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Characteristics of novel psychoactive substance exposures reported to New York City Poison Center, 2011–2014

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Abstract

Background—Novel psychoactive substances (NPS) are emerging at an unprecedented rate. Likewise, prevalence of use and poisonings has increased in recent years.

Objective—To compare characteristics of NPS exposures and non-NPS-drug-related exposures and to examine whether there are differences between exposures involving synthetic cannabinoid receptor agonists (SCRAs) and other NPS.

Methods—Poison control center data from the five counties of New York City and Long Island were examined from2011–2014. We examined prevalence and characteristics of NPS exposures (classified as intentional abuse) and compared characteristics of cases involving SCRAs and other NPS.

Results—Prevalence of NPS exposures was 7.1% in 2011, rising to 12.6% in 2014. Most exposures (82.3%) involved SCRA use. The second and third most prevalent classes were phenethylamines/synthetic cathinones ("bath salts"; 10.2%) and psychedelic phenethylamines (4.3%). Compared to other drug-related exposures (i.e. involving licit and illicit drugs), those who used NPS were more likely to be younger, male, and to have not co-used other drugs (ps < 0.001). SCRA exposures increased sharply in 2014 and the mean age of users increased over time (p < 0.01). Females exposed to SCRAs were younger than males (p < 0.001), and in 2014, individuals exposed to SCRAs were more likely to report concomitant use of alcohol than users of other NPS (p = 0.010). Users of other NPS were more likely than SCRA users to report concomitant use of ecstasy/3,4-methylenedioxymethamphetamine (MDMA)/"Molly" (p < 0.001).

Conclusion—Exposures reported to the poison center that involve NPS are increasing and the majority involve SCRAs. These findings should inform prevention and harm reduction approaches.

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Declaration of interest

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

Keywords

Novel psychoactive substances; synthetic cannabinoid receptor agonists; drug exposures; synthetic cathinones; ecstasy (3; 4-methylenedioxymethamphetamine; MDMA)

Introduction

Novel psychoactive substances (NPS), also known as new psychoactive drugs, have been emerging at an unprecedented rate in the United States and worldwide. In 2014, 101 NPS were discovered throughout Europe, and this was a substantial increase from the 41 NPS discovered in 2010 (1,2). Emergence of NPS and exposures related to NPS have also been increasing in the US (3–7). Exposures related to synthetic cannabinoid receptor agonist (SCRA) use in particular have been increasing in the US in recent years (6,7). Unfortunately, there is a lack of epidemiology data on use and exposures related to NPS in the US, particularly with regard to correlates and characteristics of users and exposures. Various NPS classes exist, yet there has been little to no research comparing users of different classes, which is important as some classes of NPS might pose unique risks to susceptible individuals.

The American Association of Poison Control Centers' National Poison Data System – a large surveillance database containing information regarding all reported poisonings in the US – reported that between 2011 and 2013, there were 14,866 exposures to synthetic cannabinoid receptor agonists (SCRAs), 9823 exposures to synthetic cathinones (aka: "bath salts"), and 8915 exposures to hallucinogenic amphetamines (8–12). Although exposures to synthetic cathinones have decreased in recent years (with the National Poison Data System reporting only 898 exposures from 2014 through July 31, 2015), SCRA exposures are still being reported at high rates (e.g. 8902 from 2014 through August 11 2015) (8,9). Data on hallucinogenic amphetamines and other NPS are not yet available for 2014–2015.

Recently, of all NPS in the US, the SCRAs are of particular concern. SCRAs – sometimes erroneously referred to as "synthetic marijuana" or "synthetic cannabis" – are compounds with at least some receptor mediated effects similar to Δ^9-tetrahydrocannabinol, the main psychoactive component in natural cannabis (marijuana) (13,14), although SCRAs tend to have a much higher binding affinity and higher dose-response efficacy (15). There are at least 134 of these compounds available worldwide and more are being discovered at an alarming rate (2). According to Monitoring the Future, the only nationally representative survey in the US that asks about SCRA use (as "synthetic marijuana"), in 2011–2013, 10% of high school seniors (12th graders modal age: 18 years) reported use in the last year (16). Even though overall prevalence of substance use (via self-report on surveys) appears to be decreasing since 2014 (17), reports of exposures related to SCRA use have increased in recent years. From 2010 through 2011, emergency department visits in the US more than doubled from 11 406 to 28 531 (7). The United States Centers for Disease Control and Prevention (CDC) also recently reported that exposures increased 330% in the first quarter of 2015 (6).

Synthetic cathinones ("bath salts") are a class of synthetic phenethylamines that have also increased in popularity in recent years. "Bath salts" have clinical effects similar to amphetamine and 3,4-methylenedioxymethamphetamine (MDMA; ecstasy, commonly referred to as "Molly" in the US) and common drugs in this class include methylenedioxypyrovalerone (MDPV; naphyrone, "NRG-1"), bk-MDMA (mephedrone), and now alpha-pyrrolidinopentiophenone (alpha-PVP; "Flakka"). According to Monitoring the Future survey results, self-reported use is low with only 1% of high school seniors (modal age: 18 years) reporting use (17,18). However, synthetic cathinones have been associated with a variety of adverse medical outcomes such as agitation, insomnia, dysphoria, paranoia, and psychosis (19). In 2011, almost 23 000 emergency department visits were related to "bath salt" exposures in the US alone (20).

Analyses are needed not only to determine the prevalence of use and exposures related to use of NPS, but information is also needed to determine differences in user characteristics of different NPS and NPS classes. Understanding user profiles of different NPS and NPS classes is important to inform prevention and harm reduction in a time of increasing emergence of NPS and increasing prevalence and exposures related to use. Utilizing local metropolitan New York City Poison Control data, we sought to examine correlates of NPS exposures and to compare user characteristics of the NPS most commonly involved in exposures – SCRAs – to other, less common NPS.

Methods

The New York City Poison Control Center provides treatment advice to both the public and to healthcare staff who are treating individuals with suspected poisonings involving chemicals, licit and illicit drugs, and plants. The catchment area of the poison control center includes the ~11 million people who reside in the five counties of New York City proper and some surrounding counties including Nassau and Suffolk. Drug and demographic information are recorded as per American Association of Poison Control Center standards and stored in a SQL database. Retrospective data for drug-related primary complaints reported to the New York City Poison Control Center at the New York City Department of Health and Mental Hygiene were examined. Preliminary analyses focused on reported exposures between January 2002 and December 2014, focusing on cases that were classified as involving intentional abuse of a substance (regardless of whether follow-up was conducted). We sorted the data according to drug name (or drug class) reported by the user or healthcare provider as well as the drug (or "street" drug) name reported by users. Cases involving use of an NPS were identified via three iterations of sorting and coding the full dataset. All "street" or unknown drug names were searched via Google and on popular websites such as Erowid, which contain information on drug effects posted by "psychonauts" (individuals who use mind-altering substances to explore other states of consciousness) (21). A dichotomous variable indicating use of an NPS was created and then drugs were further categorized into NPS classes (e.g. SCRA, tryptamine). The comparison group to NPS was thus reported exposures involving intentional abuse of other licit or illicit drugs (e.g. marijuana, cocaine, alcohol, benzodiazepines, tricyclic antidepressants).

We first examined reported prevalence (percentage of reported cases) of exposures involving any NPS and specific NPS classes overall and by year of report. As shown in Table 1, reported NPS exposures were very rare through 2010 so all analyses focused on years 2011–2014 (n = 5469). Reported route of administration was examined for each NPS class, and then we compared prevalence of reported NPS exposures to reported non-NPS exposures (exposures to other substances, which were not deemed NPS) within the full sample. Bivariable statistics were used to examine whether prevalence differed by key variables – year (2011–2014), reported sex, age, and number of self-reported concomitant drugs used during the instance of the cases' complaint. Bivariable statistics were computed using independent samples t-tests for continuous covariates and using Chi-square and Fisher's Exact tests for categorical covariates. All covariates were then fit into a multivariable logistic regression model to determine how all covariates relate to reported prevalence of NPS exposures with all else being equal. Thus, all covariates were entered simultaneously and each covariate in the model is associated with an adjusted odds ratio (AOR) and 95% confidence interval (CI). These bivariable and multivariable statistics were then repeated within the NPS exposure subsample, but comparing reported exposures involving "other" NPS to reported exposures involving use of SCRAs. Polydrug use was then compared between reported exposures involving other NPS and reported exposures involving SCRAs, and we also compared these two groups more specifically with regard to year and mean age. Finally, within these two subgroups we examined whether there were significant differences between covariates (e.g. between polydrug use, route of administration, and sex). The New York City Department of Health and Mental Hygiene Institutional Review Board approved of this secondary data analysis.

Results

Between 2011 and 2014, of exposures reported to the New York City Poison Control Center involving intentional abuse, the reported prevalence of NPS exposures was 7.7% (n = 423). The majority (82.3%) involved SCRA use. The second and third most prevalent classes were phenethylamines/synthetic cathinones (aka: "bath salts"; 10.2%) and psychedelic phenethylamines (e.g. 2C and N-(2-methoxybenzyl)phenethylamine [NBOMe] series; 4.3%). Descriptive statistics across NPS classes are presented in Table 2. With regard to route of administration (Table 3), the majority of users either ingested or inhaled the drug. Inhalation-only was most common for SCRAs (72.7%) and ingestion-only was most common for phenethylamines/synthetic cathinones (48.8%). Seven percent of phenethylamine/synthetic cathinone users reported injection.

NPS users were significantly different from the rest of the cases on all key covariates examined (Table 4). Reports of NPS exposures increased substantially between 2011 and 2014 from 7.1–12.6% with users at more than twice the odds of reporting an NPS exposure in 2014 (AOR = 2.06, $p < 0.001$, compared to 2011). Only a fifth (20.3%) of females reported an NPS exposure (compared to 32.3% of females reporting exposures related to non-NPS), and holding all other covariates constant, females were at about half the odds for reporting an NPS exposure (AOR = 0.54, $p < 0.001$). On average, those who were exposed to an NPS were about 5 years younger than non-NPS exposures with the average age of NPS users being 26.7 (SD = 11.7) compared to 31.3 years old (SD = 13.9) ($p < 0.001$). Older

cases remained at lower odds for reporting NPS use in the multivariable model. Concomitant use of other drugs was examined in both a dichotomous and continuous manner and both methods had similar results. Any polydrug use (co-use of at least one psychoactive drug with an NPS) was reported by 14.9% of those exposed to an NPS (compared to 31.3% of non-NPS users) with NPS users being at 65% lower odds of reporting polydrug use during the exposure (AOR = 0.35, $p < 0.001$).

Within the subsample of NPS users (comparing users of other NPS to users of SCRAs), there were no significant differences with regard to sex, age, or polydrug use (Table 5). However, in 2014, compared to SCRA use, reported exposures involving other NPS were much lower. As shown in Figure 1, reported exposures involving other NPS use remained relatively stable from 2011–2014; however, reported SCRA exposures increased in 2011–2012, decreased in 2013, and steeply increased in 2014. In addition, we found that average age of those with reported SCRA exposure increased over time (Figure 2), while the average age of reported users of other NPS significantly decreased from 2011 through 2012 and then remained relatively stable. Alcohol (4.5%) and marijuana (4.3%) were the two most common drugs reportedly co-used with NPS (Table 6). When comparing concomitant use of other psychoactive drugs, the only significant difference was that ecstasy/MDMA/"Molly" was more commonly reported to be co-used with other NPS (6.7%) and not with SCRAs (0%) ($p < 0.001$).

There were no significant differences between covariates in the subsample of users of other NPS, but with regard to users of SCRAs, we found that cases that reported co-use of alcohol were more likely to report inhalation-only ($p < 0.001$). In addition, all reported SCRA users who co-used marijuana were male ($p = 0.049$), and females who reportedly used SCRAs were significantly younger than males ($M = 22.5$ years [SD = 10.3] vs. $M = 28.4$ years [SD = 12.3]), $p < 0.001$). Finally, in 2014, the year use steeply increased, users who reported exposures were less likely to report ingestion-only (13.6% vs. 24.2% [2011–2013], $p = 0.013$); and in 2014, users were more likely to report concomitant use of alcohol (8.4% vs. 2.1% [2011–2013], $p = 0.010$).

Discussion

NPS are emerging at an unprecedented rate both in the US and worldwide (1–5). Exposures related to NPS such as "bath salts" have increased in recent years (20), and exposures related to SCRA use in particular are increasing in the US (6–8). There is a lack of epidemiology data on use of NPS and exposures related to NPS in the US, particularly regarding characterstics of users and exposures. This analysis was among the first to compare correlates and characteristics of reported exposures to SCRAs and other NPS classes.

There were relatively few reports of NPS-related exposures in the US prior to 2010, and in 2010, SCRAs ("Δ^9-tetrahydrocannabinol homologs") and "designer amphetamine ('bath salt')" exposures were identified by the American Association of Poison Control Centers as emerging public health threats (22). Prevalence of NPS-related exposures in the US (and in New York City) began to increase in 2011 (10). Thus, we limited all statistical analyses to

years 2011–2014, and recently within New York City, prevalence of NPS-related exposures more than doubled within a single year (from 4.8% in 2013 to 12.6% of reported exposures in 2014). The majority of cases (82.3%) involved SCRAs.

Compared to males, females were at about half the odds for reporting an exposure related to NPS use. Even though there was not a significant sex difference between use of SCRAS and other NPS, females exposed to SCRAs on average were significantly younger than males who were exposed. Females are already at lower risk for use of various drugs, but adding to previous studies examining poisoning data (7,23–26), this study adds evidence that females are much less likely to have a reported exposure to NPS. A previous analysis of a nationally representative sample of American high school seniors found that females are less likely to report recent use of SCRAs; however, they are not significantly less likely to report more frequent recent use (16). In the same national sample, fewer females reported use of “bath salts”, but this result was not statistically significant (18).

Results also suggest that younger individuals were more likely to report an NPS exposure than older individuals. While there were no significant age differences between SCRAS and other NPS overall, we did delineate a significant trend demonstrating that the mean age of individuals with reported exposure to SCRAs has steadily increased in New York City between 2011 and 2014. We also found that in 2014, the year reported SCRA exposures steeply increased in New York City, a significantly smaller portion of individuals reported ingesting-only, and they were more likely to report concomitant use of alcohol. Similar to the recent CDC report describing SCRA exposures increasing in the US in 2015 (6), our 2014 New York City data suggest that route of administration and concomitant use of alcohol may serve as contributing factors to increasing rates of reported exposures. Further research is needed as exposures continue to increase.

Interestingly, reported NPS exposures were much less likely to be associated with reported polydrug use than those with other drug exposures (only 14.9% vs. 31.3% of non-NPS exposures). Alcohol (4.5%) and marijuana (4.3%) were the most commonly reported drugs taken in conjunction with NPS. Results are consistent with previous research suggesting that polydrug use is common among NPS users and that alcohol was the drug most commonly used in combination with NPS (as a general category) and with specific NPS such as mephedrone (27,28). We must keep in mind that when an individual uses more than one drug it cannot necessarily be determined whether the poisoning occurred due to effects of the NPS itself, an interaction of the NPS and another drug, or due to the other drug (or surrounding circumstances involving “set” [mindset] and/or setting). It should be noted that all SCRA reports involving co-use of marijuana were male, and compared to SCRAs, users of other NPS were significantly more likely to report concomitant use of ecstasy/MDMA/“Molly”. More specifically, the cases involving co-use of ecstasy reportedly used 25i-NBOMe, benzylpiperazine (BZP), dimethyltryptamine (DMT), or unspecified “bath salts”. Evidence has been emerging that in the US, ecstasy – especially in powder form which is referred to as “Molly” (which is often thought to be pure MDMA) – is commonly being adulterated with other drugs such as “bath salts” (29). While this study does not add to the dearth of research focusing on the purity of “Molly” in the US, our findings do suggest that

some individuals appear to intentionally (or at least knowingly) combine ecstasy with other NPS.

Ingestion and inhalation were the main routes of NPS administration and inhalation-only was the most common method of use of SCRAs (72.7%), followed by ingestion-only (19.5%). These findings are similar to the recent 2015 CDC report, which suggests that 80.3% of SCRA users who were exposed in the US inhaled and 19.5% ingested the drug (6). We did find a link between inhalation-only and alcohol use as those who smoked SCRAs were more likely to report concomitant use of alcohol, but further research is necessary to determine whether this specific route of administration is a particular risk factor when alcohol is being co-used.

Compared to exposures related to use of non-NPS, NPS users were also more likely to be treated at a healthcare facility. More research is needed, but this may be indicative of a reporting bias in which poison control centers are more likely to receive reports from healthcare facilities because the substance(s) used may be relatively unknown to staff (and thus may be more likely to be reported). Visits to healthcare facilities may in fact be related to severity of adverse effects (as we found that NPS users were more likely to report mild or moderate effects), but this may also suggest that users of NPS may be less familiar with adverse effects associated with use of NPS and take extra precaution by admitting themselves.

With regard to severity of adverse effects, similar to the 2015 CDC report (6), less than 4% of those exposed to NPS in New York City reported “no adverse effects”; and there were no deaths reported (compared to 0.5% in the CDC report). In this sample, 7.0% of cases were coded by poison control centers as having a “major adverse effect” (compared to 11.3% in the CDC report), which indicates a life-threatening effect or an effect that can result in substantial disability. However, a higher percentage of “moderate adverse effects” (61.6% vs. 47.5%) (which are not life-threatening, but tend to require treatment) and a lower percentage of minor adverse effects (24.5% vs. 37.0%; which tend to resolve quickly) were reported compared to the national sample in the CDC report (6).

These analyses compared user characteristics of individuals with reported NPS exposures and those with exposures to non-NPS drugs, but importantly, we examined whether there are key differences between users of SCRAs and users of other NPS. While we did not find key differences with regard to sex, age, number of drugs co-used, or severity of adverse effects, we did find some differences suggesting that SCRA use still may be a bit of a “different animal” (30) than other NPS with regard to types of users. Specifically, we found that rates of reported exposures (SCRA vs. other NPS) did not coincide with one another as other NPS-related exposures remained relatively stable while SCRA exposures fluctuated dramatically and sharply increased in 2014. We also found that average age of those with reported SCRA exposures increased over time, suggesting that the user profile may be shifting over time. We believe that users of these two categories of drugs tend to have different reasons for use. For example, psychedelic or hallucinogen-using psychonauts and nightclub and festival attendees appear to be more drawn to NPS that have stimulant and/or psychedelic effects (31). Nightclub attendees (primarily those who prefer electronic dance

music) also report high rates of NPS use compared to the general population (31,32). Our results appear to confirm associations between drugs of this type, as users of other NPS are more likely to report concomitant use of ecstasy (which is among the most common "club drugs" (17,33,34). Research suggests, however, that SCRAs are commonly used by individuals whose drug of choice is marijuana (16,35–37), and they may be using these compounds in order to avoid arrest (hence the term "legal weed") (38).

Limitations

A main limitation of poison control center studies is that results only reflect users or their healthcare providers who voluntarily contact a poison control center to report an adverse effect; therefore, NPS exposures are underestimated. Results also should not be used to infer rates of actual use as users have different drugs have different levels of risk and thus different likelihoods of experiencing and/or reporting an adverse effect. However, the main reason for these analyses was not to estimate rates, but to examine and compare overall characteristics between SCRA and other NPS-related exposures. Polydrug use was not common within the NPS group, but when polydrug use did occur, it is unknown which drug – or a combination of both drugs – led to the reported adverse effect(s). Finally, many individuals appear to use "traditional" drugs that may happen to be adulterated with NPS (e.g. "Molly" adulterated with "bath salts") (29,39), and many users are not aware of the exact drug they are taking (e.g. lysergic acid diethylamide [LSD] vs. NBOMe). Therefore, without toxicological confirmation we lacked the ability to be sure that the drugs reported were in fact the drugs used. There were only 423 cases involving NPS in this sample, so we had limited power to detect associations and differences. Finally, we were unable to obtain race/ethnicity data; thus, we were not able to detect potential key race/ethnicity associations.

Conclusions

NPS are emerging at an unprecedented rate in the United States and worldwide (1–5), and prevalence in use and exposures has increased in recent years. Increases in exposures involving NPS in the US and in New York City are being driven primarily by SCRAs. This was among the first studies to investigate correlates of reported NPS exposures and compare correlates between SCRA exposures and other NPS. Further research is needed to compare subclasses of NPS to inform prevention and harm reduction, but special attention needs to be paid to SCRAs, which are emerging at a rapid rate and leading to thousands of poisonings in the US every year.

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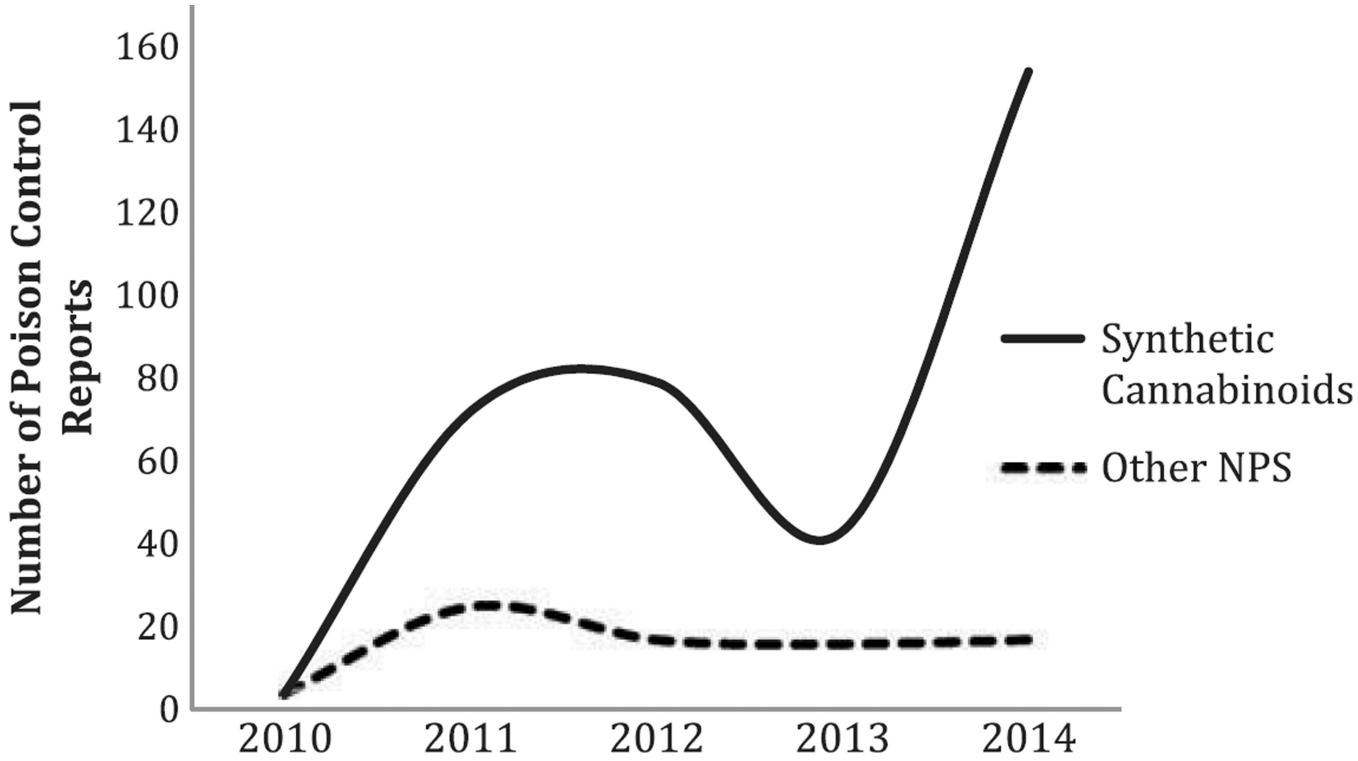

Figure 1.

Comparison of SCRA reports to reports of other NPS from 2011–2014. Number of exposures to SCRAs increased compared to number of exposures to other NPS ($\chi^2[3] = 14.98$, $p = 0.002$). *Note*: Year 2010 was not included in statistical computation.

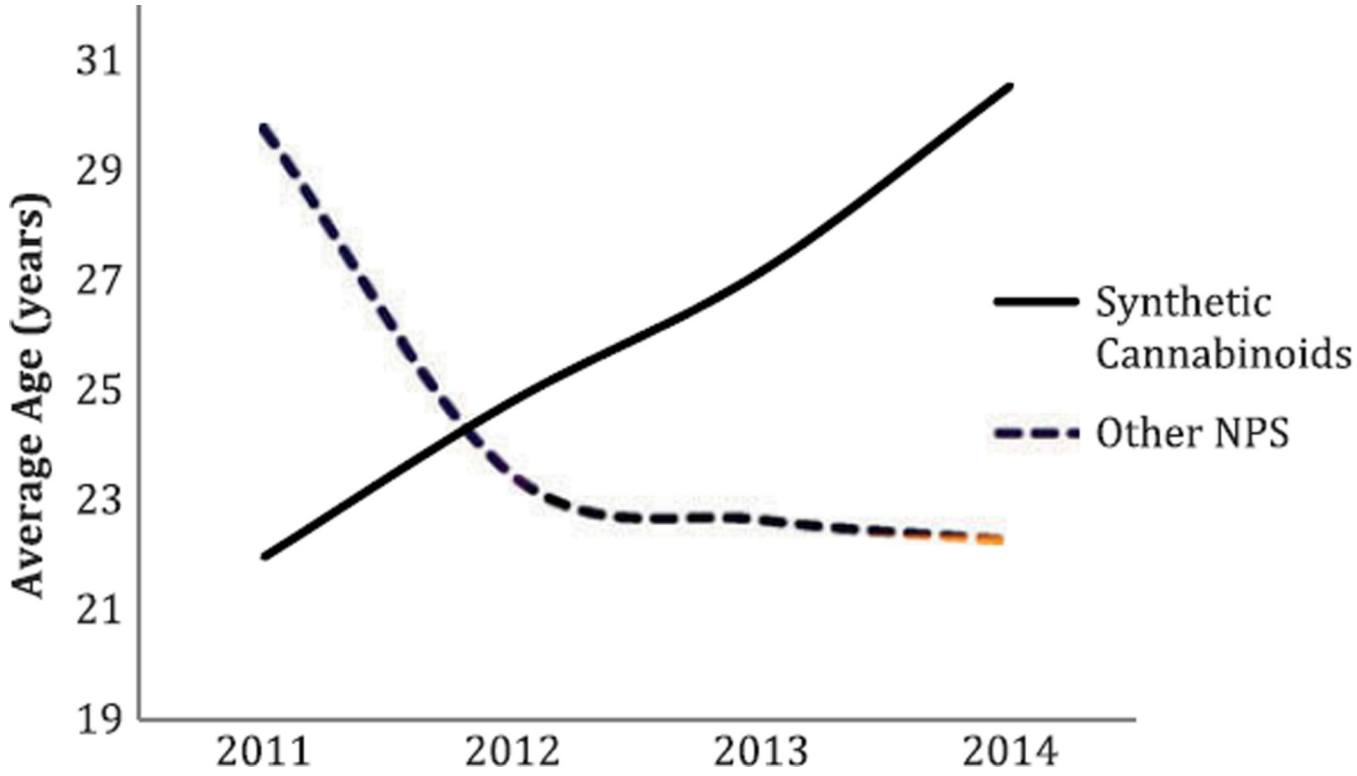

Figure 2.

Comparison of mean age of SCRA related cases to mean age of other NPS related cases from 2011–2014. Mean age (in years) increased over time for SCRA use (F[3,324] = 9.50, $p < 0.001$) and mean age significantly decreased over time for use of other NPS (F[3,65] = 2.86, $p = 0.043$).

Table 1

NPS drug classes: number of reports by year.

	Not included in analyses (*n* = 15)									Included in analyses (*n* = 423)				
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Tryptamine	1	0	3	0	0	0	0	0	0	1	0	2	0	3
Psychedelic phenethylamine	0	1	0	0	0	0	1	1	4	1	4	5	8	18
2C series	0	1	0	0	0	0	1	0	3	0	0	3	3	6
Dox series	0	0	0	0	0	0	0	1	1	1	1	0	0	2
NBOMe series	0	0	0	0	0	0	0	0	0	0	3	2	5	10
Phenethylamine/synthetic cathinone	0	0	0	0	0	0	0	0	0	20	12	7	4	43
Depressant	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Arylcyclohexylamine	0	0	0	0	0	0	0	0	0	1	1	2	2	6
Stimulant	0	0	0	0	0	0	0	0	0	1	0	0	2	3
Psychedelic (non-phenethylamine)	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Synthetic cannabinoid	0	0	0	0	0	0	0	0	4	72	79	43	154	348
Total	1	1	3	0	0	0	1	1	8	97	96	59	171	423

Note. Years 2002–2010 are not included in Total *N*s and the *N*s for 2C, Dox, and N-(2-methoxybenzyl)phenethylamine (NBOMe) series are not included in Total *N* as they were already counted in the psychedelic phenethylamine category. The tryptamine category includes N,N-Dimethyltryptamine (DMT), 4-acetoxy-DMT (4-AcO-DMT), 5-methoxy-DMT (5-MeO-DMT), and α-Methyltryptamine (AMT). The psychedelic phenethylamine category includes (2C series): 2,5-dimethoxy-4-ethylphenethylamine (2C-E), 2,5-dimethoxy-4-iodophenethylamine (2C-I), 2,5-dimethoxy-4-ethylthiophenethylamine (2C-T-2), 2,5-dimethoxy-4-propylthiophenethylamine (2C-T-7), 2C unspecified, (Dox series): 2,5-Dimethoxy-4-chloroamphetamine (DOC), 2,5-Dimethoxy-4-iodoamphetamine (DOI), 2,5-Dimethoxy-4-methylamphetamine (DOM), (NBOMe series): NBOMe, “25b”, “25c”, and “25i”. The phenethylamine/synthetic cathinone category includes 5-Iodo-2-aminoindane (5-IAI), α-Pyrrolidinopentiophenone (alpha-PVP), “bath salts”, Methylenedioxypyrovalerone (MDPV), 4-methylmethcathinone (mephedrone), and 3,4-methylenedioxy-N-methylcathinone (methylone). The depressant category includes 1,4-Butanediol. The Arylcyclohexylamine category contains Methoxetamine (MXE). The stimulant category contains 4-fluoroamphetamine (4-FA). The psychedelic (non-phenethylamine) category contains d-lysergic acid amide (LSA). The synthetic cannabinoid group could not be categorized into subgroups.

Table 2

Descriptive statistics for each NPS class.

	Arylcyclohexylamine *n* (%)	Depressant *n* (%)	Phenethylamine/cathinone *n* (%)	Psychedelic *n* (%)	Psychedelic phenethylamine *n* (%)	Stimulant *n* (%)	Synthetic cannabinoid *n* (%)	Tryptamine *n* (%)
Sex								
Male	5 (83.3%)	1 (100.0%)	38 (88.4%)	1 (100.0%)	16 (88.9%)	1 (33.3%)	273 (78.5%)	2 (66.7%)
Female	1 (16.7%)	0 (0.0%)	5 (11.6%)	0 (0.0%)	2 (11.1%)	2 (66.7%)	75 (21.6%)	1 (33.3%)
Age (years)								
Mean (SD)	21.5 (3.7)	53.0 (−)	27.7 (10.1)	17.0 (−)	18.5 (3.4)	26.3 (1.2)	27.1 (12.1)	27.7 (13.0)
Number of drugs used								
1	6 (100.0%)	1 (100.0%)	35 (81.4%)	0 (0.0%)	16 (88.9%)	2 (66.7%)	298 (85.6%)	2 (66.7%)
2–9 (polydrug use)	0 (0.0%)	0 (0.0%)	8 (18.6%)	1 (100.0%)	2 (11.1%)	1 (33.3%)	50 (14.4%)	1 (33.3%)
Number of drugs used								
Mean (SD)	1.0 (−)	1.0 (−)	1.35 (0.81)	3.0 (−)	1.1 (0.3)	1.3 (0.6)	1.2 (0.5)	1.3 (0.6)
Site reporting exposure								
Healthcare facility	6 (100.0%)	1 (100.0%)	35 (83.3%)	1 (100.0%)	18 (100.0%)	3 (100.0%)	308 (89.5%)	3 (100.0%)
Other	0 (0.0%)	0 (0.0%)	7 (16.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	36 (10.5%)	0 (0.0%)
Medical outcome								
No adverse effect	1 (16.7%)	0 (0.0%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	21 (7.0%)	0 (0.0%)
Minor adverse effect	2 (33.3%)	1 (100.0%)	7 (20.0%)	1 (100.0%)	2 (12.5%)	1 (33.3%	74 (24.5%	0 (0.0%)
Moderate adverse effect	3 (50.0%)	0 (0.0%)	25 (71.4%)	0 (0.0%)	11 (68.8%)	1 (33.3%)	186 (61.6%)	3 (100.0%)
Major adverse effect	0 (0.0%)	0 (0.0%)	2 (5.7%)	0 (0.0%)	3 (18.8%)	1 (33.3%)	21 (7.0%)	0 (0.0%)
Death	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Note. Results are presented for descriptive purposes. Since most subgroups were small, significance tests were not computed. SD, standard deviation.

Table 3

Route of administration for each NPS drug class.

	Ingested only *n* (%)	Inhaled only *n* (%)	Ingested and inhaled *n* (%)	Injected only *n* (%)	Injected and inhaled *n* (%)	Injected and ingested *n* (%)	Unknown *n* (%)
Arylcyclohexylamine	2 (33.3%)	3 (50.0%)	0 (0.0%)	1 (16.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Depressant	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Phenethylamine/cathinone	21 (48.8%)	13 (30.2%)	2 (4.7%)	2 (4.7%)	1 (2.3%)	0 (0.0%)	4 (9.3%)
Psychedelic	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Psychedelic phenethylamine	15 (83.3%)	0 (0.0%)	1 (5.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (11.1%)
Stimulant	2 (66.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (33.3%)
Synthetic cannabinoid	68 (19.5%)	253 (72.7%)	21 (6.0%)	0 (0.0%)	0 (0.0%)	1 (0.3%)	5 (1.4%)
Tryptamine	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
All NPS (total)	112 (26.5%)	269 (63.6%)	25 (5.9%)	3 (0.7%)	1 (0.2%)	1 (0.2%)	12 (2.8%)

Table 4

Demographics of NPS-related exposures compared to non-NPS-drug-related exposures.

		Bivariable comparisons			Multivariable model (non-NPS = comparison group)		
	% NPS within full sample	% within NPS users	% within non-NPS users	*p*	AOR	95% CI	*p*
Year				< 0.001			
2011	7.1	22.9	25.2		1.00		
2012	6.3	22.7	28.2		0.99	(0.71, 1.38)	0.948
2013	4.8	14.0	23.0		0.75	(0.52, 1.10)	0.138
2014	12.6	40.4	23.6		2.06	(1.53, 2.78)	< 0.001
Sex				< 0.001			
Male	9.0	79.7	67.7		1.00		
Female	5.0	20.3	32.3		0.54	(0.41, 0.72)	< 0.001
Age (years)							
Mean (SD)	31.0 (13.8)	26.7 (11.7)	31.1 (13.9)	< 0.0001	0.97	(0.96, 0.98)	< 0.001
Number of drugs used				< 0.001			
1	9.3	85.1	68.9		1.00		
2–9 (polydrug use)	3.9	14.9	31.3		0.35	(0.26, 0.47)	< 0.001
Number of drugs used							
Mean (SD)	1.5 (0.8)	1.2 (0.5)	1.5 (0.9)	< 0.001			
Site reporting exposure				< 0.001			
Healthcare facility	8.9	89.7	77.1		1.00		
Other	3.6	10.3	22.9		0.15	(0.06, 0.42)	< 0.001
Medical outcome[a]				.001			
No adverse effect	5.1	6.3	10.6		1.00		
Minor adverse effect	8.7	23.7	22.5		1.80	(1.11, 2.93)	0.017
Moderate adverse effect	9.5	62.7	54.2		1.90	(1.21, 2.98)	0.005
Major adverse effect	5.3	7.4	12.0		0.98	(0.54, 1.74)	0.934
Death	0.0	0.0	0.6		–		

AOR, adjusted odds ratio (controlling for all other variables in model); CI, confidence interval; SD, standard deviation. Mean number of concomitant drugs was presented for descriptive purposes and not included in the multivariable model.

[a]Death not included in models.

Table 5

Characteristics of SCRAs exposures compared to other-NPS-related exposures.

	Bivariable comparisons			Multivariable model (Synthetic cannabinoid use = comparison group)		
	% SCRA	% Other NPD	*p*	AOR	95% CI	*p*
Year			.002			
2011	20.7	33.3		1.00		
2012	22.7	22.7		0.42	(0.19, 0.95)	0.037
2013	12.4	21.3		1.05	(0.47, 2.34)	0.907
2014	44.3	22.7		0.28	(0.13, 0.60)	0.001
Sex			0.179			
Male	78.4	85.3		1.00		
Female	21.6	14.7		0.65	(0.29, 1.44)	0.283
Age (years)						
Mean (SD)	27.1 (12.1)	24.9 (9.6)	0.159	0.99	(0.96, 1.02)	0.502
Number of drugs used			0.513			
1	82.7	85.6		1.00		
2–9 (polydrug use)	17.3	14.4		1.32	(0.64, 2.71)	0.454
Number of drugs used						
Mean (SD)	1.2 (0.5)	1.3 (0.7)	0.196			
Site reporting exposure			0.796			
Healthcare facility	89.5	90.5		1.00		
Other	10.5	9.5		1.73	(0.15, 19.65)	0.661
Medical outcome[a]			0.487			
No adverse effect	6.9	3.1		1.00		
Minor adverse effect	24.5	20.0		1.98	(0.40, 9.78)	0.400
Moderate adverse effect	61.6	67.7		2.53	(0.56, 11.50)	0.229
Major adverse effect	7.0	9.2		3.96	(0.68, 22.96)	0.125
Death	0.8	0.0		–		

AOR, adjusted odds ratio (controlling for all other variables in model); CI, confidence interval; SD, standard deviation. Mean number of concomitant drugs was presented for descriptive purposes and not included in the multivariable model.

[a]Death not included in models.

Table 6

Concomitant use of other drugs (polydrug use).

	All NPS *n* (%)	SCRAs *n* (%)	Other NPDs *n* (%)	*p*
Alcohol	19 (4.5%)	17 (4.9%)	2 (2.7%)	0.548
Marijuana	18 (4.3%)	15 (4.3%)	3 (4.0%)	1.000
Cocaine	9 (2.1%)	8 (2.3%)	1 (1.3%)	1.000
Opioids/opiates	9 (2.1%)	9 (2.6%)	0 (0.0%)	0.372
Hallucinogens	6 (1.4%)	4 (1.2%)	2 (2.7%)	0.289
Ecstasy/“Molly”	5 (1.2%)	0 (0.0%)	5 (6.7%)	<0.001
Other drug or OTC	5 (1.2%)	4 (1.2%)	1 (1.3%)	1.000
Unknown drug	4 (1.0%)	2 (0.6%)	2 (2.7%)	0.146
Benzodiazepines	2 (0.5%)	2 (0.6%)	0 (0.0%)	1.000
Dissociatives	2 (0.5%)	1 (0.3%)	1 (1.3%)	0.324
Amphetamine	1 (0.2%)	0 (0.0%)	1 (1.3%)	0.177