstasy had contained. Participants were able to type in names of multiple drugs. Type-in responses were double-coded to ensure that responses accurately reflected the drugs reported and iterations continued until 100% agreement was reached. We coded the names of drugs typed in into indicator variables for descriptive purposes.

Independent of questions asking about adulteration, past-year users were then asked if they or someone else had ever tested their ecstasy/Molly using a drug testing kit in the past year. Those answering affirmatively were asked how often they test their ecstasy (or get it tested) to make sure it is really MDMA and answer options were “rarely”, “sometimes”, “usually”, and “always”. All past-year ecstasy users were then asked how often they get their ecstasy/Molly from a dealer they do not know well or trust. Answer options were “never”, “sometimes”, “often”, and “always” and we dichotomized responses into “often/always” vs. “sometimes/never”. We asked users if on average, they think their ecstasy/Molly is as pure as others’ ecstasy/Molly and answer options were “more pure”, “just as pure”, and “less pure”, and finally, we asked users if there is anything that would make them less likely to use ecstasy/MDMA/Molly again. We asked specifically if they would be less likely to use again

if they found out it contained “bath salts”, methamphetamine, or MDA.

Participants were also queried about past-year use of various other drugs including ketamine, amphetamine (nonmedical use), opioids (nonmedical use), and synthetic cathinones (“bath salts”). Specifically, participants were asked about 17 different opioids (e.g., Vicodin, fentanyl) and 25 “bath salts” (e.g., methyldone, “bath salt” unknown) and if the participant reported use of any, he or she was coded as using a drug in the corresponding class.

Analyses

Analyses focused on the 351 participants (of 943 surveyed in the full sample) who reported past-year ecstasy use. We first examined descriptive statistics for all relevant variables. We then compared those who reported testing their ecstasy to those who reported not testing their ecstasy along each covariate using Rao-Scott chi-square, and then fit all covariates into a multivariable model. Specifically, covariates were fit into a generalized linear model using Poisson and log link with the binary drug-testing variable as the outcome. This model produced adjusted prevalence ratios (aPRs) for each covariate. Finally, we examined descriptive statistics regarding adulterant drugs participants reported finding out and/or suspecting were in their ecstasy.

We created sample weights to account for our complex survey design. Weights were calculated based on reported frequency of party attendance and response rates for each night of recruitment. Participant selection probability was computed and we weighted our prevalence estimates by the inverse of that probability (32,35). Weighted analyses accounted for clustering of participants in each party and differential selection probability using Taylor series estimation, which allowed us to obtain accurate standard errors (36). Data were analyzed using Stata 13 SE.

Results

Prevalence of reagent test-kit use

The majority (62.9%) of this past-year ecstasy-using sample identified as white, and over half (61.8%) had at least a college degree (Table 1). Half (51.3%) of past-year users reported past-month use. Past-year pill use (73.4%) was most common, followed by past-year use of crystals (69.6%) and powder (62.9%). A quarter (24.5%) reported using all three forms in the past year; 29.2% used pills only, 18.5% used crystals only, 8.3% used powder only, 11.9% used powder and crystals, 5.7% used pills and powder, and 1.9% used pills and crystals.

[Insert Table 1]

Over one-fifth (23.1%) reported having tested their ecstasy in the past year. Most of these participants reported always testing (31.2%) or usually testing (32.3%) while a quarter (24.3%) reported sometimes and 12.2% reported rarely testing their ecstasy. As shown in Table 2, compared to white participants, Asian participants were less likely to test their ecstasy (aPR=0.44, p=.042). Compared to those reporting a high school education or less, those reporting having attended some college (aPR=0.49, p=.019) or having earned a college degree (aPR=0.42, p=.049) were also less likely to have reported testing their ecstasy. Compared to those earning <\$500 per week, those earning \geq \$500 were more likely to report having tested their ecstasy (aPR=1.83, p=.005) and compared to those identifying as heterosexual, those identifying as bisexual (aPR=2.11, p=.005) or identified as another sexuality (aPR=2.75, p=.043) were more than twice as likely to report having tested their ecstasy. Regarding form(s) of ecstasy used, compared to those reporting no past-year use of pills and crystals, those reporting use of pills (aPR=1.93, p=.043) or crystals (aPR=1.95, p=.005) \geq 3 times in the past year were more likely to report having tested their ecstasy. Finally, compared to those who report usually not purchasing their ecstasy from an unknown or untrustworthy dealer, those who did report usually purchasing their ecstasy from such dealers were less likely to report having tested their ecstasy (aPR=0.61, p=.018).

[Insert Table 2]

Perceptions of purity

Half (51.1%) reported that they had found out or suspected their ecstasy had contained a drug other than MDMA. Specifically, 22.8% reported both finding out and suspecting adulteration, 9.9% reporting only finding out and 18.2% reported only suspecting adulteration. Table 3 presents drugs past-year ecstasy users (independent of having tested their ecstasy in the past year) found out or suspected their ecstasy had contained. Half (49.2%) reported having found out their ecstasy had ever contained methamphetamine or speed/amphetamine, and nearly half (46.5%) suspected these drugs had been present in their ecstasy. Almost a quarter (23.9%) reported finding out their ecstasy had contained cocaine and 11.2% suspected cocaine as an adulterant.

[Insert Table 3]

Close to a third (32.0%) reported they felt their ecstasy, on average, is purer than others'

ecstasy; 42.6% felt theirs' is just as pure; while 25.4% felt their ecstasy, on average, is less pure than others' ecstasy. While we did not fit perceived purity into the model examining correlates of testing one's ecstasy because perception of purity may be dependent on testing, we did find that perceived purity differed ($\chi^2=20.90$, $p<.001$) by whether the participant tested his or her ecstasy. Specifically, those who had tested their ecstasy were more likely to perceive their ecstasy as purer (67.5%) compared to those believing their ecstasy is just as pure (24.0%) or less pure (8.5%).

Behavioral intentions following test results

Regarding what would make participants less likely to use ecstasy again, 54.8% reported they would be less likely to use again if they learned their ecstasy contained "bath salts", 54.3% said they would be less likely to use again if they learned it contained methamphetamine, and 36.2% said they would be less likely to use again if MDA was detected.

Discussion

Previous research has determined that ecstasy users in NYC are at high risk for using ecstasy adulterated with "bath salts", other NPS, and/or methamphetamine (13,14), and many of these drugs can be more dangerous than MDMA, especially when ingested unknowingly or in combination with MDMA. 'Drug checking' has become an important harm reduction measure to help users determine content of the ecstasy or other drugs they use, but more research was needed to determine prevalence estimates and correlates of testing in this population. Further, this paper sought to fill in the gap in research regarding what adulterants users believe or found out they had unintentionally used.

We estimate that over a fifth (23.1%) of past-year ecstasy users in the NYC EDM scene have tested their ecstasy in the past year, and of these, most (63.6%) usually or always test their ecstasy. We did not detect gender or age differences regarding who was more or less likely to test their ecstasy; however, prevalence of testing was still almost 12% higher among males compared to females. While further research is needed to continue to examine user characteristics, these results do suggest that female ecstasy users may require further education about adulteration and drug-testing. Findings were somewhat mixed regarding common indicators of socioeconomic status. Specifically, while those who earned more money per week were at higher odds for testing their ecstasy, many attendees who attended or had graduated from college were at lower odds of testing their ecstasy. While it is

unknown which attendees purchased their own test kits, test kits can be expensive for an individual with lower income. For example, a full set of eight reagents can cost about \$100 USD and these reagents expire after 12 months. We also found that ecstasy users with high school education were more likely to report testing their ecstasy than those with some college or completed college degrees. Further research is needed to determine the extent to which use of reagents is a function of cost, as well as knowledge about adulterants and the limitations of test kits.

More frequent ecstasy pill and crystal users were at higher odds for having tested their ecstasy in the past year. This finding corroborates previous studies finding that more regular or frequent users are more likely to report using a test kit (23,24). Higher frequency of ecstasy use may result in more experiences of adulteration and greater knowledge of mitigation strategies. Less experienced users, however, may have less knowledge about adulteration and may also use in a more opportunistic manner (e.g., purchasing from unknown individuals), which may further place them at risk for obtaining adulterated substances. Thus, it appears more awareness about drug-testing may be needed among less frequent or novice users.

Another finding was that individuals who usually or always purchased their ecstasy from an unknown or ‘untrustworthy’ dealer were at lower odds for testing their ecstasy. The circumstances of these transactions however are unknown. Not testing and purchasing from such dealers may indicate, for example, either a lack of education about adulterants (or about ecstasy in general (34)), or simple indifference. However, purchasing ecstasy from an unknown dealer at a party may not allow the opportunity to test the drug even if one desires to do so. Other research has identified an association between obtaining drugs before the drug use event and higher likelihood of testing those drugs (26). More research is needed to determine how risky purchasing practices relate to use of harm reduction tactics such as reagent testing.

Half (51.1%) of ecstasy users reported that they had either found out or suspected their ecstasy had contained a drug other than MDMA, and half (49.2%) of these individuals found out or suspected adulteration with methamphetamine/“speed”. These results add to results from a previous study of this population in which among past-year ecstasy users whose hair tested positive for methamphetamine, over half (55.2%) denied known use (13). Interestingly, only 2.9% reported finding out their ecstasy contained “bath salts” (and only 5.1% suspected

adulteration with “bath salts”) as previous studies of this population have found that among ecstasy users whose hair tested positive for “bath salts”, 50.0–68.0% denied known use of such compounds (13,14). Therefore, ecstasy users in NYC may be underestimating their exposure to such compounds.

Behavioral intentions regarding future ecstasy use also appear to be affected according to hypothetical situations of individuals learning their ecstasy contains or contained adulterants. For example, over half of users said they would be less likely to use ecstasy again if they learned their ecstasy contained “bath salts” or methamphetamine. Thus, learning about the extent of adulteration or learning one’s ecstasy is adulterated may be preventative against future use or encourage users to engage in harm reduction practices such as ecstasy-testing, as suggested by prior research (23,37,38).

Limitations

Results may not be fully generalizable to the EDM scene outside of NYC. Frequency of ecstasy use was queried separately for pills, powder, and crystals, and the ordinal nature of the items (and lack of data regarding whether separate forms were used on the same or on separate occasions), we were unable to combine these items into a single frequency of use variable. High-frequency use (e.g., use 10+ times) for any single form was rare ($\leq 5\%$) when considering those who used a particular form 0 times, and after extensive sensitivity testing, we concluded that our current trichotomous frequency variables best represented the data and provided the best fit in models.

Conclusions

Individuals in the NYC EDM scene are at high risk of consuming ecstasy that contains other psychoactive substances, including ‘bath salts’ which are associated with greater dependence liability and higher overdose rates (fatal and non-fatal) than MDMA alone (19,21). Evidence from other countries demonstrates that drug checking services can prevent such unintentional consumption of NPS (38-40). Drug checking services are preferable to self-administration of reagent test kits because more sophisticated equipment can be utilized and staff are trained in equipment use, interpretation, and provision of harm-reducing advice (41). These data reiterate an urgent need for policy changes that facilitate development of drug checking services. The operation of such services in over 20 countries (27) provides multiple blueprints from which to design an appropriate service to cater for the needs of this population.

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Declaration of interests

There are no relevant interests to declare.

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