HHS Public Access

Author manuscript

Am J Addict. Author manuscript; available in PMC 2022 January 01.

Shifts in Unintentional Exposure to Drugs Among People Who Use Ecstasy in the Electronic Dance Music Scene, 2016–2019

Joseph J. Palamar, PhD, MPH[1], **Alberto Salomone, PhD**[2,3]

[1]Department of Population Health, New York University Grossman School of Medicine, New York, New York

[2]Dipartimento di Chimica, Università di Torino, Torino, Italy

[3]Centro Regionale Antidoping e di Tossicologia, Orbassano (TO), Italy

Abstract

Background and Objectives: Electronic dance music (EDM) party attendees who use ecstasy (3,4-methylenedioxymethamphetamine [MDMA], Molly) are at high risk for ingesting adulterant drugs, but little is known regarding trends in exposure. We sought to determine whether adulteration has shifted in recent years.

Methods: Adults entering EDM events at nightclubs and dance festivals in NYC were surveyed in 2016 and 2019. We tested hair samples from a subsample of those reporting past-year ecstasy use using ultra-high performance liquid chromatography—tandem mass spectrometry. Differences in unreported drug exposure and suspected adulteration were compared between 2016 ($n = 90$) and 2019 ($n = 72$).

Results: MDMA detection was stable at 72–74%. We detected decreases in unreported use of methamphetamine (from 22.2% to 5.6% [$P = .003$], an 74.8% decrease), new psychoactive substances (from 31.1% to 2.8% [$P < .001$], a 91.0% decrease), and synthetic cathinones in particular (from 27.8% to 2.8% ($P < .001$, an 89.9% decrease). Unreported ketamine exposure increased from 18.9% to 34.7% ($P = .022$, an 83.6% increase). We also detected decreases in participants' suspicion of their ecstasy being adulterated with methamphetamine (from 20.0% to 5.6% [$P = .010$], an 72.0% decrease) and "bath salts" (synthetic cathinones, from 8.9% to 1.4% [$P = .044$], an 84.3% decrease).

Discussion and Conclusions: Unknown exposure to adulterants among people who use ecstasy in the EDM scene is shifting. Monitoring of exposure to adulterants is needed to inform harm reduction.

Scientific Significance: This was among the first studies to examine unintentional exposure to drugs over time in this population and unintentional exposure to synthetic cathinones in particular appears to be declining.

Address correspondence to Dr Palamar, Department of Population Health, New York University Grossman School of Medicine, 180 Madison Avenue, Room 1752, New York, NY 10016. joseph.palamar@nyulangone.org.

Declaration of Interest

The authors declare no conflicts of interest. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

INTRODUCTION

People who attend electronic dance music (EDM) events at nightclubs and festivals are at high risk for ecstasy use.[1,2] Ecstasy, commonly known as Molly when in powder or crystalline form, is a drug marketed as containing 3,4-methylenedioxymethamphetamine (MDMA). However, ecstasy often contains adulterant psychoactive drugs in addition to or in replacement of MDMA.[3] Little is known about the extent of ecstasy adulteration in the United States, in part, because few studies have directly tested contents of purported MDMA.

"Drug checking," in which drug product such as pills or powders are tested, is the most direct way to test the contents of drugs such as ecstasy. However, researchers in the US face barriers that limit our ability to use such methods in research studies. The biggest barrier is that it is difficult to obtain approval from institutional review boards (IRBs) and from local and federal law enforcement to test illegal drugs. Since drug checking is often not feasible in US studies, some researchers have tested drug adulteration by proxy, post-use, through testing of biological specimens.[4] Such testing provides not only an opportunity to detect unintentional exposure to drugs, but continued testing over time may allow us to examine trends in adulteration.

Cross-sectional studies of the EDM party-attending population suggest high levels of unintentional exposure to adulterant drugs among those who report ecstasy use. Multiple studies focusing on EDM dance festival attendees in Florida have detected extensive, likely unintentional, exposure to new psychoactive substances (NPS), particularly synthetic cathinones (which are commonly referred to as "bath salts" in the United States).[5,6] Although participants were not asked about use of specific NPS in these studies, 12–47% of those reporting ecstasy use had their saliva, blood, and/or urine test positive for one or more NPS, mainly synthetic cathinones. Similarly, hair testing studies of EDM party attendees in NYC have detected extensive unknown exposure to synthetic cathinones, methamphetamine, and other drugs, among people reporting ecstasy use.[1,2] These studies found that 41–51% of detected drugs were not reportedly used, suggesting unknown exposure. Such findings in this population, however, are by no means limited to the United States. For example, a recent drug checking study at a dance festival in Portugal found that 9% of purported MDMA contained synthetic cathinones.[7]

Indeed, people who use illegal drugs such as ecstasy are likely aware that they may be taking a risk by using, but many adulterants detected in ecstasy are more potent and more dangerous than MDMA.[3,8] Thus, adulterated ecstasy, in some respects, can place people who use at greater risk for harm. While seizure data indeed informs the extent to which NPS and other common adulterant drugs are available on the black market,[9,10] little is known about the extent of unintentional exposure to such drugs. Even less is known about how unintentional exposure has been shifting over time in specific high-risk populations. In this report, we examine changes in unintentional drug exposure among EDM party attendees who use ecstasy as we believe results can inform prevention and harm reduction efforts both in the EDM scene and in the general population.

METHODS

Study Procedures and Participants

In 2016 and 2019, we surveyed adults entering EDM parties throughout NYC using time-space sampling methods.[11] Specifically, each week, parties (primarily at nightclubs) were randomly selected to survey individuals. The party sample space was created each week based on (a) parties listed on EDM websites, (b) nightclubs that commonly host EDM parties, and (c) through recommendations of key informants. Recruitment typically occurred on one or two nights per week on Thursday through Sunday. Participants were also surveyed entering two large daytime EDM dance festivals in 2016 and one in 2019. Individuals were eligible if they were 18 years of age or older and were about to enter the selected event. These surveys were anonymous and taken on tablets at the point of recruitment after informed consent was provided. Survey response rates for 2016 and 2019 were 77% and 64%, respectively.

During the survey, participants were asked if they were willing to provide a hair sample to be tested for drug exposure at a future date. If the participant agreed, the recruiter then cut a small lock of hair (~100 hairs) from the participant with a clean scissor as close to the skin/scalp as possible. While hair was usually taken from the head, participants were also allowed to provide hair from the armpit, arm, leg, or face (beard). Hair was folded into a small sheet of tin foil and stored in an envelope labeled with the participant's study ID number. This number was used to link hair test results to survey responses after hair analysis. Hair response rates for 2016 and 2019 among those surveyed were 17% and 35%, respectively. All methods were approved by the New York University Langone Medical Center IRB.

Measures

Participants were asked about past-year use of ecstasy/MDMA/Molly and about use of 90 or more other drugs. When possible, street names were included with chemical names. To query use of various NPS or other uncommon drugs, we provided checklists of compounds within each group. For example, in 2016, we asked about use of 26 synthetic cathinones and participants checked off which compound(s) (if any) they had knowingly used in the past year. We also noted that synthetic cathinones are commonly referred to as "bath salts." We included options in which participants could check off use of a "bath salt" in which they did not know the specific compound or if the compound was not listed. However, item lists were shortened in 2019 as many compounds in previous years were never reportedly used. Therefore, in 2019, we only listed 13 synthetic cathinones (with the list also including newer compounds such as *N*-ethylpentylone). However, compounds removed from the checklist were still in fact listed below the last option for "other" compounds in the drug class. For example, metamfepramone was removed from the synthetic cathinone list in 2019, but it was still listed as an "other" compound below the checklist. We also asked about use of 8–27 tryptamines (eg, 4-AcO-DMT), 5–18 2C series drugs (eg, 2C-E), and 1–6 NBOMe series drugs (eg, 25I-NBOMe). An affirmative response to any compound in a class was coded as past-year use of a drug within the specific class. For example, those reporting use of α-PVP ("Flakka") were coded as reporting synthetic cathinone use. Test-retest reliability of these items (from an earlier cohort) were shown to be high ($\kappa = 0.88–1.00$).[12] Participants

reporting past-year ecstasy use were also asked if they had found out or suspected their ecstasy being adulterated, and if so with what drug(s). These type-in responses of drug names were double coded to ensure accuracy.[13]

Hair Testing

Hair samples were analyzed as per published methods using ultra-high performance liquid chromatography—tandem mass spectrometry.[14–17] Once a drug is ingested, it is incorporated into the hair, leading to a potential trace of exposure. Although hair is limited in detecting very recent exposure (eg, in the past week), hair is most ideal to detect repeated exposure over longer diagnostic windows (eg, over weeks or months). Continued improvement of instrumental technologies and analytical procedures allows us to detect very small quantities of drugs including single exposures, many months post-exposure, given adequate hair length.[17,18] Table 1 presents a list of target analytes in this study. We tested for 22 analytes in both 2016 and 2019 and we added testing for an additional 48 analytes in 2019. Although the main focus of this paper is to examine potential changes in unreported detection over time, we also considered analytes added in 2019 to inform estimates. We set the limits of detection as the minimum criterion to identify positive samples because we aimed to detect any amount of exposure (eg, via adulterants). However, we considered detection of benzoylecgonine (BZE), the main cocaine metabolite, as a further criterion to confirm cocaine exposure.[19]

Statistical Analysis

Analyses were limited to participants reporting past-year ecstasy use who provided a hair sample. First, participant demographic and drug use characteristics were compared between 2016 and 2019 to determine whether there were differences between participants each year. χ^2 and Fisher's exact test were used to detect potential differences. Next, for each drug, a variable was coded indicating whether there was a positive hair test in light of no self-reported use. Absolute and relative differences in prevalence in unreported use between 2016 and 2019 were calculated and χ^2 and Fisher's exact test were used to determine whether changes over time were significant. Finally, we calculated the prevalence of unreported use of drugs in 2019 that we could not test for in 2016.

RESULTS

Table 2 compares demographic and drug use characteristics between participants in 2016 and 2019. In both cohorts, the majority of participants identified as white and heterosexual, and the majority had a college degree or higher. Most participants reported attending EDM parties at least every other week, and among these ecstasy-using cohorts, ketamine and amphetamine were the most commonly used drugs in the past year. There were no significant differences in participant characteristics between 2016 and 2019. It should be noted that within the parent study, self-reported past-year ecstasy use remained consistent at 26%.

Table 3 presents comparisons in prevalence of drugs detected in hair samples among those not reporting use in 2016 and in 2019. Detection of MDMA was consistent in 2016 and

2019 at 72.2–74.4% ($P = .750$). However, we detected decreases in unreported use of methamphetamine (from 22.2% to 5.6% [$P = .003$], a 74.8% decrease), amphetamine (from 17.8% to 6.9% [$P = .041$], a 61.2% decrease), and NPS (from 31.1% to 2.8% [$P < .001$], an 91.0% decrease). Among NPS, unreported exposure to synthetic cathinones decreased from 27.8% to 2.8% ($P < .001$, an 89.9% decrease). Within synthetic cathinones, there were significant decreases in detection of unreported use of butylone (from 14.4% to 0.0% [$P = .001$], an 100% decrease) and pentylone (from 10.0% to 0.0% [$P = .005$], an 100% decrease). Prevalence of unreported ketamine exposure increased from 18.9% to 34.7% ($P = .022$, an 83.6% increase). With regard to self-reported suspicion of participants' ecstasy being adulterated, suspicion of adulteration with methamphetamine decreased from 20.0% to 5.6% ($P = .010$, an 72.0% decrease) and suspicion of "bath salt" (synthetic cathinone) adulteration decreased from 8.9% to 1.4% ($P = .044$, an 84.3% decrease).

Finally, Table 4 presents prevalence of analytes detected in 2019, among those denying use, for analytes not tested for in 2016. Almost a fifth (18.1%) of participants not reporting cocaine use in 2019 tested positive for exposure. In addition, 8.3% tested positive for an opioid or opiate after not reporting use, with one participant testing positive for fentanyl exposure after not reporting use. No other analytes tested for in our analysis were detected in 2016 or 2019 among those not reporting use.

DISCUSSION

This was among the first studies to examine trends in unintentional exposure to adulterants among people who use ecstasy. Detection of MDMA, the chemical that ecstasy is typically purported to contain, remained stable, with 72–74% of participants testing positive after reporting past-year use. This suggests that most participants reporting ecstasy use did in fact use real MDMA, with or without adulterants. Results suggest major shifts in unintentional exposure to other drugs among people who use ecstasy in the NYC EDM party- attending population.

Detection of unreported exposure to common adulterants such as amphetamine and methamphetamine decreased between 2016 and 2019. Detection of unreported use of NPS also decreased, especially synthetic cathinones. Butylone and pentylone in particular were detected in at least a tenth of participants reporting ecstasy use in 2016, but we detected no instances of exposure to these compounds in 2019. These decreases may indicate that unintentional exposure to synthetic cathinones is decreasing in this population, although it is possible that other adulterant drugs are replacing these compounds. Seizure data in the United States suggest rapidly shifting availability of different synthetic cathinones. Specifically, related compounds more commonly seized in 2016 such as methylone, α-PVP, ethylone, and pentylone, became rarely or no longer seized in 2019.[9,10] However, we also tested for some newer synthetic cathinones in 2019, including *N*-ethylpentylone, which was the second most- seized compound from this class in early 2019,[10] and no samples tested positive. We believe this suggests that unintentional exposure to synthetic cathinones among people in this scene who use ecstasy is decreasing overall in NYC, although we were not able to detect some other newer synthetic cathinones such as eutylone.

Although we did not detect unintentional exposure to other NPS or uncommon drugs in 2019, we did detect unreported exposure to fentanyl in one participant. According to an auxiliary analysis, this participant did not report use of heroin (the most common source of fentanyl[20]), suggesting fentanyl was likely an adulterant or contaminant in another drug used —either ecstasy, cocaine, or amphetamine. Drugs such as methamphetamine, which are commonly used in EDM scenes, rarely contain fentanyl as an adulterant or contaminant,[20] and to our knowledge, there is no published scientific literature describing detection of fentanyl in ecstasy. However, the NYC Department of Health and Mental Hygiene has issued public alerts that they suspect fentanyl has made its way into some of the cocaine supply in NYC.[21] We cannot deduce the source of fentanyl exposure with confidence but suspect exposure was related to party drug use. Continued monitoring is needed to determine whether fentanyl or its analogs are becoming present in drugs such as ecstasy.

While detection of most adulterants decreased between 2016 and 2019, unreported exposure to ketamine actually increased from 18.9% to 34.7%, suggesting that ketamine may be appearing more commonly as an adulterant in ecstasy or other drugs used by EDM party attendees in NYC compared to previous years. It is possible that ketamine is appearing in ecstasy more often in recent years as a replacement to NPS. Further, although we were unable to test for cocaine or opioid exposure in 2016, 18.1% of participants in 2019 tested positive for exposure to cocaine after not reporting use, and 8.3% tested positive for an opioid or opiate after not reporting nonmedical use. It is unknown to what extent such drugs are being used as adulterants in ecstasy or in other drugs. However, it is possible that some participants simply denied known use on the survey. Most recent research on adulteration or drugs such as ecstasy has focused on NPS; however, historically, ecstasy has in fact been somewhat commonly adulterated with drugs such as ketamine and cocaine.[13,22,23] Research is clearly needed to determine the source(s) of unintentional exposure to these more common drugs and research is also needed to determine whether some of this discrepant reporting is due to intentional underreporting of use.

Importantly, findings regarding self-report of suspected adulteration corroborated our hair test results. Specifically, learning or suspecting that one's ecstasy was adulterated with methamphetamine and/or "bath salts" decreased between 2016 and 2019. Suspicion of adulteration with methamphetamine, in particular, dropped, with a fifth (20.0%) of participants suspecting adulteration with methamphetamine in 2016, and this decreased to 5.6% in 2019. We believe these findings are important as they confirm both via hair testing and self-report that unintentional use of methamphetamine and "bath salts" has been decreasing.

This study is not without limitations. Hair testing is unable to detect very recent use (eg, use within the past week), and shorter hair samples (eg, <12 cm) limited our ability to detect exposure within a full year. It is possible that newer NPS that we were not able to detect were unintentionally used. Our updated test methods allowed us to detect a wider variety of analytes in 2019 and this limited our analyses as we were not able to test for exposure to such analytes in 2016. We cannot deduce whether unreported exposure to other drugs occurred through use of ecstasy or other drugs, and with regard to amphetamine and opioids, participants were asked about nonmedical use, so it is possible that we detected medical use.

In addition, it is also possible that some individuals intentionally denied use of specific drugs, although we feel this is unlikely as everyone in the analytical sample reported ecstasy use. Finally, given the relatively small sample sizes in this study, results may not be fully generalizable to the EDM party scene in NYC, and results may not be generalizable to the general population.

In conclusion, it appears that unintentional exposure to adulterant drugs is shifting among people in the NYC EDM party-attending population who use ecstasy. Unknown exposure to NPS such as synthetic cathinones appears to be decreasing, but unknown exposure to more common drugs such as ketamine appears to be increasing. We believe these results can inform scientists and the public about the extent of unknown exposure to drugs among people who use ecstasy in this scene. However, continued monitoring is needed. While studies that examine presence of drugs in biospecimens, post-use, are indeed informative, studies that focus on drug checking are sorely needed. Not only would such results provide more direct information about adulteration, but this would also allow people who use to make a decision whether or not to use the drug once he or she learns of the actual contents. Future research needs to focus more on testing of drug product.

Acknowledgments

Research reported in this publication was supported by the National Institute on Drug Abuse of the National Institutes of Health under Award Numbers K01 DA038800 (PI: Palamar) and R01 DA044207 (PI: Palamar).

REFERENCES

1. Palamar JJ, Salomone A, Vincenti M, et al. Detection of “bath salts” and other novel psychoactive substances in hair samples of Ecstasy/MDMA/“Molly” users. Drug Alcohol Depend. 2016;161:200–205. [PubMed: 26883685]
2. Palamar JJ, Salomone A, Gerace E, et al. Hair testing to assess both known and unknown use of drugs amongst ecstasy users in the electronic dance music scene. Int J Drug Policy. 2017;48: 91–98. [PubMed: 28810159]
3. Oliver CF, Palamar J, Salomone A, et al. Synthetic cathinone adulteration of illegal drugs. Psychopharmacology. 2018;236:869–879. [PubMed: 30338489]
4. Palamar JJ, Salomone A, Barratt MJ. Drug checking to detect fentanyl and new psychoactive substances. Curr Opin Psychiatry. 2020; 33:301–305. [PubMed: 32187173]
5. Krotulski AJ, Mohr ALA, Fogarty MF, et al. The detection of novel stimulants in oral fluid from users reporting ecstasy, Molly and MDMA ingestion. J Anal Toxicol. 2018;42:544–553. [PubMed: 30371847]
6. Mohr ALA, Friscia M, Yeakel JK, et al. Use of synthetic stimulants and hallucinogens in a cohort of electronic dance music festival attendees. Forensic Sci Int. 2017;282:168–178. [PubMed: 29216523]
7. Valente H, Martins D, Carvalho H, et al. Evaluation of a drug checking service at a large scale electronic music festival in Portugal. Int J Drug Policy. 2019;73:88–95. [PubMed: 31398488]
8. Watterson LR, Olive MF. Synthetic cathinones and their rewarding and reinforcing effects in rodents. Adv Neurosci. 2014;2014:209875.
9. US Drug Enforcement Administration. National Forensic Laboratory Information System: Year 2016 Annual Report. Springfield, VA; 2017.
10. US Drug Enforcement Administration. National Forensic Laboratory Information System: NFLIS-Drug 2019 Midyear Report. Springfield, VA; 2020.

11. MacKellar DA, Gallagher KM, Finlayson T, et al. Surveillance of HIV risk and prevention behaviors of men who have sex with men—a national application of venue-based, time-space sampling. Public Health Rep. 2007;122(suppl 1):39–47. [PubMed: 17354526]
12. Palamar JJ, Le A, Acosta P, et al. Consistency of self-reported drug use among electronic dance music party attendees. Drug Alcohol Rev. 2019; 38:798–806. [PubMed: 31523872]
13. Palamar JJ, Barratt MJ. Prevalence of reagent test-kit use and perceptions of purity among ecstasy users in an electronic dance music scene in New York City. Drug Alcohol Rev. 2019;38: 42–49. [PubMed: 30575155]
14. Di Corcia D, D'Urso F, Gerace E, et al. Simultaneous determination in hair of multiclass drugs of abuse (including THC) by ultra-high performance liquid chromatography-tandem mass spectrometry. J Chromatogr B Analyt Technol Biomed Life Sci. 2012;899: 154–159.
15. Salomone A, Gazzilli G, Di Corcia D, et al. Determination of cathinones and other stimulant, psychedelic, and dissociative designer drugs in real hair samples. Anal Bioanal Chem. 2016;408:2035–2042. [PubMed: 26680593]
16. Salomone A, Palamar JJ, Bigiarini R, et al. Detection of fentanyl analogs and synthetic opioids in real hair samples. J Anal Toxicol. 2018; 43:259–265.
17. Vincenti M, Salomone A, Gerace E, et al. Application of mass spectrometry to hair analysis for forensic toxicological investigations. Mass Spectrom Rev. 2013;32:312–332. [PubMed: 23165962]
18. Kintz P, Salomone A, Vincenti M. Hair Analysis in Clinical and Forensic Toxicology. San Diego, CA: Academic Press; 2015.
19. Cooper GA, Kronstrand R, Kintz P. Society of hair testing guidelines for drug testing in hair. Forensic Sci Int. 2012;218:20–24. [PubMed: 22088946]
20. Tupper W, McCrae K, Garber I, et al. Initial results of a drug checking pilot program to detect fentanyl adulteration in a Canadian setting. Drug Alcohol Depend. 2018;190:242–245. [PubMed: 30064061]
21. New York City Department of Health and Mental Hygiene. Presence of fentanyl in cocaine contributing to increase in drug overdose deaths; New York City, NY; 2017.
22. Parrott AC. Is ecstasy MDMA? A review of the proportion of ecstasy tablets containing MDMA, their dosage levels, and the changing perceptions of purity. Psychopharmacology. 2004;173:234–241. [PubMed: 15007594]
23. Tanner-Smith EE. Pharmacological content of tablets sold as "ecstasy": results from an online testing service. Drug Alcohol Depend. 2006;83:247–254. [PubMed: 16364567]

TABLE 1.

Target analytes in 2016 and 2019

Target analytes examined in 2016 and 2019 (*n* = 22)	Target analytes examined only in 2019 (*n* = 48)	
Common drugs	*Common drugs*	4-MeO-PCP
MDMA	Marijuana (THC)	4-AcO-DiPT
Amphetamine	Cocaine	4-AcO-DMT
Methamphetamine	LSD	4-HO-DET
Ketamine	Mescaline	5-MeO-AMT
MDA	Psilocybin	5-MeO-DALT
MDEA	DMT	5-MeO-DPT
NPS	PCP	5-MeO-MiPT
Synthetic cathinones	Heroin (6-MAM)	25I-NBOMe
α-PVP	Hydrocodone	25H-NBOMe
MDPV	Oxycodone	25B-NBOMe
Butylone	Tramadol	25C-NBOMe
Methylone	Morphine	Fentanyl
Ethylone	Codeine	Acetyl fentanyl
4-MEC	*NPS*	Furanyl fentanyl
Ethylcathinone	2C-P	Acrylfentanyl
Methcathinone	5-MAPB	Cyclopropylfentanyl
Mephedrone	5-EAPB	4-Methyl fentanyl
Pentedrone	Pentylone	Butyryl fentanyl
2C-B	*N*-Ethylpentylone	3-Methylnorfentanyl
4-FA	3,4-DMMC	Acetyl norfentanyl
5/6-APB	Buphedrone	Ocfentanyl
PMA/PMMA	Methedrone	U-47700
MXE	Mexedrone	AH-7921
Diphenidine	Naphyrone	MT-45

NPS = new psychoactive substance (which in this study includes uncommon drugs that are not always considered NPS).

TABLE 2.

Participant demographic and drug use characteristics

	2016 (*n* = 90), % (*n*)	2019 (*n* = 72), % (*n*)	*P*
Age, years			.157
18–25	61.1 (55)	50.0 (36)	
≥26	38.9 (35)	50.0 (36)	
Sex			.261
Male	46.7 (42)	55.6 (40)	
Female	53.3 (48)	44.4 (32)	
Race/ethnicity			.275
White	76.7 (69)	61.1 (44)	
Black	3.3 (3)	4.2 (3)	
Hispanic	6.7 (6)	13.9 (10)	
Asian	7.8 (7)	13.9 (10)	
Other/mixed	5.6 (5)	6.9 (5)	
Education			.468
High school or less	14.4 (13)	9.7 (7)	
Some college	23.3 (21)	30.6 (22)	
College degree	48.9 (44)	41.7 (30)	
Graduate school	13.3 (12)	18.1 (13)	
Sexual orientation			.696
Heterosexual	73.3 (66)	72.2 (52)	
Gay/lesbian	4.4 (4)	8.3 (6)	
Bisexual	15.6 (14)	15.3 (11)	
Other sexuality	6.7 (6)	4.2 (3)	
Past-year EDM party attendance			.093
Once or twice	7.8 (7)	6.9 (5)	
Every couple of months	10.0 (9)	19.4 (14)	
Every month	26.7 (24)	13.9 (10)	
Every other week	20.0 (18)	30.6 (22)	
Every week or more often	35.6 (32)	29.2 (21)	
Where recruited			.456
Nightclub	91.1 (82)	87.5 (63)	
Dance festival	8.9 (8)	12.5 (9)	
Past-year self-reported drug use			
Ketamine	46.7 (42)	34.7 (25)	.125
Amphetamine (nonmedical)	41.1 (37)	45.8 (33)	.547
MDA	22.2 (20)	12.5 (9)	.109
NPS	21.1 (19)	13.9 (10)	.233
Synthetic cathinones	12.2 (11)	4.2 (3)	.070
2C-B	11.1 (10)	9.7 (7)	.774

	2016 (*n* = 90), % (*n*)	2019 (*n* = 72), % (*n*)	*P*
4-FA	3.3 (3)	0.0 (0)	.118
5/6-APB	2.2 (2)	0.0 (0)	.203
Methamphetamine	13.3 (12)	6.9 (5)	.187

Nonmedical use was defined as use without a prescription or in a manner in which it was not prescribed; for example, to get high.

EDM = electronic dance music; NPS = new psychoactive substance (which in this study includes uncommon drugs that are not always considered NPS).

TABLE 3.

Comparison of positive hair test results and perception of adulteration among past-year ecstasy users, 2016–2019

	2016 (*n* = 90), % (*n*)	2019 (*n* = 72), % (*n*)	Absolute change, %	Relative change, %	*P*
MDMA	74.4 (67)	72.2 (52)	−2.2	−3.0	.750
Tested positive after not reporting use					
MDA	34.4 (31)	38.9 (28)	4.5	13.1	.559
MDEA	15.6 (14)	6.9 (5)	−8.7	−55.8	.091
Amphetamine	17.8 (16)	6.9 (5)	−10.9	−61.2	.041
Methamphetamine	22.2 (20)	5.6 (4)	−16.6	−74.8	.003
Ketamine	18.9 (17)	34.7 (25)	15.8	83.6	.022
PCP	2.2 (2)	0.0 (0)	−2.2	−100.0	.050
NPS	31.1 (28)	2.8 (2)	−28.3	−91.0	<.001
Synthetic cathinones	27.8 (25)	2.8 (2)	−25.0	−89.9	<.001
Methylone	1.1 (1)	0.0 (0)	−1.1	−100.0	1.00
Ethylone	11.1 (10)	2.8 (2)	−8.3	−74.8	.067
Butylone	14.4 (13)	0.0 (0)	−14.4	−100.0	.001
Pentylone	10.0 (9)	0.0 (0)	−10.0	−100.0	.005
α-PVP	2.2 (2)	0.0 (0)	−2.2	−100.0	.503
4-FA	3.3 (3)	0.0 (0)	−3.3	−100.0	.255
5/6-APB	1.1 (1)	0.0 (0)	−1.1	−100.0	1.00
PMA/PMMA	1.1 (1)	0.0 (0)	−1.1	−100.0	1.00
2C-B	1.1 (1)	0.0 (0)	−1.1	−100.0	1.00
MXE	2.2 (2)	0.0 (0)	−2.2	−100.0	.503
Diphenidine	1.1 (1)	0.0 (0)	−1.1	−100.0	1.00
Suspected adulteration					
Any drug	36.7 (33)	23.6 (17)	−13.1	−35.7	.074
Methamphetamine	20.0 (18)	5.6 (4)	−14.4	−72.0	.010
“Bath salts”	8.9 (8)	1.4 (1)	−7.5	−84.3	.044

Suspected adulteration refers to self-report that the person who used ecstasy in the past year has ever found or suspected that his or her ecstasy contained another drug other than MDMA. “Bath salts” is a street name for synthetic cathinones in the US.

NPS = new psychoactive substances (which in this study includes uncommon drugs that are not always considered NPS).

TABLE 4.

Unreported exposure to drugs in 2019 that were not tested in 2016

Target analyte	% (*n*)
Cocaine (+BZE)	18.1 (13)
Opioid/opiate (any)	8.3 (6)
Prescription opioid (any)	6.9 (5)
Tramadol	4.2 (3)
Hydrocodone	1.4 (1)
Oxycodone	1.4 (1)
Fentanyl	1.4 (1)

BZE = benzoylecgonine, which is the main metabolite of cocaine.