BRIEF REPORT

Novel psychoactive substance use by US adolescents: Characteristics associated with use of synthetic cannabinoids and synthetic cathinones

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Abstract

Introduction and Aims. *The current study documents the characteristics associated with the use of two novel psychoactive substances: synthetic cannabinoids and synthetic cathinones.* ***Design and Methods.*** *Nationally representative samples of students in 8th (n = 9665), 10th (n = 10 655) and 12th (n = 10 057) grades across the US were included in the Monitoring the Future study from 2012 to 2014.* ***Results.*** *There were relatively few differences in prevalence based on sociodemographic characteristics, although boys were at greater risk for use of synthetic cannabinoids in 12th grade (used by 10.3% of boys and 6.4% of girls) and for use of synthetic cathinones in 10th grade (used by 1.0% of boys and 0.4% of girls). Synthetic drug use was also associated with truancy and use of cigarettes, alcohol, and marijuana.* ***Discussion and Conclusions.*** *Prevention and intervention efforts for novel psychoactive substance use should focus primarily on polysubstance users and youth who are disengaged from school.* [Patrick M, O'Malley P, Kloska D, Schulenberg J, Johnston L, Miech R, Bachman J. Novel psychoactive substance use by US adolescents: Characteristics associated with use of synthetic cannabinoids and synthetic cathinones. *Drug Alcohol Rev* 2016;35:586–590]

Key words: synthetic cannabinoids, synthetic cathinones, synthetic marijuana, bath salts, novel psychoactive substances.

Introduction

Synthetic drugs are 'barely legal toxic highs' [1], substances with 'psychotropic effects that are intentionally marketed and distributed for recreational use by exploiting inadequacies of existing controlled substance legislation' [2]. These novel psychoactive substances are often labeled 'not for human consumption' (to avoid legal culpability in the US) but are used to get high [2]. Testimony by the Director of the US National Institute on Drug Abuse has highlighted the public health issues related to these substances [3]. In April 2015, the American Association of Poison Control Centers [4] issued a warning about the emergence of new synthetic drug compounds, as the chemical properties of the drugs continue to change. Synthetic drugs are very difficult to regulate because of the rapidly changing and widely varying chemical compounds; when regulation is enforced for a specific version of the drug, new variants often emerge (see [5] for a review of legal status in the US).

Synthetic cannabinoids (also called synthetic marijuana or spice) refer to a combination of herbs and manufactured chemicals that mimic cannabinoids found in marijuana but can have much stronger effects [6–9]. Among adolescents in the US synthetic cannabinoids are the most-used illicit drug after marijuana [2,10,11]. Little is known about the health consequences of their use [3] although associated physical effects include seizures, chest pain, vomiting and breathing problems [12–14] and psychoactive effects include panic, anxiety, paranoia and psychosis [14–16], as well as possible drug dependence [12].

Synthetic cathinones, typically called bath salts, are stimulants very similar to amphetamines such as methamphetamine and MDMA [6–8]. Synthetic cathinones can be powerful drugs [3] that can lead to acute physical and neuropsychiatric symptoms including seizure, heart

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attack and psychosis [17], as well as addiction [18]. These drugs have been linked to high numbers of emergency department visits [19].

Despite the dangers associated with synthetic drug use, little is known about characteristics associated with use among adolescents [11]. The present analysis was designed to examine the prevalence of synthetic cannabinoids and synthetic cathinones as well as the sociodemographic and adolescent school and social engagement characteristics associated with their use among 8th-, 10th- and 12th-grade students in the US.

Methods

Participants and procedures

Monitoring the Future data derive from annual, national samples of 8th-, 10th- and 12th-grade students in the US. This study analysed data of US 8th ($n = 9665$), 10th ($n = 10\,655$) and 12th graders ($n = 10\,057$) from 2012 through 2014 (see [10,20] for study design).

Measures

School-based surveys from 2012 to 2014 included questions about students' use of synthetic cannabinoids, described as ' "synthetic marijuana" ("K2," "Spice") to get high,' and synthetic cathinones, described as 'bath salts (synthetic stimulants) to get high,' in the past 12 months. Sociodemographics (geographical region of country, population density, gender, race/ethnicity, parent education, and two-parent family structure), adolescent engagement (school grades, truancy [i.e. cutting class], number of evenings out for fun and recreation), and other substances use (cigarettes in the past 30 days, alcohol and marijuana in the past 12 months) were also included.

Statistical analysis

All analyses used SAS software [21] survey procedures to account for the complex sample design [10]. Prevalence of 'synthetic marijuana' and 'bath salts' use by grade and covariates was computed using weighted means. Logistic regression was used for pairwise comparisons of covariates with use and for the multivariable models predicting use.

Results

'Synthetic marijuana' use in the past 12 months was reported by 3.5% of US 8th graders, 7.2% of 10th graders and 8.3% of 12th graders for the years 2012–2014 combined. 'Bath salts' use in the past 12 months was reported

by 0.6% of 8th graders, 0.7% of 10th graders and 0.7% of 12th graders. Table 1 shows use by cohort year and sociodemographic subgroups. Pairwise comparisons within grades are shown for each set of variables. 'Synthetic marijuana' use declined significantly from 2012 to 2014 among 10th and 12th graders but not 8th graders; 'bath salts' use did not change significantly. Gender differences emerged for 12th graders' use of 'synthetic marijuana' (10.3% of boys, 6.4% of girls) and for 10th graders' use of 'bath salts' (1.0% of boys, 0.4% of girls). Use was consistently lower among adolescents living with two parents. Among students who have used 'synthetic marijuana,' 11.6% of 8th graders, 6.7% of 10th graders and 6.3% of 12th graders also used 'bath salts.'

Synthetic cannabinoid use

In multivariable comparisons in logistic regression models (Table 2), recent cohorts had progressively significantly lower prevalence of 'synthetic marijuana' use among 10th and 12th graders, but not among eighth graders. With only one exception, region was not a significant predictor in these models. There were no significant differences based on population density or gender, with the exception that, among 12th graders, boys had higher odds of using 'synthetic marijuana' than girls did. Hispanic eighth graders had higher odds of using than White eighth graders, and Black 10th graders had lower odds of using than White 10th graders; otherwise, race/ethnicity did not emerge as a consistent predictor in the multivariable model. Parent college education among 10th graders was associated with lower odds of using 'synthetic marijuana', but family structure was not significant. Adolescent school and social engagement factors were also associated with use. Having higher grades in school was associated with less use for eighth graders. Truancy, number of evenings out for fun and recreation per week, cigarette use in the past 30 days and alcohol and marijuana use in the past 12 months were all associated with 'synthetic marijuana' use.

Synthetic cathinones use

In multivariable models (Table 2), 10th graders had higher odds of using 'bath salts' in 2014 than in 2012 (reference year). Sociodemographic factors were not predictive of use, with the exception that 10th-grade boys had higher odds of use than 10th-grade girls and that Black youth in 12th grade had higher odds of use than White youth. Adolescent engagement factors were associated with 'bath salts' use. Having higher grades in school was associated with less use among eighth graders. Truancy for 8th and 10th graders, cigarette use in the past 30 days, alcohol use in the past 12 months for 10th graders and

Table 1. *Prevalence of use of synthetic cannabinoids and synthetic cathinones in the past 12 months by grade and covariates*

	'Synthetic marijuana' use			'Bath salts' use		
	8th grade	10th grade	12th grade	8th grade	10th grade	12th grade
Overall	3.5%	7.2%	8.3%	0.6%	0.7%	0.7%
By subgroup						
Cohort year						
2012	3.9%[a]	9.0%[a]	10.9%[a]	0.6%[a]	0.5%[a]	0.7%[a]
2013	3.7%[a]	7.0%[b]	7.8%[b]	0.9%[a]	0.7%[a]	0.7%[a]
2014	3.0%[a]	5.2%[c]	5.8%[c]	0.4%[a]	0.8%[a]	0.6%[a]
Region of country						
South	3.7%[a]	7.7%[a]	7.9%[a]	0.8%[a]	0.6%[a]	0.8%[a]
Northeast	2.9%[a,b]	5.7%[b]	7.5%[a]	0.6%[a]	0.8%[a]	0.6%[a]
Midwest	2.5%[b]	7.3%[a,b]	9.4%[a]	0.4%[a]	0.5%[a]	0.6%[a]
West	4.6%[a]	7.5%[a,b]	8.1%[a]	0.6%[a]	0.8%[a]	0.5%[a]
Population density						
Rural	3.8%[a]	8.5%[a]	8.0%[a]	0.6%[a]	0.9%[a]	0.7%[a]
Urban	3.3%[a]	6.4%[b]	9.0%[a]	0.7%[a]	0.8%[a]	0.7%[a]
Suburban	3.5%[a]	7.1%[a,b]	7.9%[a]	0.6%[a]	0.5%[a]	0.6%[a]
Gender						
Female	3.5%[a]	6.8%[a]	6.4%[a]	0.6%[a]	0.4%[a]	0.6%[a]
Male	3.5%[a]	7.6%[a]	10.3%[b]	0.6%[a]	1.0%[b]	0.7%[a]
Race/ethnicity						
White	2.8%[a]	7.5%[a]	8.8%[a]	0.5%[a]	0.7%[a]	0.6%[a]
Black	2.0%[a]	3.9%[b]	5.9%[b]	0.9%[a]	0.9%[a]	1.2%[b]
Hispanic	5.9%[b]	7.2%[a]	8.6%[a,b]	0.9%[a]	0.5%[a]	0.8%[a,b]
Other races	4.4%[b]	7.9%[a]	7.2%[a,b]	0.7%[a]	0.6%[a]	0.6%[a,b]
Parent education						
High school or less	5.2%[a]	9.9%[a]	9.1%[a]	1.0%[a]	0.9%[a]	0.9%[a]
Some college or more	3.0%[b]	6.3%[b]	8.0%[a]	0.5%[b]	0.6%[a]	0.6%[a]
Family composition						
None or one parent	5.0%[a]	10.5%[a]	10.6%[a]	1.1%[a]	1.1%[a]	1.0%[a]
Two parents	3.1%[b]	6.0%[b]	7.2%[b]	0.5%[b]	0.5%[b]	0.5%[b]

Notes. Weighted sample sizes for 8th/10th/12th grades: 'synthetic marijuana' $Ns=9665/10655/10057$; 'bath salts' $Ns=9640/10655/10068$. [a,b,c]Superscript letters are shorthand to indicate pairwise comparisons within grade and subgroup for each drug. Similarities are noted first. The same superscript letters within grade and subgroup for each drug indicate that values do not differ significantly from the others within that grade and subgroup. If values do not share the same superscript letter, these different superscript letters indicate significant differences at $P<0.05$ among the values within grade and subgroup for each drug. For example, use of 'synthetic marijuana' for 8th graders by region of country shows that South, Northeast and West do not differ significantly (marked [a]), nor do Northeast and Midwest (marked [b]); however, South and Midwest differ significantly from each other, as do Midwest and West.

marijuana use in the past 12 months for 12th graders were associated with use of 'synthetic marijuana.'

Discussion

Despite dangers associated with use of synthetic cannabinoids and synthetic cathinones, very little information regarding the prevalence rates or characteristics of adolescent users is available. This is among the first studies to document the national prevalence of synthetic drugs as a function of historical year, sociodemographic characteristics and other adolescent behaviors. The present study further elaborates on recent work examining correlates of use of synthetic cannabinoids [11] and synthetic cathinones [22] among 12th graders by including 8th and 10th graders and more recent data. This information is designed to help identify and target youth at risk for novel psychoactive substance use. Although synthetic cannabinoid use has decreased in the past 2 years, the drug remains relatively prevalent [2]. Prevalence of synthetic cathinones use is not high, but identifying the adolescents at greatest risk remains important considering the severity of potential consequences and the emergence of problems associated with newly emerging variations of the drugs.

Similar to previous research on use and consequences [2,11,23], we found limited support for gender differences with boys reporting more synthetic cannabinoids use in 12th grade (used by 10.3% of boys and 6.4% of

Table 2. *Novel psychoactive substance use in the past 12 months for grades 8, 10 and 12*

	'Synthetic marijuana' use			'Bath salts' use		
	8th grade AOR [95% CI]	10th grade AOR [95% CI]	12th grade AOR [95% CI]	8th grade AOR [95% CI]	10th grade AOR [95% CI]	12th grade AOR [95% CI]
Cohort year [a]						
2013	0.99[0.70, 1.41]	0.74[0.59, 0.91]**	0.69[0.56, 0.86]***	1.57[0.79, 3.12]	1.70[0.83, 3.48]	0.92[0.50, 1.68]
2014	0.76[0.52, 1.12]	0.61[0.47, 0.80]***	0.50[0.39, 0.64]***	0.80[0.38, 1.70]	2.33[1.07, 5.09]*	0.76[0.41, 1.41]
Sociodemographic						
Region of country [b]						
Northeast	1.03[0.65, 1.63]	0.75[0.54, 1.03]	0.71[0.53, 0.97]*	1.15[0.43, 3.06]	1.95[0.79, 4.80]	0.80[0.40, 1.61]
Midwest	0.91[0.57, 1.46]	1.18[0.86, 1.61]	1.29[0.99, 1.68]	0.78[0.29, 2.08]	0.95[0.42, 2.18]	1.01[0.49, 2.09]
West	1.19[0.80, 1.75]	1.01[0.76, 1.35]	0.95[0.69, 1.31]	0.85[0.35, 2.07]	1.63[0.59, 4.53]	0.65[0.33, 1.30]
Population density [c]						
Urban	0.77[0.46, 1.27]	0.91[0.66, 1.26]	0.95[0.69, 1.29]	1.32[0.54, 3.22]	0.94[0.38, 2.33]	0.98[0.48, 2.01]
Suburban	0.83[0.54, 1.28]	0.88[0.66, 1.18]	0.86[0.65, 1.14]	1.08[0.47, 2.51]	0.62[0.27, 1.44]	0.96[0.50, 1.84]
Male gender [d]	1.00[0.73, 1.38]	0.95[0.76, 1.20]	1.44[1.17, 1.77]***	1.00[0.54, 1.84]	2.33[1.30, 4.20]**	1.05[0.57, 1.93]
Race/ethnicity [e]						
Black	0.75[0.43, 1.31]	0.52[0.35, 0.79]**	0.73[0.47, 1.13]	2.20[0.81, 6.00]	2.17[0.90, 5.20]	2.44[1.15, 5.19]*
Hispanic	1.77[1.16, 2.71]**	0.83[0.64, 1.09]	0.95[0.71, 1.26]	1.49[0.57, 3.90]	0.69[0.24, 1.96]	1.47[0.66, 3.27]
Other	1.51[0.98, 2.32]	1.10[0.85, 1.43]	0.90[0.65, 1.25]	1.51[0.62, 3.68]	0.91[0.39, 2.13]	1.27[0.60, 2.69]
Parent college education [f]	0.97[0.68, 1.37]	0.75[0.59, 0.94]**	0.87[0.71, 1.08]	0.87[0.45, 1.67]	0.87[0.47, 1.64]	0.79[0.40, 1.54]
Two-parent family [g]	1.10[0.83, 1.46]	0.90[0.72, 1.13]	0.86[0.69, 1.07]	0.80[0.47, 1.38]	0.78[0.45, 1.34]	0.75[0.42, 1.33]
Adolescent engagement						
High grades in school [h]	0.68[0.47, 0.98]*	0.85[0.68, 1.05]	0.83[0.66, 1.03]	0.45[0.24, 0.84]**	0.62[0.30, 1.25]	0.96[0.50, 1.83]
Truancy [i]	1.66[1.18, 2.32]**	1.53[1.24, 1.88]***	1.30[1.06, 1.61]**	2.08[1.03, 4.19]*	3.07[1.64, 5.75]***	2.02[0.96, 4.23]
Evenings out [j]	1.00[0.74, 1.36]	1.28[1.06, 1.56]**	1.29[1.06, 1.56]**	0.85[0.42, 1.73]	1.53[0.87, 2.67]	1.46[0.81, 2.63]
Substance use						
Any 30 day cigarette use [k]	2.23[1.54, 3.22]***	2.62[2.08, 3.29]***	2.53[2.10, 3.05]***	3.78[1.50, 9.51]**	4.71[2.32, 9.57]***	2.85[1.34, 6.08]**
Any 12 m alcohol use [l]	3.57[2.32, 5.50]***	2.72[2.03, 3.63]***	1.90[1.22, 2.97]***	2.67[0.90, 7.94]	2.11[1.01, 4.40]*	1.02[0.49, 2.14]
Any 12 m marijuana use [m]	22.97[14.63, 36.07]***	24.82[17.30, 35.61]***	21.90[14.15, 33.91]***	3.11[1.25, 7.75]**	1.92[0.73, 5.05]	3.86[1.80, 8.27]***

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. AOR, adjusted odds ratio; CI, confidence interval. Reference groups are as follows: [a]2012, [b]South, [c]Rural, [d]Female gender, [e]White, [f]No parent had any college education, [g]Other family structure, [h]Grades of C+ or lower, [i]Did not cut class in the past 4 weeks, [j]Fewer than three evenings out per week for fun and recreation, [k]No past 30 day cigarette use, [l]No past 12 month alcohol use, [m]No past 12 month marijuana use. Weighted sample sizes for 8th/10th/12th: 'synthetic marijuana' *N*s = 9665/10 655/10 057; 'bath salts' *N*s = 9640/10655/10068.

girls) and synthetic cathinones use in 10th grade (used by 1.0% of boys and 0.4% of girls).

Based on multivariable models including other substance use, relatively few differences in prevalence were observed for sociodemographics including region, population density, gender, race/ethnicity and parental education. Higher grades in school were associated with less synthetic substance use, but only for eighth graders, suggesting that early signs of low grades may be a specific indicator of risk. Truancy was associated with use of synthetic drugs. Evenings out for fun and recreation was also associated with synthetic cannabinoid use, but only among high school students (10th and 12th graders). Use of cigarettes, alcohol and marijuana was the most consistently associated with synthetic drug use, suggesting that existing screens for substance use may identify adolescents who use or are at risk for using synthetic drugs. These findings are consistent with existing research documenting that other substance use is the most robust predictor of synthetic drug use [11].

Limitations of the study include that the data are cross-sectional, self-reported and based on in-school surveys, so school dropouts are not included. Nonetheless, this study points prevention and intervention efforts toward polysubstance using US adolescents and those who are disengaged from school. Future research should continue to track the historical changes in the use of these drugs and their associated consequences, as well as assess the reasons adolescents report for using novel psychoactive substances and how these may or may not correspond to reasons for using other substances.

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