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Self-Reported Use of Novel Psychoactive Substances in a US Nationally Representative Survey: Prevalence, Correlates, and a Call for New Survey Methods to Prevent Underreporting[*]

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Abstract

Background—In recent years, there has been an increase in emergence and use of novel psychoactive substances (NPS) in the US and worldwide. However, there is little published epidemiological survey data estimating the prevalence of use in the US.

Method—Data on self-reported NPS use came from the National Survey of Drug Use and Health (2009–2013), a national representative sample of non-institutionalized individuals in the US. Subjects were asked to provide names of (non-traditional) drugs they used that they were not specifically asked about. We examined lifetime prevalence and sociodemographic correlates of

self-reported use of new and uncommon synthetic drugs (NPS) among subjects ages 12–34-years-old.

Results—1.2% of subjects self-reported any use of the 57NPS we examined. Use of psychedelic tryptamines (primarily DMT) was most common, followed by psychedelic phenethylamines (e.g., 2C series) and synthetic cannabinoids. Prevalence of self-reported use of NPS increased from 2009–2013 and use was most common among males, whites, older subjects, those of lower income, and among those residing in cities. Lifetime use of various other illicit drugs (e.g., LSD, cocaine, ecstasy/MDMA) was highly prevalent among NPS users.

Conclusion—This the first study reporting on use of a variety of NPS in a nationally representative US sample; however, use appears to be underreported as other national data suggest higher rates of NPS (e.g., synthetic cannabinoid) use. Developing more adaptable survey tools and systematically assessing NPS use would allow researchers to ask about hundreds of NPS and improve reporting as new drugs continue to rapidly emerge.

Keywords

novel psychoactive substances; novel psychoactive drugs; phenethylamines; tryptamines; synthetic cannabinoids; synthetic cathinones

1. INTRODUCTION

Novel psychoactive substances (NPS) have been emerging in the US and worldwide at an unprecedented rate. In 2009, the US National Forensic Laboratory Information System (NFLIS)received drug identification reports of two synthetic cannabinoids and four synthetic cathinones (Senate Caucus on International Narcotics Control, 2013). By 2012, NFLIS received reports on 57 different synthetic cannabinoids and 31 synthetic cathinones. In Europe, 101NPS were discovered in 2014, up from 73 in 2012, 49 in 2011 and 41 in 2010(European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2012, 2015). Globally, 348 NPS were reported by December 2013 to the United Nations Office on Drugs and Crime (UNODC), up from 166 in 2009(UNODC, 2014).

NPS are often sold as "research chemicals," "plant food" or "bath salts," labeled "not for human consumption," and are sold over the Internet, in head shops, or by street dealers. These (often "legal") drugs tend to be synthetic derivatives or analogues of older, more traditional drugs such as cannabis (marijuana), ecstasy (3,4-methylenedioxymethamphetamine [MDMA]), amphetamine, and lysergic acid diethylamide (LSD). Such drugs usually become controlled, but replacement drugs with similar chemical structures are often created to continue to evade law enforcement (Cohen, 2014; Khazan, 2013).

There are hundreds of NPS and many can be classified into somewhat distinct categories. One of the largest stimulant classes that contain many NPS is the phenethylamine class, which includes synthetic cathinones (commonly referred to as "bath salts"), empathogenic stimulants (e.g., N-methyl-1,3-benzodioxolylbutanamine; MBDB), and new psychedelics (e.g., 2C or NBOMe series drugs; Hill and Thomas, 2011). There are also many other stimulant NPS (e.g., piperazines), new synthetic dissociative drugs (e.g., methoxetamine

[MXE], which mimics ketamine), and other psychedelics similar to LSD. Synthetic cannabinoids, which mimic -9-tetrahydrocannabinol (THC), the main psychoactive component in cannabis, have gained prevalence at a fast pace since 2008 (EMCDDA, 2015).

In recent years, numerous case reports and systematic reports from poison centers and forensic laboratories have been published to alert the medical community about rates of reported poisonings and associated adverse outcomes associated with NPS use (Dart et al., 2015; Elliott and Evans, 2014; Forrester, 2013, 2014; Hill et al., 2014; Murphy et al., 2013; Vazirian et al., 2015). However, epidemiologic survey data is sorely needed from representative samples to estimate prevalence of NPS use generally, as well as use of specific NPS or classes of NPS.

While population surveys tend to assess self-reported use of various "traditional" psychoactive drugs (e.g., cocaine), very few national surveys ask about use of newer, less traditional drugs. Some European surveys such as the Crime Survey for England and Wales started asking about mephedrone and benzylpiperazine (BZP)in 2010 (United Kingdom Focal Point on Drugs, 2014) and the Monitoring the Future (MTF) study, a US national representative sample of adolescents in high schools, started asking students about synthetic cannabinoids in 2011 and "bath salts" in 2012 (Miech et al., 2015). However, there are now hundreds of new (or uncommon) psychoactive drugs that are not systematically assessed in these surveys.

According to NFLIS data on NPS cases analyzed by federal, state, and local forensic laboratories, there were 469 reports of synthetic cannabinoids in the first half of 2010, 23,123 reports in the first half of 2012, and 19,838 in the first half of 2014(US Drug Enforcement Administration [DEA], 2014). Reported poisonings involving synthetic cannabinoids have skyrocketed in the US with poisonings increasing 330% in the first quarter of 2015(Law et al., 2015). With respect to synthetic cathinones (a.k.a.: "bath salts"), reports to NFLIS increased from 142 in the first half of 2010 to 7,997 in the first half of 2013 (US DEA, 2014). National and state-specific (e.g., Texas, North Carolina) Poison Control Center data also suggest that use of NPS is on the rise (Dart et al., 2015; Forrester, 2013, 2014; Murphy et al., 2013).

MTF national survey data suggest that about 10% of high school seniors in the US (modal age: 18) have used synthetic cannabinoids and 1% have used "bath salts" in the last 12 months (Miech et al., 2015; Palamar and Acosta, 2015). Indicator data presented by the Community Epidemiology Work Group (CEWG) in the US suggests that synthetic cannabinoids and cathinones appear to be the most prevalent NPS in the US; but there are mixed patterns throughout US cities (CEWG, 2014). Rates of use of psychedelic phenethylamines (e.g., 2C-I) have begun to increase in some US cities as well. However, such indicator data tends to rely on reported poisonings, arrests, seizures, and treatment admissions. Few surveys or assessments ask about use of specific new drugs, so indicator data does not always detect increasing rates of use. Some Internet surveys have focused on users of specific NPS(Carhart-Harris et al., 2011; Johnson and Johnson, 2014), other surveys have focused on individuals at high risk for use (e.g., nightclub attendees; Kelly et al., 2013), and every year the Global Drug Survey (this year taken by users in over 50 countries)

asks thousands of club-goers about use of dozens of NPS(Barratt et al., 2014; Morley et al., 2015; Uosukainen et al., 2015; Winstock et al., 2015; Winstock and Barratt, 2013; Winstock et al., 2014).

While studies of targeted samples have begun to provide rates of use of NPS in high-risk populations (e.g., club-goers), there are little to no data on these drugs from general US population samples. We utilized data from the National Survey on Drug Use and Health (NSDUH), which does not ask specifically about NPS, but allows subjects to enter names of NPS. While this method is limited, this feature helps provide much needed data as national surveys are currently lacking standard questions about NPS. We also delineated sociodemographic and other drug use correlates of use of NPS to inform prevention among subgroups found to be at risk, and provide recommendations for future surveys that assess NPS use.

2. METHODS

2.1. Sample

Data came from the five most recent cohorts (2009–2013) of NSDUH, an ongoing cross-sectional survey of non-institutionalized individuals in the 50 US states and District of Columbia (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014). NSDUH is a nationally representative probability sample of populations living in households obtained through four stages: first, census tracts (subdivisions of counties that are the primary sampling units in the NSDUH survey design) were selected within each state; then, segments (one or more blocks or streets) in each tract were selected; then dwelling units were selected, and finally, respondents were selected.

Surveys were administered through computer-assisted interviewing (CAI) conducted by an interviewer and audio computer-assisted self-interviewing (ACASI). For the CAI, field interviewers administered a computer-based survey to respondents. The CAI collected all core variables. For the ACASI, respondents were provided with a computer and headphones and asked to complete the survey; field interviewers were trained to not look at the screens while the ACASI was being administered in order to maintain privacy and confidentiality, and to increase honest reporting (Butler et al., 2012). The ACASI collected noncore variables including the NPS data reported here (LeBaron and Dean, 2010).

NSDUH provided sampling weights to address unit- and individual-level non-response. Weights were adjusted to ensure estimates are consistent with estimates provided by the US Census Bureau. Since this analysis utilized aggregated data from five cohorts (to increase sample size), weights were divided by 5 (the number of combined datasets). Further information on sampling and survey techniques can be found elsewhere (SAMHSA, 2014). We aggregated data from all cohorts and examined data for individuals, ages 12–34 (*N*=212,123). The weighted interview response rates for 2009, 2010, 2011, 2012, and 2013 were 75.6%, 74.6%, 74.4%, 73.0%, and 71.7%, respectively.

2.2. Drug Use

Subjects were asked whether they had ever used a variety of ("traditional") drugs. NSDUH did not ask about specific NPS; however, after being asked about hallucinogens (e.g., LSD), subjects were then asked: "Have you ever, even once, used any other hallucinogens besides the ones that have been listed?" Those who answered "yes" were told: "Please type in the name of the other hallucinogens you have used." Subjects were able to list up to five drugs. NSDUH provided five variables in its public dataset, each containing coded drug name response categories (containing the number of subjects who typed that NPS name in); e.g., category response #6185 was labeled "25I-NBOMe, 2C-I-NBOMe, BOM-CI, Cimbi-5" to indicate that the subject typed in the name of this particular NBOMe drug. A small number of mentions of NPS (n=31) were also extracted from similar questions where subjects were asked to type in drug names of drugs (not asked about specifically beforehand) for nonmedical use of stimulants, other inhalants, or other drugs they have injected. The only NPS systematically asked about by NSDUH were use of a subclass of tryptamines via the following question: "Have you ever, even once, used any of the following: DMT, also called dimethyltryptamine, AMT, also called alpha-methyltryptamine, or Foxy, also called 5-MeO-DIPT?" Responses to this item were included in our indicator variables representing use of 1) any NPS, and 2) the specific tryptamine class. Survey questions and information on survey skip-patterns are presented in Supplementary Table 1[1].

We chose to examine synthetic drugs reported to NSDUH that were either "new" or "uncommon" (e.g., non-traditional synthetic psychoactive drugs). We chose to include "uncommon" to our criteria because there is currently no standard definition for "new" or "novel" drugs (King et al., 2014). Similarly, while some synthetic drugs are in fact "new" (e.g., the NBOMe series), others such as the 2C series are often seen as "new," even though use has been reported for well over a decade. Other drugs were discovered decades ago and are either uncommon or have re-emerged in recent years. MDA, for example, was discovered over a century ago, but use is not common (as is MDMA). We ultimately chose to include 57 synthetic drugs reported to NSDUH for analysis (listed in Supplemental Table 2[2]). We then collapsed data for all subjects (all five years) into a single cross-section, and collapsed all NPS responses into a single variable indicating whether subjects self-reported use of any NPS. We then categorized all 57 drugs into categories (and subcategories) with categorization guided by government reports (e.g., EMCDDA, NFLIS) and popular websites that discuss these drugs including Erowid, BlueLight, and Wikipedia.

We also created a three-level variable indicating whether each subject used: 1) no illicit drug or NPS, 2) an illicit drug, but not an NPS, or 3) an NPS and an illicit drug. All but 26 subjects who reported use of NPS reported use of any other illicit drug. For consistency, these 26 subjects were omitted from the variable.

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[1]Supplementary material can be found by accessing the online version of this paper at http://dx.doi.org and by entering doi:...
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2.3. Sociodemographic Variables

We examined subject sex, race (i.e., white non-Hispanic, black non-Hispanic, Hispanic, other race), employment status, educational attainment, annual family income, and marriage status. We also examined population density, which was measured in terms of metropolitan statistical areas (MSAs).

2.4. Analyses

We first examined descriptive statistics to determine the prevalence of self-reported use of NPS overall and in each category. We then computed X^2 statistics to determine whether there were significant differences according to use of any NPS with regard to each covariate. We then replicated these bivariable analyses focusing on the three NPS categories that were most prevalent.

Using the three-level variable as the outcome, we then examined correlates of use of 1) an illicit drug, but not an NPS and 2) an illicit drug and an NPS, in comparison to those who reported use of neither. This was done to examine whether NPS users were similar to non-NPS-illicit drug users in comparison to those who used neither. Results were modeled using multinomial logistic regression. We first examined associations of each covariate with both outcome categories (compared to those who reported no use) in a bivariable manner (without controlling for other covariates). We then examined all covariates simultaneously in the same multivariable model. Thus, in the bivariable models each covariate was associated with an odds ratio (OR) and adjusted ORs (AORs) were produced in the single multivariable model. No statistical correction was utilized for multiple testing and all analyses were weighted to account for the complex sample design and analyzed using Stata SE 13 (StataCorp, College Station, TX, 2009), which used the Taylor series estimation methods in order to provide accurate standard errors (Heeringa et al., 2010). This secondary data analysis deemed exempt by the New York University Langone Medical Center Institutional Review Board.

3. RESULTS

A total of 2,423 subjects (1.2%)self-reported use of any NPS (Table 1). The most common classes of drugs reported were tryptamines, psychedelic phenethylamines, and synthetic cannabinoids. The 2C subclass of psychedelic phenethylamines was the most prevalent subclass.

Table 2 presents sample descriptives and results of bivariable analyses by overall NPS and by the three most common classes of NPS. Males, whites, subjects age 18–25, and those residing in MSAs (especially large MSAs), or who were employed full-time, had some college education, or were not married, were at highest risk for NPS use. Lifetime use of each drug was robustly associated with increased risk of using an NPS (all ps<.001). Almost all (95%) subjects who used an NPS also reported lifetime use of alcohol, marijuana, or cigarettes, and lifetime use of ecstasy (79.4%), opioids (79.1%), cocaine (74.3%), and LSD (73.7%)were also common. Regarding analyses of NPS subclasses, results tended to be similar to overall use of NPS, but there were some notable differences across categories. Use of synthetic cannabinoids appeared to be much higher (26.8%) among 12–17-year-olds,

compared to the other two categories, which were used by only 4.6–7.2% of those in this age group. Similarly, use of synthetic cannabinoids does not appear to be as rare among females, Hispanics, or among those in small MSAs compared to other categories. In addition, use of various other drugs among users of synthetic cannabinoids tended to be rarer in comparison to those who used drugs from other classes; however, this might be a function of age as many synthetic cannabinoid users were young and possibly not yet exposed to as many other drugs.

Finally, Table 3 presents results of the multinomial models. Compared to use of other illicit drugs, NPS use has increased in recent years, particularly in 2013. Older subjects were at higher risk for NPS use, as were those residing in cities and those with some college. Racial minorities and married individuals were also at low risk for reporting use of NPS. These significant findings were not only compared to those who reported no use of drugs, but also compared to those who reported use of any other illicit drugs.

4. DISCUSSION

This the first study reporting on self-reported use of a variety of NPS in a nationally representative US sample. Results suggest that about one out of 100 (1.2%) subjects self-reported any use of the 57NPSexamined. Self-reported use of tryptamines (primarily DMT) was most common (reported by 86.1% of NPS users), followed by use of psychedelic phenethylamines and synthetic cannabinoids. We present prevalence and correlates of self-reported use of NPS and some specific NPS classes, but results suggest that the method of assessing NPS use led to (possibly severe) levels of underreporting.

The only other nationally representative US survey that asks about NPS use is MTF, which assesses last 12-month use of synthetic cannabinoids and "bath salts." In MTF, 1% of high school seniors (modal age: 18) report last-year use of "bath salts" and about 10% have reported use of synthetic cannabinoids (Palamar, 2015; Palamar and Acosta, 2015). Therefore, it appears that synthetic cannabinoid use is being underreported to NSDUH, as there is no specific question asking about use. NSDUH only asks specifically about use of DMT/AMT/Foxy, and DMT happened to be the most prevalent NPS reported. While we do not doubt the prevalence of DMT use, we do believe that use of many other NPS (e.g., synthetic cannabinoids) is severely underreported as subjects are not specifically asked about use. Thus, we believe we discovered a bias in which self-reported use of DMT was the most reported NPS solely because it was the only NPS systematically assessed by NSDUH. Past ketamine prevalence helps confirm this bias. Ketamine was used by 1.6% of high school seniors in 2005 (Miech et al., 2015), but NSDUH only received 78 mentions of ketamine use that year via the type-in option (SAMHSA, 2013a). However, in 2006, the first year NSDUH specifically asked about ketamine, prevalence was 1.27% (N=700; SAMHSA, 2013b), suggesting that extreme underreporting occurred prior to asking specifically about ketamine.

Prevalence of use of NPS in this study differed not only from MTF results, but also from other surveillance studies (e.g., NFLIS), which have largely focused on poisoning data or seizure data from law enforcement. From January through June of 2014, NFLIS (US DEA,

2015)received drug identification reports of 19,838 cases revealing synthetic cannabinoids and 14,770 reports of (new) phenethylamines; however, the number of cases involving tryptamines was much lower. In fact, between 2006 and 2010, NFLIS(US DEA, 2012) only received 1,302 reports involving tryptamines. Similarly, a Swedish study focusing on NPS found that reported poisonings associated with synthetic cannabinoids were most common, followed by poisonings by synthetic cathinones (Helander et al., 2013). A study in the UK also found that synthetic cathinones (particularly mephedrone) were most commonly associated with reported poisonings, followed by piperazines (e.g., BZP), "miscellaneous" compounds (e.g., synthetic cannabinoids), and tryptamines (Elliott and Evans, 2014). Interesting, our study found self-report of stimulants (synthetic cathinones) to be rare compared to other NPS.

Despite the limitation of underreporting due to survey design, our study did corroborate correlational results from other studies. Consistent with other literature (CEWG, 2014; Elliott and Evans, 2014; EMCDDA, 2015; Wood, 2013), prevalence of NPS use increased between 2009 and 2013. We also confirmed that males and young adults are at highest risk for use of various NPS(Forrester, 2013; Helander et al., 2013; Murphy et al., 2013; Van Hout and Brennan, 2011; Vazirian et al., 2015). However, results were not as robust within the synthetic cannabinoid subgroup with slightly fewer males and more adolescents reporting use than did for other subgroups. Adding to previous studies, we also found that NPS users tended to have also used various other illicit drugs (Carhart-Harris et al., 2011; Elliott and Evans, 2014; Helander et al., 2013; Murphy et al., 2013). This adds to previous evidence that multi-drug use is common among NPS users just as it is among "club drug" users (Halkitis et al., 2007). Interestingly, rates of other drug use were different among synthetic cannabinoid users compared to users of psychedelic phenethylamines and tryptamines. Specifically, rates of multidrug use tended to be lower among synthetic cannabinoid users. Thus, synthetic cannabinoid users may have different reasons for use than users of other NPS, and these differences might also have to do with availability or shared determinants of "natural" marijuana use.

Results also suggest that NPS use appears to be more prevalent in large cities; although synthetic cannabinoid use appears to be more prevalent in smaller cities. Research is needed to determine whether high rates of use of synthetic cannabinoids in smaller cities are related to local marijuana policies. We also found that NPS users are more likely to be employed (full-time) and/or college-educated; however, again, this did not apply to synthetic cannabinoid users and these users were also more likely to report lower income. Therefore, it appears that synthetic cannabinoid use is a "different animal" compared to other NPS. Adding to our hypothesis that synthetic cannabinoids is a "different animal," we found that white individuals were more likely to report any NPS use; however, over a quarter (27%) of synthetic cannabinoid users identified as Hispanic (compared to 7–10% for other subgroups). It may be that racial minorities are using this "legal" synthetic version of THC to evade arrest because racial minorities are at highest risk for arrest related to marijuana possession (American Civil Liberties Union, 2013; Golub et al., 2007; Johnson et al., 2008; Palamar, 2014; Palamar et al., 2014).

4.1. Limitations

Aside from the limitations previously discussed, it should be noted that NSDUH does not survey active military personnel, homeless individuals (not in shelters), or residents of institutional group quarters, including jails or hospitals. We did not correct for proportions within variables, but data were nationally representative. For each drug class (e.g., "hallucinogens"), subjects were only able to list up to five "other" drugs not asked about. As a result, some subjects who used more than five drugs may have been forced to underreport use; however, <1% of users reported using five NPS or NPS classes.

While many investigations focus solely on what they consider NPS, there is no standard definition for "new" or "novel" (King et al., 2014). For example, many drugs were discovered decades ago, but did not become prevalent until recently. DMT has been a popular drug for decades, but NSDUH combined it with two similar and newer synthetic drugs (AMT and Foxy) so we were unable to disaggregate DMT use; therefore, we simply categorized all drugs as "NPS."

We did not consider mentions of drugs that are not synthetic that happen to contain drugs that are often synthetically produced. For example, we intentionally omitted ayahuasca even though it contains a natural form of DMT. We also did not include salvia divinorum and we did not include d-lysergic acid amide (LSA) as it is often (but not always) derived from natural and not synthetic sources. It is also unlikely that many subjects were sophisticated enough to know the chemical names of all drugs they have used in their lifetime. Moreover, it is not uncommon—especially with "Molly," which is marketed as pure MDMA powder— for drugs to contain NPS as adulterants (Mohr et al., 2015). So it is possible that some subjects who used drugs such as ecstasy did in fact unintentionally use drugs NPS as "bath salts." Finally, the main outcome (lifetime NPS use) was relatively rare (1.2%) as were the subgroups we examined, but we still found many robust and highly significant associations.

Fundamentally, these limitations likely result in misclassification of the outcome. NPS use appears to be severely underestimated in this sample. There also is the possibility of misclassification among drugs with similar effects. Without pill or powder testing, it is often impossible for NPS users to accurately report the specific drugs they have taken; rather users usually report what they have been told they were sold. We must also keep in mind that poisonings and seizures do not necessarily reflect prevalence of use as each drug is associated with its own risk of poisoning and legal sanctions. Likewise, such indicator data may not always accurately reflect rates of use because drug users are a "hidden population" and users tend to remain unrecognized unless they are hospitalized or arrested (National Institute on Drug Abuse, 2006).

4.2. Conclusions

This was the first study to examine self-reported use of a variety of NPS in a nationally representative US sample. About one out of 100 subjects self-reported use within their lifetime and we believe this is an underestimation. While this nationally representative study was able to acquire valuable information on use of various NPS, new drugs are emerging at

a rapid rate (hundreds in the last few years) and we risk underreporting when subjects are not asked about specific new drugs (or drug classes) in a systematic manner.

Asking subjects if they have used "other" hallucinogens, stimulants, inhalants, or whether they have injected "other" drugs does not appear to adequately detect NPS use. We realize that NSDUH did not specifically intend to systematically detect NPS use, and NSDUH does not report on prevalence of NPS in reports, but NPS data is becoming increasingly important. NSDUH also did not begin asking about ketamine, GHB, or DMT until 2006, when use was already prevalent for many years. "Molly" use has also been prevalent and problematic in the US for years and MTF did not add it to the definition of ecstasy until 2014 (Miech et al., 2015) and NSDUH has just added it to its 2015 survey (Federal Register, 2014). Timely inclusion of new drugs is essential in order for researchers to examine correlates of use to help prevent epidemics. Standard questions are needed for many drugs (or drug classes). We believe this can be accomplished by asking about a specific drug class (e.g., "bath salts") and listing NPS in that class (e.g., "Flakka"). If the subject answers affirmatively, then follow-up questions would be asked for specific drugs. Surveys can provide options to type in names of NPS (provided back-end coding of misspellings and street names is in place), but programming can be informed by annual/semi-annual reports published by NFLIS and EMCDDA. Thus, an updated and adaptable survey tool, which asks about various NPS and/or NPS classes would prevent underreporting and allow us to detect use of new drugs in a timely manner.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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HIGHLIGHTS

1.2% of individuals in the US, age 13–34, reported use of a novel psychoactive substance

Use of tryptamines was most common, followed by psychedelic phenethylamines

Use increased from 2009 through 2013 and use of other illicit drugs was common

Males, whites and older or unmarried subjects were more likely to report use

An adaptable survey tool would improve reporting as new drugs continue to emerge

Table 1

Prevalence of lifetime self-reported use of NPS.

	Users (Unweighted *N*)	% in subsample of 2,423	% of full sample (Unweighted *N* = 213,076)
Any New or Uncommon Synthetic Drug Use	2,423	100.0	1.230
Psychedelic Phenethylamines	447	17.5	0.216
NBxx (NBOMe) Series	32	1.2	0.015
2C Series	400	15.8	0.195
Dox Series	41	1.5	0.019
Phenethylamines, Cathinones, and Euphoric Stimulants	79	3.9	0.048
Psychedelic Tryptamines	2,037	86.1	1.060
Synthetic Cannabinoids	118	3.6	0.045
Arylcyclohexylamines (dissociatives)	5	0.2	0.002
Psychedelics (non-phenylethylamine)	3	0.3	0.003

Note. The values presented were derived from five years (five cohorts) of data for subjects age 12–34 years old. Subjects were given the opportunity to type in names of NPS they used. The only NPS systematically asked about was DMT/AMT/Foxy, which is in the psychedelic tryptamine category. Since some subjects self-reported use of NPS from more than one class, the percentages above exceed 100%. Nbxx, 2C and Dox series are subcategories within the Psychedelic Phenethylamine class. See Supplemental Table 1 for list of specific drugs in each category.

Table 2

Sample characteristics and bivariable analyses examining differences among those who self-reported use of any NPS and among the three most prevalent self-reported NPS categories (within the full sample).

	Full Sample (N = 213,076)	Any NPS Use (N = 2,423)	Psychedelic Phenethylamines (N = 447)	Psychedelic Tryptamines (N = 2,037)	Synthetic Cannabinoids (N = 118)
	%	%	%	%	%
Year					
2009	19.7	12.3	9.7	12.9	0.0[++]
2010	19.8	16.7	19.5	17.3	5.3
2011	20.0	17.8	19.9	16.7	21.1
2012	20.2	24.0	19.1	24.3	34.0
2013	20.3	29.2	31.9	28.8	39.7
Age					
12–17	25.9	7.6	4.6	7.2	26.8[++]
18–25	35.8	57.0	67.7	55.4	55.6
26–34	38.3	35.4	27.7	37.4	17.7
Sex					
Male	50.2	74.3	79.8	75.0	71.2[+++]
Female	49.8	25.7	20.2	25.0	28.8
Race					
White	57.8	81.8	88.8	81.9	70.2[+]
Black	13.6	2.4	0.9	2.4	0.0
Hispanic	20.4	10.3	6.7	9.9	26.7
Other	8.2	5.6	3.6	5.8	3.2
Population Density					
Non-MSA	14.5	10.9	12.0[+]	11.0	19,2[+++]
Small MSA	30.6	35.6	32.7	35.7	47.6
Large MSA	54.9	53.4	55.3	53.4	33.2
Employment [a]					

	Full Sample (N = 213,076)	Any NPS Use (N = 2,423)	Psychedelic Phenethylamines (N = 447)	Psychedelic Tryptamines (N = 2,037)	Synthetic Cannabinoids (N = 118)
	%	%	%	%	%
Not employed	31.2	31.5	25.8+++	32.3	37.4+
Part-time	17.5	23.3	26.3	22.1	29.7
Full-time	38.7	44.4	47.8	44.8	29.1
(age 12–14)	12.6	0.8	0.0	0.8	3.4
Education [b]					
Less than high school	11.0	13.3	7.7	14.1	17.6+
High school graduate	22.1	26.5	26.7	26.8	26.2
Some college	22.5	34.2	43.8	33.7	16.8
College graduate	18.5	18.4	17.3	18.3	12.6
(age 12–17)	25.9	7.6	4.6	7.2	26.8
Family Income					
<$20,000	22.7	28.0+++	29.2+	28.3+++	22.0+
$20000–$49,999	33.8	32.9	27.9	32.9	47.5
$50,000–$74,599	16.5	16.8	15.8	16.7	12.4
$75,000	26.9	22.2	27.0	22.1	18.0
Married [c]					
No	65.6	90.0	95.2	89.9	92.5
Yes	21.8	9.2	4.8	9.3	3.7
(age 12–14)	12.6	0.8	0.0	0.8	3.8
Drug Use					
Alcohol	73.9	98.7	99.7	98.5	98.2
Marijuana	43.9	97.3	99.6	97.5	87.9
Cigarettes	53.6	95.4	97.3	96.0	81.9+++
Ecstasy (MDMA)	11.3	79.4	87.7	80.5	41.7
Opioids (e.g., Percocet, Vicodin)	19.3	79.1	82.3	79.6	65.6
Cocaine	12.2	74.3	81.3	75.2	49.2
LSD	7.7	73.7	84.3	76.1	33.2

	Full Sample (N = 213,076)	Any NPS Use (N = 2,423)	Psychedelic Phenethylamines (N = 447)	Psychedelic Tryptamines (N = 2,037)	Synthetic Cannabinoids (N = 118)
	%	%	%	%	%
Tranquilizers (e.g., Xanax, Valium)	10.7	66.1	74.0	67.2	54.1
Stimulants (e.g., amphetamine)	8.0	56.9	65.2	57.9	37.9
Ketamine	1.9	36.9	40.6	39.4	16.2
Methamphetamine	3.1	28.8	35.6	30.4	14.1
Heroin	1.7	23.9	29.5	25.5	8.0[+++]
PCP	1.3	16.3	11.4	17.5	8.3
GHB	1.0	13.0	15.9	14.1	3.8[+]
Sedatives (e.g., Methaqualone)	1.4	11.9	14.8	12.3	12.7

Note. Significance was determined for all covariates for overall NPS and for NPS classes using the full national sample, $N = 213,076$. The *N*s below each category title only represent the number of subjects in that category. The values presented were derived from five years (five cohorts) of data for subjects age 12–34 years old. Subjects were given the opportunity to type in names of NPS they used. Desoxyn and Methedrine were included in the methamphetamine category.

[a] One (under-age) subject was not included in chi-square calculations for psychedelic phenethylamines because not enough subjects in this cell.

[b] The three subjects who graduated college were not included in chi-square calculation for synthetic cannabinoids because not enough subjects in this cell.

[c] One (under-age) subject was not included in chi-square calculations for psychedelic phenethylamines, and chi-square was not computed for synthetic cannabinoids because only three were married (and seven were under-age). Most tests were $p < .001$ so those with larger *p*-values are indicated by:

[+] p .05,

[++] $p < .05$,

[+++] $p < .01$.

Table 3

Multinomial logistic regression models delineating correlates of use of any new or uncommon synthetic and other illicit drugs.

| | Unconditional Models | | | | Conditional Model | | | |
| | Used Any Illicit Drug (other than an NPS) | | Used Any NPS | | Used Any Illicit Drug (other than an NPS) | | Used Any NPS | |
	OR	95% CI	OR	95% CI	AOR	95% CI	AOR	95% CI
Year								
2009	1.00		1.00		1.00		1.00	
2010	0.99	(0.95, 1.03)	1.32	(0.99, 1.77)	0.97	(0.93, 1.02)	1.27	(0.96, 1.69)
2011	0.99	(0.94, 1.04)	1.42*	(1.09, 1.84)	1.00	(0.95, 1.06)	1.43**	(1.10, 1.88)
2012	1.00	(0.98, 1.02)	1.39***	(1.21, 1.59)	1.01	(0.98, 1.03)	1.40***	(1.22, 1.60)
2013	0.99	(0.93, 1.06)	2.32***	(1.82, 2.95)	1.00	(0.94, 1.07)	2.37***	(1.86, 3.01)
Age								
12–17	1.00		1.00		1.00		1.00	
18–25	4.69***	(4.56, 4.82)	10.00***	(8.48, 11.79)	2.41***	(2.28, 2.55)	4.72***	(3.76, 5.93)
26–34	5.36***	(5.18, 5.55)	6.18***	(5.01, 7.62)	3.29***	(3.07, 3.53)	4.84***	(3.64, 6.43)
Sex								
Male	1.00		1.00		1.00		1.00	
Female	0.82***	(0.79, 0.84)	0.31***	(0.26, 0.36)	0.80***	(0.77, 0.83)	0.31***	(0.26, 0.36)
Race								
White	1.00		1.00		1.00		1.00	
Black	0.76***	(0.73, 0.80)	0.10***	(0.07, 0.15)	0.68***	(0.64, 0.72)	0.08***	(0.05, 0.11)
Hispanic	0.63***	(0.60, 0.66)	0.27***	(0.22, 0.34)	0.56***	(0.53, 0.59)	0.22***	(0.17, 0.27)
Other	0.48***	(0.46, 0.52)	0.32***	(0.24, 0.43)	0.44***	(0.41, 0.47)	0.27***	(0.20, 0.36)
Population Density								
Non-MSA	1.00		1.00		1.00		1.00	
Small MSA	1.11***	(1.06, 1.16)	1.64***	(1.36, 1.98)	1.18***	(1.12, 1.24)	1.86***	(1.53, 2.26)

| | Unconditional Models | | | | Conditional Model | | | |
| | Used Any Illicit Drug (other than an NPS) | | Used Any NPS | | Used Any Illicit Drug (other than an NPS) | | Used Any NPS | |
	OR	95% CI	OR	95% CI	AOR	95% CI	AOR	95% CI
Large MSA	1.10***	(1.05, 1.15)	1.35**	(1.10, 1.67)	1.25***	(1.19, 1.31)	1.92***	(1.54, 2.39)
Employment								
Not employed	1.00		1.00		1.00		1.00	
Part-time	1.38***	(1.34, 1.43)	1.56***	(1.31, 1.87)	1.13***	(1.09, 1.18)	1.08	(0.90, 1.30)
Full-time	1.71***	(1.64, 1.78)	1.51***	(1.29, 1.77)	1.23***	(1.17, 1.29)	1.06	(0.87, 1.29)
Education								
Less than high school	1.00		1.00		1.00		1.00	
High school graduate	1.12**	(1.04, 1.20)	1.09	(0.86, 1.38)	1.07	(1.00, 1.14)	1.01	(0.79, 1.28)
Some college	1.22***	(1.14, 1.30)	1.45**	(1.16, 1.80)	1.14***	(1.07, 1.22)	1.27*	(1.02, 1.59)
College graduate	1.04	(0.97, 1.11)	0.85	(0.65, 1.12)	0.93	(0.87, 1.00)	0.84	(0.63, 1.13)
Family Income								
<$20,000	1.00		1.00		1.00		1.00	
$20000–$49,999	0.97	(0.93, 1.01)	0.77**	(0.64, 0.93)	0.96	(0.92, 1.00)	0.85	(0.71, 1.03)
$50,000–$74,599	0.89***	(0.84, 0.95)	0.78	(0.59, 1.02)	0.88***	(0.83, 0.94)	0.84	(0.63, 1.10)
$75,000	0.80***	(0.76, 0.83)	0.59***	(0.49, 0.72)	0.83***	(0.79, 0.87)	0.60***	(0.49, 0.73)
Married								
No	1.00		1.00		1.00		1.00	
Yes	0.91***	(0.86, 0.95)	0.28***	(0.22, 0.36)	0.64***	(0.61, 0.68)	0.24***	(0.19, 0.31)

Note. NPS use (1.2%) and other illicit drug use (47.5%) were compared to subjects who never had used any drug (51.3%). Significance was determined for any NPS use using the full national sample, $N = 213,076$. OR = odds ratio, AOR = adjusted odds ratio, CI = confidence interval. The unconditional models do not adjust for other covariates. All covariates were adjusted in the conditional model. Models examining employment, education and marital status contained an indicator variable for subjects who legitimately skipped the item because they were underage. Results of these indicators are not presented as they subsample sizes were very small. Models do not contain a subgroup for the 26 users of new or uncommon drugs who did not report use of another illicit drug.

*
 $p < .05$,

**
 $p < .01$,

***
$p < .001$