Past 30–Day Marijuana Vaping: Prevalence and Predictors of Use in a Nationally Representative Study of U.S. Youth

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Abstract

Introduction: Vaping has become an increasingly common mode of administration for marijuana among youth, but there are limited data on its prevalence. There is a need to better understand youth prevalence of past 30–day marijuana vaping and its predictors.

Methods: Data were from a nationally representative sample of students from the Monitoring the Future Survey in 2018 (N=9,131). This study examined past 30–day prevalence of marijuana vaping and (for a subset with complete data: *n*=5,755) predictors of marijuana vaping among respondents asked about that behavior. Bivariate chi-square tests and multivariable logistic regression estimated the extent to which various factors were associated with marijuana vaping. These factors included current use of various substances, school-related risk behaviors, attitude and risk behaviors related to substance use, and selected sociodemographic variables.

Results: Past 30–day prevalence of marijuana vaping was higher among 10th graders, male youth, and those in the "other" race/ethnicity category. Students who engaged in current past 30–day alcohol use, cigarette use, binge drinking, and non-medical use of prescription drugs had significantly greater odds of past 30–day marijuana vaping. Past 30–day use was more common among students with a lower perceived risk of marijuana use, those who claimed that it is easy to obtain a vaporizer or marijuana, students with a lower grade point average, and those who with recent truancy.

Conclusions: Past 30–day marijuana vaping is prevalent among U.S. students, and there are robust associations between use and school- and substance-related risk behaviors. These results suggest that the emergence of vaping products might redefine populations at risk, which should be taken into account by marijuana regulatory policies or prevention programs.

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INTRODUCTION

Public health is facing a new challenge: rising e-cigarette and marijuana vaporizer use among youth, and a related lung-injury outbreak in the U.S.[1,2] It is concerning that the largest increase in consumption of these electronic devices (herein referred to as "vaporizers"), even though the health consequences of use specific to marijuana consumption are unknown.[3,4] Several states have implemented varying bans on nicotine and marijuana vaping products to combat the crisis. It is critical to understand youth vaping prevalence rates and patterns.

The U.S. has been undergoing a national change concerning marijuana legalization, with 11 states enacting adult use ("recreational") marijuana legalization. Although legalization only applies to adult use, the potential for spillover effects on youth is of increasing concern. Nationally, marijuana is the most used illicit substance among youth,[5] a group susceptible to the adverse effects of marijuana use as their brains are still undergoing neurobiological maturation.[6] Marijuana vaping among youth is especially concerning for various reasons, including availability of concentrated formulations, increasing potency levels, and ease of vaporizer concealment.[7-12] Vaping marijuana may be appealing because of the perception of reduced negative health effects compared with smoking marijuana.[13-15]

Self-reported past 30–day marijuana vaping has been rising among U.S. students. The most recent results from the 2019 Monitoring the Future (MTF) survey indicate increases in marijuana vaping rates from 2017 to 2019 across all ages.[16,17] Identifying past 30–day marijuana vaping is critical to formulating strategies for prevention and interventions. However, only a handful of studies have assessed factors associated with past 30–day marijuana vaping.[14,18-21] The objective of this study is to examine the prevalence of past 30–day marijuana vaping and evaluate associated predictors using a representative sample of U.S. school students. Previous studies have examined associations between nicotine vaping,[22] past 30–day marijuana vaping,[14,21] and school- and substance-related risk behaviors. However, to the authors' knowledge, this is one of the first studies to assess predictors of past 30–day marijuana vaping, including several unique substance- and school-related risk behavior variables.

METHODS

Study Sample

A secondary analysis was conducted using data from the MTF survey. The samples analyzed in this study included 14,836 Grade 8 and 15,144 Grade 10 respondents from the 2018 cohort. The response rates were 88% and 86%, respectively. The MTF study includes many questions and the questionnaire content is divided into 4 different forms, randomly distributed to students. The measures relevant for this study were only asked on some forms; thus, this study focused on the cross-sectional subsamples receiving the questions of interest. Additional details about the design and methods are available elsewhere.[23]

This study was not submitted for IRB approval because it utilized publicly available deidentified data from a survey that was approved by the University of Michigan Behavioral Sciences IRB.

Measures

The MTF study includes a wide range of variables relevant to vaporizer use. The research questions explored involve predictors of marijuana vaping, including demographic characteristics and substance- and school-related risk behavior measures.

The dependent variables for the analysis included past 30–day marijuana use and past 30–day marijuana vaping. For both questions, marijuana use status was coded as yes (1 occasions) and no (0 occasions) for each category separately.

Independent variables can be grouped in several domains listed below.

A series of questions ascertained the frequency of use of other substances in the past 30 days. Measures included past 30–day use of illicit drugs, nonmedical use of prescription drugs, alcohol, cigarette, and binge drinking. Past 30–day marijuana use was not included as an independent variable as it correlates with the outcome variables. All substance use variables were dichotomized (yes/no), similar to previous work.[22-26]

Measures assessing availability of marijuana and vaping devices were dichotomized into probably impossible/very difficult/fairly difficult versus fairly easy/very easy. Measures assessing perceived risk of using marijuana occasionally/regularly, and perceived risk of using a vaping device to consume nicotine regularly were dichotomized into no/slight/ moderate risk versus great risk, based on previous work.[27] Disapproval of using a vaping device to consume nicotine regularly was dichotomized into don't disapprove versus disapprove/strongly disapprove.

School academic performance was assessed as a response scale for cumulative average grade, with response options dichotomized into 2 subgroups: C or below and B– or higher.[22] Truancy was assessed as missing a whole day of school in the past 4 weeks, with response options dichotomized into 2 subgroups: did versus did not skip or cut any whole days in the past 4 weeks.[22]

Demographic variables included sex, race, college plans, parental education, geographical region, and metropolitan statistical area type. These characteristics were selected based on prior work, showing them to be related to e-cigarette use, marijuana vaping, or marijuana use.[18] Parental education was used as a proxy for SES.[20]

Statistical Analysis

This study used two samples of student participants for the separate research questions. Almost one third (30.5%) of all randomly selected 8th and 10th graders received a questionnaire form where they were asked whether they had used a vaporizer in the past 30 days to consume marijuana. Of those, 9,131 (34%) answered the question (Sample 1). Reported past 30–day prevalence was estimated for all student participants that received the

marijuana vaping question. For subsequent analyses, the authors dropped data participants who had missing data on any of the other examined variables, resulting in an analytic sample of 5,755 participants (Sample 2). This sample was used to estimate predictors of past 30–day marijuana vaping (Appendix Figure 1).

Analyses were weighted to adjust for grade, sex, race/ethnicity, and student nonresponse, to ensure that estimates are representative of all students within the study population. This study examined frequencies for all study variables within the total sample.

To gain a better understanding of the demographic profile of each user, chi-square tests were computed for association of each level of each sociodemographic covariate with whether the subject vaped marijuana, consumed marijuana but not through a vaporizer, and did not consume any marijuana in the past 30 days (yes/no). Chi-square tests were also computed for associations of past 30–day use of various other substances (alcohol, cigarettes, illicit drugs, nonmedical use of prescription drugs, binge drinking) with each outcome variable separately. Finally, chi-square tests were computed to examine associations for various school and substance use risk behaviors (easy to get vaping device, easy to get marijuana, perceived risk of regular and occasional marijuana use, disapproval of nicotine vaping, truancy, and grade point average) with the outcome variables.

Two multivariable logistic regressions were estimated to evaluate the extent to which various factors were associated with each marijuana behavior. These factors included past 30–day use of various substances, school- and substance-related risk behaviors, and sociodemographic variables. Model 1 predicted past 30–day marijuana vaping and Model 2 predicted past 30–day marijuana use without a vaporizer. All variables were entered simultaneously into both models. Statistical significance was determined using a cut off of $p<0.05$ and the explanatory power of the model was assessed using the pseudo R^2. Svy: commands were used for the regression models to take into account the complex survey structure. All analyses were conducted using Stata, version 15.

RESULTS

The reference group used to examine prevalence, bivariate associations, and predictors of past 30–day marijuana vaping comprised students who had not vaped marijuana in the past 30 days. This group included students who had and had not reported past 30–day marijuana use.

Prevalence was significantly higher among 10th graders (7.2%) compared with 8th graders (Table 1). In addition, prevalence was significantly higher among Hispanic students (6.7%), compared with that of all other race groups combined: White students (6.0%), students in the "other" race/ethnicity category (6.0%), and Black students (2.4%) (Table 2). Prevalence of past 30–day marijuana vaping was not conditional on having used marijuana.

Substance use behaviors were significantly associated with past 30–day marijuana vaping (Table 3). Students who vaped marijuana in the past 30 days had significantly higher past 30–day prevalence of alcohol use (25.0%), cigarette use (30.9%), binge drinking (34.7%), illicit drug use (57.1%), and non-medical use of prescription drugs (66.7%). Similarly, these

substance use behaviors were significantly associated with past 30–day marijuana use without a vaporizer.

All school and substance use risk behaviors were significantly associated with past 30–day marijuana vaping (Table 3). Marijuana vaping was significantly more prevalent among students who reported that it was easy to get a vaping device (8.6%), easy to get marijuana (9.8%), had a lower perceived risk of occasional (3.5%) and regular (4.2%) marijuana use, did not disapprove of nicotine vaping (3.0%), had a lower grade point average (12.6%), or had skipped class in the past 4 weeks (21.4%) Similar results held for past 30–day use without a vaporizer.

Model 1 (Table 4) accounted for 35.5% of the variance in past 30–day marijuana vaping (p<0.05). Nearly all substance use variables (except illicit substance use) were significantly associated with increased odds of past 30–day marijuana vaping. Significantly higher odds of reporting past 30–day use of vaping marijuana were observed for student respondents who reported past 30–day use of alcohol, cigarettes, non-medical use of prescription drugs, or binge drinking. The regression results also indicated that attitudes, perceived risks, and availability of substances were significantly associated with past 30–day marijuana vaping. Higher odds of use were found for those reporting that it is easy to obtain a vaping device or to obtain marijuana. Interestingly, variables assessing attitudes toward marijuana were significantly associated with vaping marijuana, but variables assessing attitudes toward nicotine vaping were not. Specifically, students who indicated that there is a high risk of harm associated with regular marijuana use were significantly less likely to report marijuana vaping, whereas youth who perceived vaping nicotine to be high risk were more likely to report marijuana vaping compared with youth who perceived little risk in vaping nicotine. In addition, truancy was associated with higher odds of reporting past 30–day marijuana vaping as was lower grade point average. Finally, some sociodemographic variables were associated with past 30–day use. Female youth had lower odds, and students in the other race/ethnicity category (compared with White students) had higher odds of past 30–day marijuana vaping (p> values and 95% CIs presented in Table 4).

Regression Model 2 (Table 4) accounted for 38.1% of the variance in past 30–day marijuana use without a vaporizer (p<0.05). Some results were qualitatively similar to Model 1, including: marijuana use without a vaporizer being more common among 10th graders, male students, those using other substances, those who reported marijuana was easy to obtain, those with recent truancy, and those with a lower grade point average. Other results differed from the findings for vaping marijuana. Specifically, using marijuana without a vaporizer was less likely among those who perceived a high risk of using marijuana occasionally.

DISCUSSION

As the use of portable devices to vaporize marijuana is becoming more popular among youth, a deeper examination of its prevalence and predictors are warranted. Compared with previous research, this study found a similar prevalence of past 30–day marijuana vaping among youth: 2.7% of 8th graders and 7.2% of 10th graders in this study of a nationally representative sample of U.S. students, compared with 4.9% in a sample of 10th grade

students in Los Angeles[20]; 3.9% in a sample of youth aged 16–19 years in the U.S.[19]; as well as 1.6% in 2017, 2.6% in 2018, and 3.9% in 2019 for 8th graders and 4.3% in 2017, 7.0% in 2018, and 12.6% in 2019 for 10th graders also in a nationally representative sample of U.S. students using MTF data.[16]

Male youth are more likely than female youth to use marijuana in both forms. When examining race, students in the other category, compared with White students, had higher odds of past 30–day marijuana vaping. These results are consistent with most previous literature that examined past 30–day marijuana vaping.[18,21] Other non-nationally representative studies either did not find race to be a predictor of use[20] or found that White and Asian students were most likely to report past 30–day marijuana vaping.[14]

To the authors' knowledge, this is one of the first studies that assessed how past 30–day use of other substances is associated with past 30–day use of marijuana vaping. Past 30–day alcohol use and cigarette use were strongly associated with past 30–day marijuana vaping. These results are similar to those of various previous studies that identified associations between other substance use and past 30–day adolescent vaping,[14,21] and predictors of lifetime marijuana vaping among young adults.[28-31] Past 30–day non-medical use of prescription drugs and binge drinking were also associated with marijuana vaping. This is consistent with data from a youth sample where substance-related risk behaviors were associated with past-month e-cigarette use,[22] as with other studies that have found that non-medical use of prescription drugs is associated with cannabis vaping, and cannabis use among youth in general.[14,21,32,33] Overall, these results indicate that students who engaged in past 30–day alcohol use, marijuana use, nonmedical use of prescription drugs, and binge drinking had significantly greater odds of past 30–day marijuana vaping, relative to students who did not report these substance use behaviors.

In addition, the current findings add to prior research that has established a link between marijuana use and attitudes toward use,[14,21,28,34,35] extending the measurement of risk perception to include the perceived risk of vaporizing marijuana. Also, students who reported that it was easy to obtain a vaping device and easy to obtain marijuana had higher odds of reporting past 30–day marijuana vaping. These findings could reflect greater access resulting from recent state marijuana legalization policies, although this could not be assessed in the current data set.

Interestingly, attitudes toward marijuana were significantly associated with vaping marijuana; however, attitudes toward nicotine vaping were not. Specifically, students who indicated that there is a low risk of harm associated with regular marijuana use also reported statistically higher odds of marijuana vaping, whereas there was no statistically significant relationship between use and students reporting risk of harm or disapproval of vaping nicotine. This suggests a need for additional research examining associations between different categories of past 30–day vaping such as vaping nicotine versus vaping marijuana.

To the authors' knowledge, this is also one of the first studies to examine how school-related risk behaviors are associated with past 30–day marijuana vaping. As with previous work examining school-related risk behaviors and e-cigarette use, this study found that students

who skipped at least 1 school day in the past 4 weeks were more likely to engage in past 30–day marijuana vaping, as were students with a lower grade point average.[22]

Limitations

The present study has several strengths that build upon previous literature examining vaping marijuana and other health behaviors. This study used a sample that is diverse and nationally representative of U.S. 8th and 10th grade students, and data on self-reported past 30–day marijuana vaping behaviors. Despite these advantages, this study also has limitations that warrant some consideration. As this study did not use the restricted version of the MTF data, the design remains cross-sectional, which weakens the ability to interpret causally the relationships found between past 30–day marijuana vaping and the predictor variables. Future longitudinal research is needed to assess a more comprehensive set of predictors of vaping marijuana among youth. Furthermore, this study examined national estimates of past 30–day marijuana vaping without addressing heterogeneity across states.[36,37] It is critical that future research assess and adjust for states with varying marijuana laws, specifically states with medicinal and adult use laws with provisions permitting home cultivation and retail stores. These laws and provisions may result in regional patterns important to monitor. Although this study was unable to control for state, there is clear variation among other important variables across the sample, which could have important policy implications. Prevention-based state regulations could target metropolitan and lower-SES areas. Regulations, such as advertising and limits of retail store density per capita, could be considered by states enacting marijuana legalization. Youth in states permitting sales of vaporizers (for nicotine and marijuana use) may be more at risk of marijuana vaping. Vaporizing may be appealing as a method of consumption to youth specifically because these products are easier to conceal owing to the both the size/appearance of product, often resembling commonly used school products, and the variety of flavors, which mask the smell of marijuana. The reference group for all analyses includes students who have and have not reported past 30–day marijuana use. This should be considered when interpreting findings, as there may be meaningful differences between students who have used marijuana in the past 30 days (but not vaped) and those who have not used marijuana at all in the past 30 days. Another limitation is the smaller sample size, because two thirds of students were not asked about marijuana vaping. However, there was no systematic bias in those who were versus were not asked the question[23] and the response rate was 34%. Moreover, this study utilizes the full sample for the prevalence question, and a complete case analysis for the predictor question. A large proportion of the missingness from the dropped data is random, as past 30–day vaping was asked only of a random subset of students. However, the remaining missingness is potentially nonrandom, which could have potentially impacted study findings. Some variables used in the analyses had relatively small sample sizes, leading to larger CIs, which should be considered when interpreting findings. Furthermore, this study did not assess frequency of past 30–day marijuana vaping. Future analyses building on this paper could additionally assess frequencies versus overall percentages of past 30–day marijuana vaping. In addition, the school sampling frame is limited to students attending public schools, so results may not be generalizable. Moreover, the marijuana use construct is based on student self-report, and youth in legalized states may be more willing to report marijuana use compared with students living in non-legalized states. Finally, this

study was unable to assess the form or potency level of the marijuana vaped, as the MTF survey does not differentiate between using wax, hash oil, and e-liquid concentrates and does not track marijuana potency.

CONCLUSIONS

Despite these limitations, the current study adds to the emerging literature on the use of vaporizers like e-cigarettes and vape pens to vaporize marijuana. This is one of the first studies to examine past 30–day marijuana vaping with a specific focus on youth, as well as its predictors. The results suggest that the emergence of vaping products might redefine populations at risk, which should be taken into account by marijuana regulatory policies or prevention programs. Future research examining additional characteristics associated with vaping marijuana is needed as these devices continue to gain popularity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

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Table 1.

Prevalence of Past 30–day Marijuana Vaping Among Students, Stratified by Grade

Grade	Sample size	Past 30 day Has not used marijuana	*p*-value	Past 30 day Has vaped marijuana	*p*-value	Past 30 day Has used marijuana (not vaped)	*p*-value
Past 30–day marijuana vaping (full sample); N=9,131							
8th	4,465	94.1 (4,057)	**<0.001**	2.7 (120)	**<0.001**	3.8 (158)	**<0.001**
10th	4,666	83.6 (3,762)	**<0.001**	7.2 (363)	**<0.001**	10.4 (435)	**<0.001**
Past 30–day marijuana vaping (complete case analysis); N=5,755							
8th	2,582	94.1 (2,430)	**<0.001**	2.4 (61)	**<0.001**	3.9 (99)	**<0.001**
10th	3,173	83.0 (2,632)	**<0.001**	8.7 (275)	**<0.001**	10.1 (293)	**<0.001**

Notes: Boldface indicates statistical significance (p<0.001 for all prevalence estimates). Estimated prevalence of different categories of past 30–day marijuana use (i.e., no marijuana use, marijuana vaping only, marijuana use only) for each grade level for 2 different samples shown in Table 1. The 3 categories are mutually exclusive: the first column checks associations of each grade with no marijuana use, the second column with past 30–day marijuana vaping, and the third with past 30–day marijuana use (not vaped). The first rows depict prevalence for the full sample and the following rows show prevalence for the complete case analysis. Displayed percentages. Sample size in parenthesis.

Source: Monitoring the Future Survey, 2018.

Table 2.

Weighted Participant Characteristics Stratified by Past 30–day Marijuana Status

Variable	Total sample	Past 30 day Has not used marijuana	*p*-value	Past 30 day Has vaped marijuana	*p*-value	Past 30 day Has used marijuana (not vaped)	*p*-value
	(n=5,755)	(n=5,062)		(n=336)		(n=392)	
Sex							
Male	50.6 (2,915)	88.0 (2,567)	0.637	6.1 (175)	0.301	7.2 (210)	**0.05**
Female	49.4 (2,840)	87.8 (2,495)	0.637	5.5 (161)	0.301	6.8 (182)	**0.05**
Race/Ethnicity							
Black	11.6 (505)	87.3 (441)	**<0.001**	2.4 (12)	**<0.001**	10.8 (53)	0.310
White	44.2 (3,110)	88.8 (2,760)	0.003	6.0 (188)	**0.001**	6.1 (179)	**0.002**
Hispanic	20.0 (1,064)	90.3 (922)	0.615	6.7 (72)	**0.042**	8.3 (82)	**0.012**
Other	23.8 (1,076)	87.27 (939)	0.736	6.0 (64)	**0.001**	7.7 (78)	**0.005**
Geographical region							
Northeast	20.4 (1,173)	85.6 (1,005)	**0.008**	6.9 (81)	**0.045**	8.8 (96)	**<0.001**
North Central	26.7 (1,537)	90.6 (1,392)	**0.023**	5.0 (77)	**0.026**	5.3 (78)	**<0.001**
South	31.2 (1,797)	89.4 (1,606)	0.633	3.4 (67)	**<0.001**	7.6 (131)	**<0.001**
West	21.7 (1,248)	84.9 (1,059)	0.453	9.0 (111)	**<0.001**	7.6 (87)	**<0.001**
Metropolitan statistical area (MSA)/ Urbanicity							
MSA	78.8 (4,536)	88.7 (5,894)	0.085	6.4 (289)	**0.001**	7.2 (304)	0.172
Non-MSA	21.2 (1,219)	90.1 (1,561)	0.085	3.9 (47)	**0.001**	7.5 (88)	0.172
Parental education							
Father							
No college	35.6 (2,056)	84.6 (1,740)	**<0.001**	7.0 (142)	**<0.001**	9.8 (187)	**<0.001**
Some college	50.2 (2,889)	90.27 (2,608)	**<0.001**	5.1 (150)	0.078	5.4 (147)	**<0.001**
Don't know	14.0 (810)	88.15 (714)	**<0.001**	5.4 (44)	0.079	7.6 (58)	**<0.001**
Mother							
No college	27.5 (1,587)	84.8 (1,345)	**<0.001**	6.6 (105)	0.003	10.0 (148)	**<0.001**
Some college	63.7 (3,665)	89.0 (3,265)	**<0.001**	5.8 (212)	0.249	6.0 (210)	**<0.001**
Don't know	8.7 (503)	89.9 (452)	**<0.001**	3.8 (19)	0.096	7.0 (34)	**<0.001**
College plans							
Definitely will attend	92.6 (5,326)	88.9 (4,739)	**<0.001**	10.7 (46)	**<0.001**	6.5 (327)	**<0.001**
Will not attend/other	7.5 (429)	75.3 (323)	**<0.001**	5.4 (290)	**<0.001**	16.9 (65)	**<0.001**

Notes: Boldface indicates statistical significance (*p*<0.05). The bivariate associations between different categories of past 30–day marijuana use (i.e., no marijuana use, marijuana vaping only, marijuana use only) and for each level of demographic characteristics shown in Table 2. The 3 categories are mutually exclusive: the first column checks associations of each explanatory variable with no marijuana use, the second column with past 30–day marijuana vaping, and the third with past 30–day marijuana use (not vaped). The *Other* race category includes all responses other than *Black or African American, White (Caucasian), Hispanic (Mexican, Cuba, Puerto Rican, Other Hispanic).* It therefore includes *Asian American, American Indian or Alaska Native* as well as *Native Hawaiian or Other Pacific Islander* and respondents who fell into more than 1 of those 3 categories. Bivariate associations of the explanatory variables race, geographical region, and parental education were assessed by checking associations of each separate outcome with the reference group of not being included in the outcome being tested. Displayed percentages. Sample size in parenthesis.

Source: Monitoring the Future Survey, 2018.

Table 3.

Weighted Past 30–day "Other Substance" Use and School and Substance Use Risk Behaviors, Stratified by Past 30–day Marijuana Status

Status	Total sample (n=5,755)	Has not used marijuana (n=5,062)	Has vaped marijuana (n=336)	Has used marijuana (not vaped) (n=392)
Alcohol use				
Yes	16.0 (916)	**58.4 (535)** ***	**25.0 (230)** ***	**25.3 (174)** ***
No	84.0 (4,808)	**93.6 (4,499)** ***	**2.2 (106)** ***	**4.6 (217)** ***
Cigarette use				
Yes	2.6 (149)	**34.9 (52)** ***	**30.9 (46)** ***	**51.5 (53)** ***
No	97.4 (5,606)	**89.4 (5,010)** ***	**5.1 (290)** ***	**6.4 (339)** ***
Binge drinking				
Yes	7.6 (438)	**45.0 (197)** ***	**34.7 (152)** ***	**36.0 (103)** ***
No	92.4 (5,317)	**91.5 (4,865)** ***	**3.5 (184)** ***	**5.6 (289)** ***
Illicit drug use				
Yes	0.5 (14)	**14.3 (2)** ***	**57.1 (8)** ***	**66.7 (4)** ***
No	99.8 (5,741)	**88.1 (5,060)** ***	**5.7 (328)** ***	**7.1 (388)** ***
Non-medical use of prescription drugs				
Yes	0.5 (27)	**18.5 (5)** ***	**66.7 (18)** ***	**55.6 (5)** ***
No	99.45 (5,728)	**88.3 (5,057)** ***	**5.6 (318)** ***	**7.15 (387)**
Easy to get vaping device				
Yes	62.8 (3,611)	**83.1 (3,000)** ***	**8.6 (311)** ***	**10.0 (330)** ***
No	37.3 (2,144)	**96.2 (2,062)** ***	**1.1 (25)** ***	**3.0 (62)** ***
Easy to get marijuana				
Yes	57.7 (3,321)	**80.3 (2,668)** ***	**9.8 (324)** ***	**12.1 (361)** ***
No	42.3 (2,434)	**98.3 (2,394)** ***	**0.5 (12)** ***	**1.3 (31)** ***
Perceives high risk of using marijuana regularly				
Yes	84.5 (4,864)	**91.0 (4,430)** ***	**4.2 (203)** ***	**5.5 (258)** ***
No	15.5 (891)	**70.9 (632)** ***	**15.0 (133)** ***	**17.7 (134)** ***
Perceives high risk of using marijuana occasionally				
Yes	78.1 (4,494)	**92.7 (4,164)** ***	**3.5 (157)** ***	**4.5 (196)** ***
No	22.0 (1,261)	**71.2 (898)** ***	**14.2 (179)** ***	**18.1 (196)** ***
Perceives high risk of nicotine vaping				
Yes	88.3 (5,084)	**90.0 (4,554)** ***	**5.00 (254)** ***	**6.3 (305)** ***
No	11.7 (661)	**75.8 (508)** ***	**12.2 (82)** ***	**14.8 (87)** ***
Disapproval of nicotine vaping				
Yes	75.5 (4,357)	**93.0 (4,041)** ***	**3.0 (127)** ***	**4.6 (196)** ***
No	24.5 (1,408)	**72.5 (1,021)** ***	**14.8 (209)** ***	**16.4 (196)** ***

Status	Total sample (n=5,755)	Has not used marijuana (n=5,062)	Has vaped marijuana (n=336)	Has used marijuana (not vaped) (n=392)
Low grade point average (< C)				
Yes	16.7 (963)	73.8 (711) ***	12.6 (121) ***	16.7 (141) ***
No	83.2 (4,792)	90.8 (4,351) ***	4.5 (215) ***	5.5 (251) ***
Truancy (skip class past 4 weeks)				
Yes	88.6 (5,098)	62.3 (409) ***	21.5 (141) ***	22.7 (117) ***
No	11.4 (657)	91.2 (4,653) ***	3.8 (195) ***	5.6 (275) ***

Notes:

*
p<0.05

**
p<0.01

***
p<0.001. All associations are statistically significant with a p-value <0.001. The bivariate associations between different categories of past 30–day marijuana use (i.e., no marijuana use, marijuana vaping only, marijuana use only) and past 30–day of other substances and various school and substance use risk behaviors, shown in Table 3. For each "other substance" behavior, and each school and substance use risk behavior (row header), pairwise differences in rates between each of the groups by marijuana status (column header) were statistically significant at p<0.001. Displayed percentages. Sample size in parenthesis.

Source: Monitoring the Future Survey, 2018.

Table 4.

AORs of School- and Substance-related Risk Behaviors as a Function of Past 30-day Marijuana Vaping and Marijuana Use (Without Vaping)

Variable	Past 30-day use	
	Vaping marijuana	**Marijuana (without vaping)**
Grade (ref=8th)		
10th	**1.229 ** (1.020, 1.481)**	**1.282 *** (1.121, 1.466)**
Sex (ref=Male)		
Female	**0.712 ** (0.507, 0.998)**	**0.854 *** (0.764, 0.976)**
Race (ref= White)		
Black	0.678 (0.303, 1.515)	**2.208 *** (1.447, 3.369)**
Hispanic	1.123 (0.762, 1.655)	**1.354 * (1.001, 1.832)**
Other	**1.187 ** (1.015, 1.770)**	1.313 (0.942, 1.828)
Alcohol use (past 30 days)	**4.801 *** (2.882, 8.000)**	**3.982 *** (2.968, 5.342)**
Cigarette use (past 30 days)	**2.767 *** (1.677,4.567)**	**2.750 *** (1.432, 5.281)**
Binge drinking (past 2 weeks)	**3.671 *** (2.560,5.263)**	**3.952 *** (2.831, 5.517)**
Illicit drug use (past 30 days)	3.362 (2.543, 5.276)	**8.442 *** (1.107, 10.806)**
Non- medical prescription drug use (past 30 days)	**5.078 ** (1.286, 20.05)**	**4.979 ** (1.064,23.31)**
Easy to get vaping device	**1.587 * (0.944, 2.669)**	0.994 (0.690, 1.433)
Easy to get marijuana	**8.845 *** (4.526, 17.28)**	**5.647 *** (3.641, 8.757)**
Perceives high risk of using marijuana occasionally (ref=low risk)	**0.657 * (0.411,1.049)**	**0.397 *** (0.271, 0.584)**
Perceives high risk of using marijuana regularly (ref=low risk)	**0.663 * (0.408,1.079)**	0.866 (0.571, 1.315)
Perceives high risk of vaping nicotine (ref=low risk)	1.085 (0.682, 1.728)	1.079 (0.748, 1.556)
Don't disapprove nicotine vaping (ref=disapprove)	**0.637 ** (0.433, 0.9363)**	**0.649 *** (0.492, 0.857)**
Low grade point average (< C)	**1.437 ** (1.035, 2.097)**	**1.796 *** (1.342, 2.404)**
Truancy (skip class past 4 weeks)	**2.704 *** (1.916, 3.817)**	**2.406 *** (1.796, 3.222)**
College plans	1.230 (0.746,2.030)	**0.613 ** (0.421,0.891)**

Notes: Boldface indicates statistical significance

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*
p<0.05

**
p<0.01

***
p<0.001). CIs are displayed in parentheses.

Source: Monitoring the Future Survey, 2018.

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