



Published in final edited form as:

Am J Drug Alcohol Abuse. 2015 July ; 41(4): 317–322. doi:10.3109/00952990.2015.1043438.

K2 and Spice use among a cohort of college students in southeast region of the USA

Kathleen L. Egan, MS¹, Cynthia K. Suerken, MS², Beth A. Reboussin, PhD², John Spangler, MD, MPH³, Kimberly G. Wagoner, DrPH, MPH¹, Erin L. Sutfin, PhD¹, Beata Debinski, MHS¹, and Mark Wolfson, PhD¹

¹Department of Social Sciences and Health Policy, Wake Forest School of Medicine, Winston-Salem, NC, USA

²Department of Biostatistical Sciences, Wake Forest School of Medicine, Winston-Salem, NC, USA

³Department of Family and Community Medicine, Wake Forest School of Medicine, Winston-Salem, NC, USA

Abstract

Background—K2 and Spice consist of an herbal blend of plant matter and chemical synthetic cannabinoids. These substances emerged in the early 2000s as a popular alternative to marijuana among youth and young adults.

Objectives—This study sought to identify rates and correlates of K2 and Spice at college entry and first use during college.

Methods—In Fall 2010, 3146 students at 11 colleges in North Carolina and Virginia were recruited to participate in a longitudinal cohort survey. The cohort was invited to participate in a total of six surveys over their college career. Random-effects logistic regression models were used to identify factors associated with lifetime K2 and Spice use at college entry and first use during college, adjusting for clustering within schools and sample weights.

Results—Weighted lifetime prevalence of K2 and Spice use at college entry was 7.6%. An additional 6.6% of students reported first use during college. By the cohort's fourth year, 17.0% reported lifetime K2 and Spice use. While lifetime prevalence increased, past 6-month prevalence decreased substantially over time. K2 and Spice use at college entry was associated with sensation seeking; hookah, marijuana, and illicit drug use; and low religiosity. First use during college was associated with having a father with less than a four-year degree; alcohol and hookah use.

Conclusion—Universities should ensure that prevention efforts address current substance use, including K2/Spice, and that treatment options are available for first year students who use substances.

Address correspondence to Kathleen L. Egan, Department of Social Sciences and Health Policy, Wake Forest School of Medicine, Medical Center Blvd, Winston-Salem, NC 27157, USA. kegan@wakehealth.edu.

All authors contributed to and have approved the final manuscript.

Declaration of interest

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

Keywords

K2; college student; spice; synthetic marijuana

Background

K2 and Spice are common brands of synthetic marijuana that consist of an herbal blend of plant matter and chemical synthetic cannabinoids. Due to the presence of the synthetic cannabinoids, K2/Spice mimics the functional effects of Tetrahydrocannabinol (THC) which is the active ingredient in marijuana. When K2/Spice emerged in the early 2000s, it was legal to purchase in head shops, convenience stores, gas stations, and on the internet. Because of its widespread availability and psychoactive properties, it became a popular alternative to marijuana among youth and young adults (1–6).

Historically, substance abuse has been high among the young adult and college population (7–10), and K2/Spice is no exception. Over the past several years, among youth and young adults, K2/Spice has been the second most commonly used drug, following marijuana (9). According to *Monitoring the Future*, K2/Spice use starts as early as high school with 11.4% having reported K2 use in 2012 and 7.9% in 2013. K2/Spice use has also been reported by college students; however, use appears to be decreasing. In a national sample, 8.5% of college students reported K2/Spice use in 2011, 5.3% in 2012, and 2.3% in 2013 (9).

Among youth and young adults, K2/Spice use is more common among males (11–17), whites (14,15), poly-drug users (11,14,15), and youth of higher socioeconomic status (15,18). Little is known about other characteristics of youth and young adult K2/Spice users. However, cross-sectional studies suggest that students who are single (19), members of sororities and fraternities (19,20), and who are high sensation seekers (21,22) are more likely to use marijuana. Additionally, students who are athletes (23,24) and attend religious ceremonies regularly (19,25) are less likely to use marijuana. Thus, these may be characteristics of K2/Spice users due to the substances' similar psychoactive properties.

Although K2/Spice has been perceived as a safe alternative to marijuana (1,3), there have been many adverse events reported following use, especially among youth and young adults (12,26–28). Since 2009, there have been over 10 000 exposures reported to the American Association of Poison Control Centers (16). Adverse consequences include cardiovascular events (26,29), psychosis (30,31), seizure (13,32) and death (33). The Substance Abuse and Mental Health Services Administration (SAMHSA) found that synthetic cannabinoids, such as those found in K2/Spice, resulted in 11 406 emergency department visits in 2010, and more than doubled to 28 531 visits in 2011. Young adults aged 18–20 experienced a four-fold increase in emergency department visits, from 1881 in 2010 to 8212 visits in 2011 (34).

While there is ample literature on the use of more traditional substances among college students, little is known about K2/Spice use among this population, especially use throughout the college career. The objectives of this study were to: (i) determine prevalence and incidence of K2/Spice use among college students at the start of and over their college career, and (ii) identify predictors of K2/Spice use at college entry and first use during

college. To our knowledge, this is the first study to examine K2/Spice use at the start of and across four years of college among a cohort of college students.

Methods

Study design

The data presented were gathered from a prospective, cohort, research study called *The Smokeless Tobacco Use in College Students*. Recruitment was conducted in the fall of 2010: all first-year students at 11 participating colleges, seven in North Carolina and four in Virginia, were invited to complete a brief, web-based screener survey. Out of the 29 544 students who were invited, 10 528 (36%) participated (35).

Two weeks following the screener survey, 4190 of the participants were invited to participate in *The Smokeless Tobacco Use in College Students Cohort Fall 2010 Survey*. Since the aim of the overall study was to assess trajectories and correlates of smokeless tobacco use among college students, those who were at higher risk for using smokeless tobacco were oversampled, including lifetime smokeless tobacco users, current cigarette smokers, and males. A total of 3146 students participated in *The Smokeless Tobacco Use in College Students Cohort Fall 2010 Survey* and were recruited into the cohort (36,37).

Members of the cohort were invited to participate in a total of six web-based surveys over their college career. For each survey, invitations were sent by email and included a link to the survey. Non-responders received up to five reminders by multiple modes including email, phone call, and text message. Members of the cohort were informed that participation in the study was voluntary and that a Certificate of Confidentiality had been obtained from the Department of Health and Human Services in order to protect their confidentiality, even in the unlikely case of a court order. There was an escalating incentive (which increased at each wave), starting at \$15. The sixth survey was fielded in Fall 2013. The protocol was approved by the Wake Forest School of Medicine Institutional Review Board and the Institutional Review Boards of participating institutions where requested (36,37).

Measures

K2/Spice use

At college entry (Fall 2010), lifetime prevalence of K2/Spice was measured with the following item: “Have you ever used K2 (Spice)? (yes/no)”. Subsequent surveys queried students about use within the past 6 months. Students who reported lifetime K2/Spice use on the Fall 2010 survey only, were coded as “K2/Spice use at college entry”. Students who reported past 6-month K2/Spice use during at least one wave of the survey but not in the Fall of 2010 were coded as “first use of K2/Spice during college”.

Demographics and social characteristics

Demographics and social characteristics were measured in Fall 2010. Demographics included gender (male vs. female), race (coded white vs. non-white), Hispanic ethnicity (coded Hispanic vs. Non-Hispanic), mother’s and father’s educational attainment (coded as less than a 4-year degree vs. 4-year degree or higher), spending money (coded as “less than

\$100 per month” vs. “greater than or equal to \$100 per month”), and sensation seeking. Spending money was assessed by asking how much spending money the participant had a month, with response options increasing in \$100 increments starting from “less than \$100” to “more than \$1000”. Spending money was dichotomized based on a 50/50 split in responses. Sensation seeking was measured using the Brief Sensation Seeking Scale which consists of eight 5-point Likert scale items (38,39). The total sensation seeking score was calculated by averaging all items for those who answered a minimum of five questions on the scale. The Cronbach’s alpha was 0.81 (36).

Social characteristics include varsity athlete status (yes vs. no), participation in club sports or intramural sports (yes vs. no), being a member or pledge of a sorority or fraternity (yes vs. no), religiosity (coded as attends religious services at least twice per month vs. less than twice a month), residence location (on vs. off campus), and relationship status (in a relationship vs. not in a relationship).

Other substance use

Other substance use was measured in Fall 2010, and included past 30-day cigarette use, past 30-day alcohol use, past 30-day hookah tobacco use, lifetime marijuana use, and lifetime other illicit drug use (all coded yes vs. no).

Statistical analyses

Analyses were performed using weights in order to account for the oversampling of some groups of students. Sampling weights correspond to the inverse probability of being selected from the screener survey. After applying a nonresponse adjustment, the weights were scaled to account for students within schools (40). All analyses accounted for clustering of students within schools. Unweighted descriptive statistics for demographic and social characteristics were calculated in order to reflect the sample. Prevalence rates of K2/Spice and other substances were weighted in order to reflect the student population.

Random-effects logistic regression models were used to identify factors associated with lifetime K2/Spice use at college entry and first use during college, adjusting for clustering within schools and sample weights. Bivariate models were generated for each predictor and K2/Spice outcome. All predictors that were significant at $p < 0.10$ in the bivariate analyses were included in the multivariable models. Variables with $p < 0.05$ were considered significant in the multivariable analysis. Results are presented as Odds ratios (OR), Adjusted odds ratios (AOR), and 95% Confidence intervals.

All descriptive statistics were computed using SAS version 9.3 (SAS Institute Inc., Cary, NC). All models were constructed using the GLAMM procedure in Stata version 10 (StataCorp LP, College Station, TX).

Results

Sample characteristics

The cohort sample consisted of 3146 participants, with a range of $n=2459$ – 2520 completions in waves two through six (response rate=78.6–88.1%). The demographics, social

characteristics, and substance use of the sample, students who reported lifetime K2/Spice use at college entry, and students who first tried K2/Spice use during college are reported in Table 1 (unweighted).

K2/Spice use: prevalence, incidence and repeated use over the college career

The weighted prevalence of individuals who reported lifetime K2/Spice use at college entry (Fall 2010) was 7.6%. At the subsequent survey (Spring 2011), the past 6-month weighted prevalence was 5.8% and declined each wave of the survey to 1.0% by Fall 2013 (Table 2). Of those who reported lifetime K2/Spice use at college entry, 65.8% reported K2/Spice use in the past 6 months at least one or more subsequent waves of the survey.

Among those who had not tried K2/Spice at the start of college, 6.6% (weighted) reported trying K2/Spice for the first time during college (Table 2). Of those who tried K2/Spice for the first time in college, about one-third reported K2/Spice use at one or more subsequent waves of the survey. By Fall 2013, 17.0% of the sample reported lifetime K2/Spice use (weighted).

Bivariate associations with K2/Spice use

Students who reported lifetime K2/Spice use at college entry were significantly less likely to be female (OR=0.5; CI=0.4, 0.7); had more than \$100 spending money per month (OR=1.4; CI=1.1, 2.0); were a member or pledge of a sorority or fraternity (OR=2.3; CI=1.6, 3.3); attended religious services less than twice a month (OR=0.3; CI=0.2, 0.5); had used cigarettes (OR=6.7; CI=4.9, 9.3), alcohol (OR=7.9; CI=3.9, 16.0), and hookah (OR=8.1; CI=5.7, 11.6) in the past 30-days; had used marijuana (OR=27.9; CI=15.0, 51.9) and other illicit drugs (OR=14.8; CI=11.5, 18.9) in their lifetime; and had higher sensation seeking scores (OR=3.4; CI=2.6, 4.6).

Students who first used K2/Spice during college had a mother (OR=0.5; CI=0.3, 0.7) or father (OR=0.4; CI=0.2, 0.8) with less than a four-year college degree, and had higher sensation seeking scores (OR=2.8; CI=1.6, 4.7). Additionally, they were more likely to have reported past 30-day cigarette (OR=6.5; CI=4.2, 9.8), alcohol (OR=5.4; CI=2.8, 10.6), and hookah use (OR=9.5; CI=5.6, 16.1); and lifetime marijuana (OR=5.0; CI=3.2, 7.8) and illicit drug (OR=8.3; CI=4.3, 15.8) use at college entry (Table 3).

Multivariate associations with K2/Spice use

Students who reported lifetime K2/Spice use at college entry attended religious services less than twice a month (AOR=0.6; CI=0.4, 0.98); used hookah in the past 30-days (AOR=2.4; CI=1.5, 3.8); had reported lifetime marijuana (AOR=10.6; CI=4.7, 24.1), and other illicit drug use (AOR=3.1; CI=2.1, 4.6); and had higher sensation seeking scores (AOR=1.5; CI=1.02, 2.2).

Students who first used K2/Spice during college had a father with less than a four-year college degree (AOR=0.4; CI=0.2, 0.9). Additionally, they were more likely to have reported past 30-day alcohol (AOR=2.3; CI=1.2, 4.3) and hookah use (AOR=4.7; CI=2.5, 8.9) (Table 3).

Discussion

To the best of our knowledge, this is the first study to examine K2/Spice use among a cohort of undergraduate students over their college career. Lifetime use of K2/Spice was 7.6% in fall of freshman year and increased to 17.0% by fall of senior year. Of those who reported lifetime K2/Spice use in the fall of their freshman year, the majority reported using K2/Spice at least one more wave during college (65.8%). There were 6.6% of students who had not previously used K2/Spice who reported trying K2/Spice for the first time during college, and of those about one-third reported use during at least one more wave of the survey by fall senior year. Given the risks associated with K2/Spice use (12,13,16,26–33), it is concerning that there is a relatively high prevalence of lifetime use and students who report using K2/Spice more than a single time. Additional research should be conducted to examine what factors influence college students' motivations to use K2/Spice or synthetic marijuana products in order to guide prevention efforts.

Despite the relatively high lifetime prevalence and reports of repeated use, past 6-month prevalence decreased with each semester, with only 1.0% of the students reporting past 6-month use in the fall of their senior year (Fall 2013). There are several reasons as to why this decrease may have occurred. One is that students may try K2/Spice early in their college careers, but do not maintain use over time (maturation). This hypothesis is supported by Hu et al.'s cross-sectional study of college students at a single university, which found that freshman and sophomore students were more likely to report K2 use than upperclassmen (17).

A second hypothesis relates to the change in national and state policies on synthetic cannabinoids found in K2/Spice and other synthetic marijuana products. In response to adverse events, in March 2011, the Drug Enforcement Agency (DEA) placed a one-year temporary ban on five of the synthetic cannabinoids commonly found in K2, Spice, and other brands of synthetic marijuana – JWH-018, JWH-073, CP 47,497, CP 47,497 C8 and JWH-200 (41). Subsequently, these substances were permanently banned under the Synthetic Drug Abuse Prevention Act of 2012 (42). At least 43 states have also passed laws to ban synthetic cannabinoids commonly found in K2/Spice, including North Carolina and Virginia (28,43). These changes in policy on K2/Spice manufacturing, sale, and use occurred during our study (coinciding with the Spring 2011 survey). Thus, the observed decrease in K2/Spice use may be due to the change in policy and a resulting decrease in availability. A nationwide, repeated cross-sectional study of college students also found a significant decrease in use among college students from 2011–2013, which supports this hypothesis (9).

Given that there are additional synthetic cannabinoids being manufactured to skirt the bans, there may be other synthetic marijuana products being sold with these analogs with brand names other than “K2” or “Spice” (1,44). Additional research is needed to determine if synthetic marijuana use is declining as a whole or if new synthetic marijuana brands that have yet to be restricted are replacing the previous products.

Of the 7.6% of students who reported lifetime K2/Spice use at college entry, these students were more likely than non-users to report use of hookah in the past 30-days, lifetime marijuana and other illicit drug use. These findings are consistent with others that suggest that many students enter college with a history of substance use (10,17,45,46), which may make them more susceptible to other substance use during college.

Students who first tried K2/Spice during college were more likely to report past 30-day alcohol and hookah use at college entry. Hu and colleagues also found that K2 users were more likely to report hookah use and report using hookah to smoke K2 (17). In addition, the majority of these students first used K2/Spice in the spring semester of their freshman year, which is a time that they would be more likely to use hookah (47,48). These may be students who are more likely to experiment with substances that are legal (K2/Spice was legal the 6 months preceding the Spring 2011 wave of the survey) and easily accessible. Our findings suggest that college prevention efforts should include information on K2/Spice and synthetic marijuana.

Limitations

The potential effects of policy change cannot be disentangled from the greater context, including possible maturation of the participants in the sample. Thus, the cause for the decline in K2/Spice use cannot be conclusively determined. The study is limited to colleges in two states within the southeastern region of the United States which limits the generalizability. The item used to assess synthetic marijuana use consisted of the terms “K2 or Spice”, because they were the most common synthetic marijuana products at the start of the study. However, these terms may not capture other synthetic marijuana products that emerged following the ban. Thus, the prevalence of synthetic marijuana use reported in this study may be an underestimate.

Conclusion

To our knowledge, this is the first investigation of K2/Spice use among a cohort of college students over the course of their college career. We found a relatively high prevalence of lifetime K2/Spice use among our cohort of college students. K2 use was most prevalent within the first year of college and decreased substantially over the cohort’s college career. This observed decrease in K2/Spice use coincided with the national and state (Virginia and North Carolina) bans on synthetic cannabinoids which may lend insight on the effectiveness of these bans. However, additional research is needed to determine if this decrease was experienced in other populations, and whether there was a corresponding increase in synthetic marijuana products other than “K2” or “Spice”. Given that K2/Spice use was high at college entry, universities should ensure that prevention efforts address a broader variety of current substance use, including synthetic marijuana, and that treatment options are available for first year students who use substances.

Acknowledgments

Ms. Egan conceptualized and drafted the manuscript. Ms. Egan and Ms. Debinski conducted literature review. Drs. Wolfson, Spangler, Reboussin, Sutfin, and Wagoner designed the study. Ms. Suerken and Dr. Reboussin conducted the statistical analysis.

Funding

This project was supported by Award Number R01CA141643 from the National Cancer Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Cancer Institute or the National Institutes of Health.

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Table 1

Demographics, social characteristics, and substance use among the sample.

Characteristics	Overall <i>n</i> =3146	Lifetime K2/Spice at college entry <i>n</i> =389	First use of K2/Spice during college <i>n</i> =163
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Demographics			
Female	1567 (49.8)	164 (42.2)	71 (43.6)
Non-white	484 (15.6)	38 (9.8)	22 (13.6)
Hispanic	205 (6.6)	18 (4.7)	9 (5.6)
Mother – 4-year college degree	1896 (61.9)	223 (59.0)	92 (57.1)
Father – 4-year college degree	1957 (64.6)	248 (66.1)	94 (58.8)
Spending money >= \$100 per month	1752 (56.6)	247 (64.2)	90 (55.9)
Sensation seeking (mean [SD])	3.1 (0.8)	3.6 (0.5)	3.5 (0.7)
Social characteristics			
Varsity athlete	189 (6.4)	18 (5.0)	3 (2.0)
Club sports	514 (17.2)	56 (15.3)	21 (13.4)
Intramural sports	721 (24.1)	82 (22.3)	42 (26.9)
Member or pledge of a sorority or fraternity	238 (7.8)	44 (11.6)	13 (8.3)
Attends religious services at least twice per month	1321 (42.3)	87 (22.5)	58 (35.6)
Lives on campus	2956 (94.9)	365 (94.8)	157 (96.9)
In a relationship	1091 (35.1)	122 (31.6)	48 (29.6)
Other substance use			
Past 30-day cigarette use	787 (25.0)	241 (62.0)	82 (50.3)
Past 30-day alcohol consumption	1899 (60.4)	351 (90.2)	135 (82.2)
Past 30-day hookah tobacco use	675 (21.8)	227 (58.4)	66 (40.5)
Lifetime marijuana use	1270 (40.1)	360 (92.5)	103 (62.6)
Lifetime other illicit drug use	323 (10.3)	159 (40.9)	34 (20.8)

Table 2

K2/Spice incidence and weighted prevalence, by survey.

	<u>College entry</u> (Fall 2010)	<u>Freshman Yr</u> (Spring 2011)	<u>Sophomore Yr</u>		<u>Junior Yr</u> (Fall 2012)	<u>Senior Yr</u> (Fall 2013)
	<i>n</i> =3146	<i>n</i> =2524	(Fall 2011)	(Spring 2012)	<i>n</i> =2516	<i>n</i> =2500
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Incidence*	—	80 (2.6)	26 (0.9)	18 (0.8)	12 (0.4)	5 (0.3)
Prevalence	389 (7.6)	204 (5.8)	97 (2.6)	74 (2.1)	63 (1.6)	41 (1.0)

* There were 22 students who reported K2/Spice use between Fall 2011–Fall 2013. Due to not participating in a survey prior to reporting K2/Spice use, we are not able to ascertain the first time that they tried K2/Spice so they are not included in the Table.

Table 3

Predictors of lifetime K2/Spice use prior to or at college entry and first use of K2/Spice during college.

Characteristics	Lifetime K2/Spice use at college entry (n=2442)		First use of K2/Spice during college (n=1397)	
	OR (95% CI)	AOR (95% CI)	OR (95% CI)	AOR (95% CI)
Demographics				
Female	0.5 (0.4, 0.7)	0.8 (0.6, 1.1)	0.7 (0.4, 1.2)	
Nonwhite	0.5 (0.2, 1.3)		0.7 (0.5, 1.0)	0.7 (0.5, 1.1)
Hispanic	1.1 (0.6, 2.1)		1.1 (0.4, 2.7)	
Mother – 4-year college degree	1.2 (0.8, 1.6)		0.5 (0.3, 0.7)	0.6 (0.3, 1.2)
Father – 4-year college degree	1.4 (0.9, 2.1)		0.4 (0.2, 0.8)	0.4 (0.2, 0.9)
Spending money >=\$100 per month	1.4 (1.1, 2.0)	1.1 (0.8, 1.5)	0.8 (0.6, 1.2)	
Sensation seeking	3.4 (2.6, 4.6)	1.5 (1.02, 2.2)	2.8 (1.6, 4.7)	1.5 (0.9, 2.6)
Social characteristics				
Varsity athlete	0.7 (0.3, 1.9)		1.4 (0.3, 7.0)	
Club sports	0.7 (0.4, 1.2)		0.5 (0.3, 1.0)	0.6 (0.3, 1.2)
Intramural sports	1.0 (0.7, 1.4)		1.5 (0.9, 2.5)	
Member or pledge of sorority or fraternity	2.3 (1.6, 3.3)	1.3 (0.8, 2.0)	0.6 (0.3, 1.2)	
Attends religious services at least twice per month	0.3 (0.2, 0.5)	0.6 (0.4, 0.98)	0.7 (0.4, 1.2)	
Lives on campus	0.9 (0.3, 2.7)		1.0 (0.3, 3.7)	
In a relationship	0.8 (0.5, 1.2)		0.7 (0.3, 1.5)	
Other substance use				
Past 30-day cigarette use	6.7 (4.9, 9.3)	1.2 (0.8, 1.6)	6.5 (4.2, 9.8)	1.6 (0.8, 3.2)
Past 30-day alcohol consumption	7.9 (3.9, 16.0)	1.3 (0.5, 3.4)	5.4 (2.8, 10.6)	2.3 (1.2, 4.3)
Past 30-day hookah tobacco use	8.1 (5.7, 11.6)	2.4 (1.5, 3.8)	9.5 (5.6, 16.1)	4.7 (2.5, 8.9)
Lifetime marijuana use	27.9 (15.0, 51.9)	10.6 (4.7, 24.1)	5.0 (3.2, 7.8)	1.6 (1.0, 2.6)
Lifetime other illicit drug use (not including marijuana)	14.8 (11.5, 18.9)	3.1 (2.1, 4.6)	8.3 (4.3, 15.8)	2.1 (0.9, 4.8)

Bolded confidence intervals are significant at the 5% level.