Adolescent Marijuana Use, Marijuana-Related Perceptions, and Use of Other Substances Before and After Initiation of Retail Marijuana Sales in Colorado (2013–2015)

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Abstract

Due to the recentness of changes to marijuana policies in a number of states, the effect on adolescent use and perceptions is not yet well understood. This study examines change in adolescent marijuana use and related perceptions in Colorado, before and after the implementation of legal commercial sale of recreational marijuana for adults starting on January 1, 2014. The data are from a repeated cross-sectional survey of a representative sample of Colorado high school students, with separately drawn samples surveyed in fall 2013 (prior to implementation) and fall 2015 (18 months after implementation). We examined change in the prevalence of adolescent marijuana use, measured by lifetime use, past 30-day use, frequent use, and use on school property. To consider the possibility of heterogeneity in the change in marijuana use, we examined change in past 30-day marijuana use by demographic characteristics (sex, grade, race/ethnicity), school characteristics (poverty, percent minority), urbanicity of the school district, and whether the city or county permitted retail marijuana stores. There was an absence of significant effects for change in lifetime or past 30-day marijuana use. Among those reporting past 30-day use, frequent use and use on school property declined. There was a significant decline in the perceived harm

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Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval The study was approved by the Colorado Multiple Institutional Review Board. All procedures performed in studies involving human participants were in accordance with the ethical standards of the Colorado Multiple Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent The data collection for this study was approved as exempt, which included a waiver of written parental consent and student assent. Student participation in data collection was voluntary and no personal identifiers were collected. Parents were notified in writing at least 2 weeks in advance of data collection and could opt out their child from data collection. Students were instructed that they could skip questions or chose not to complete the survey.

associated with marijuana use, but we did not find a significant effect for perceived wrongfulness, perceived ease of access, or perceived parental disapproval. We did not find significant variability in past 30-day use by demographic characteristics or by school and community factors from 2013 to 2015. We did not find a significant effect associated with the introduction of legal sales of recreational marijuana to adults in Colorado on adolescent (illegal) use, but ongoing monitoring is warranted, including consideration of heterogeneity in the effects of marijuana policies.

Keywords

Adolescent; Substance use; Marijuana/cannabis; Policy evaluation; Risk behaviors; Surveillance

Introduction

As US states liberalize legal access to medical and recreational marijuana for adults ages 21 and older, the potential impact of these policies on adolescent marijuana use is not yet known. Colorado and Washington passed recreational marijuana laws (RMLs) in 2012; since then, six additional states and the District of Columbia have followed suit (National Conference of State Legislatures 2017). All of the states' RMLs restrict legal access to recreational marijuana to those 21 years and older. Due to the recentness of these policy changes, few studies have evaluated the impact on adolescent marijuana use, and findings are mixed (Cerda et al. 2016; Fleming et al. 2016; Rusby et al. 2017). With data from the national Monitoring the Future Study, Cerda and colleagues used quasi-experimental methods to compare past 30-day marijuana use among 8th, 10th, and 12th graders in Washington and Colorado (states with RMLs) to students in non-RML states before (2010–2012) and after (2013–2015) the passage of the laws. Findings showed that there was a modest difference in the increase in use among 8th and 10th graders in Washington, but no other statistically significant changes. Two other studies have examined data from Washington. Fleming et al. (2016) did not find a change in marijuana use in 2010–2014 among 10th graders (Fleming et al. 2016) and Johnson et al. examined past 30-day marijuana use from 2004 to 2016 among 8th, 10th, and 12th graders and found there were increases among 12th graders, no changes among 10th graders, and decreases among 8th graders (Johnson et al. 2018). Finally, Rusby and colleagues did not find an increase in marijuana use in a longitudinal study of Oregon youth associated with change in recreational marijuana policy change (Rusby et al. 2017).

In comparison to RMLs, evaluations of *medical* marijuana legalization's impact on adolescent use are accumulating (Carliner et al. 2017). Medical marijuana laws (MMLs), like recreational marijuana laws, loosen the restrictions on the availability and legality of marijuana use, which raises a concern that marijuana may be diverted from legal medical use to illegal adolescent use. Several methodologically rigorous studies suggest that MMLs are not associated with an increase in adolescent marijuana use (Choo et al. 2014; Hasin et al. 2015; Johnson et al. 2017; Keyes et al. 2016; Martins et al. 2016; Mauro et al. 2017). Furthermore, observational studies have demonstrated that marijuana use among US adolescents has decreased since the early 2000s (Grucza et al. 2016; Johnson et al. 2015; Kann et al. 2016).

In addition to adolescent marijuana use, several studies have examined how marijuana policies are associated with adolescent attitudes and beliefs associated with marijuana use, such as perceptions of harm or parental disapproval of use, which may be indicators of future changes in marijuana use (Cerda et al. 2016; Fleming et al. 2016; Salas-Wright et al. 2017; Wu et al. 2015). For example, Cerda et al. (2016) found that perceived harmfulness of marijuana use declined among 8th and 10th graders between 2010 and 2012 and 2013–2015, corresponding to before and after the introduction of legal recreational marijuana. Fleming et al. (2016) noted changes in recent years among 10th graders in Washington for several marijuana-specific attitudes, including perceived harm, wrongfulness of use, and perception of how wrong adults in the neighborhood think it is for kids to use marijuana. Evidence from medical marijuana states shows similar changes in adolescent attitudes regarding marijuana use. Miech et al. (2015) examined attitudes associated with marijuana use in California using data from Monitoring the Future and found that California's medical marijuana law was associated with a decrease in perceived harm and disapproval of regular marijuana use and an increase in expectancy of future marijuana use among 12th graders as compared to other states. Schuermeyer et al. (2014) examined data from the National Survey on Drug Use and Health from Colorado before passage of the state's RML. Their study found a decline in the proportion of adolescents and adults who reported a great risk from using marijuana. While it may not be possible to fully understand the effects of recreational marijuana policies on substance use behavior in a short time period following enactment and implementation of laws, examining attitudes about marijuana use may provide an early indication of how behaviors may change in the future and may also provide useful information for developing prevention programs.

Analysis of marijuana use at the state-level may mask differential effects of marijuana policy that may exist within a state due to variations in implementation. For example, in Colorado, a city or county may restrict the availability of retail marijuana sales, either recreational or medical, by banning the sale or limiting the number of licenses available. Differential availability of recreational marijuana stores and the associated signage and advertising could impact adolescent use, as has been consistently observed for tobacco products (Cantrell et al. 2015; Kirchner et al. 2016). Drawing from the evidence from states with legal medical marijuana, two recent studies from California examined the relationship between physical proximity to dispensaries and marijuana use. These studies found a relationship between proximity and use for adults (Freisthler and Gruenewald 2014) but not for adolescents (Shi 2016). Marijuana stores in Colorado are more likely to be found in neighborhoods with higher minority populations and higher poverty (Shi et al. 2016), consistent with research on tobacco products (Cantrell et al. 2014; Kirchner et al. 2014). This differential availability of recreational marijuana stores in Colorado may have a differential impact on adolescents located in urban areas and areas with a higher minority population, disproportionately affecting vulnerable populations.

To enhance our understanding of short-term changes in adolescent marijuana use following RMLs, we examine marijuana use among Colorado high school students. Retail sales of recreational marijuana were implemented in Colorado on January 1, 2014, and adults aged 21 and older can legally purchase marijuana at state-regulated dispensaries. (Private consumption of marijuana became legal by the end of 2012, but commercial sales did not

begin until 2014.) Because adolescents cannot purchase recreational marijuana through legal means, it is unclear whether initiation of retail marijuana sales might have an impact on their substance use. To address this research gap, we compared the prevalence of adolescent marijuana use and marijuana-related perceptions before (2013) and after (2015) the availability of retail recreational marijuana in Colorado. We examined heterogeneity in the change in prevalence of use by differences in school characteristics, including high vs. low poverty and high vs. low percent minority student enrollment, urbanicity of the school district, and local policies controlling the sale of recreational marijuana. We included a test of change in other substance use prevalence estimates (tobacco, alcohol, prescription drug, and cocaine) to put the findings in context of changes in other substance use behavior. Cigarette smoking and excessive alcohol consumption are well established as leading causes of mortality and morbidity; therefore, much of the overall public health impact of marijuana policies will depend on whether there are concurrent increases in cigarette and alcohol use among adolescents (Guttmannova et al. 2016; Joffe 2017).

Methods

Healthy Kids Colorado Surveys

Data for this study come from Healthy Kids Colorado Survey (HKCS), an ongoing, biennial survey of Colorado middle and high school students administered in odd years (Johnson et al. 2016). HKCS methods and items remain consistent across years to allow for comparisons over time. Using data from the high school samples, we examine marijuana use, other substance use, and marijuana-related perceptions before (August through December, 2013) and after (August through December, 2015) retail sales of recreational marijuana in Colorado began (January, 2014). The HKCS methods and protocols are consistent with the Centers for Disease Control and Prevention's Youth Risk Behavior Survey (YRBS) (Kann et al. 2016). The HKCS instrument consists primarily of the core questions from the YRBS, with additional questions added for Colorado. Participation was voluntary and approved by parents; no identifying information was collected. The study was approved by the Colorado Multiple Institutional Review Board.

The HKCS sampling design is a two-stage stratified cluster design, using a sampling list-frame of all public high schools provided by the Colorado State Department of Education. The strata are 21 health statistics regions defined by the state health department. At the first stage, schools are randomly selected within strata. In 2013, alternative schools were randomly sampled from a separate frame, and in 2015, alternative schools were included in the main frame. At the second stage, classrooms are randomly selected. All students in selected classrooms were invited to participate. The overall response rates were 58% in 2013 (78.1% of schools and 71.3% of students) and 47% in 2015 (64.1% of schools and 72.6% of students).

The survey was self-administered using a machine-scannable paper booklet and pencil during a regular class period. Teachers oversaw survey administration and were directed to read a script providing instructions for students. To reduce misreporting, teachers were instructed not to circulate the room while students were completing the survey, and students were assured verbally and in writing that their responses will be held confidential.

Measurement of Study Variables

Marijuana Use—We examined four marijuana use variables: lifetime use, past 30-day use, frequent use, and use on school property. Lifetime marijuana use was defined as any response other than "zero" to the question: "During your life, how many times have you used marijuana?" Past 30-day marijuana use was defined as a response of "one or more times" to the question, "During the past 30 days, how many times did you use marijuana?" Among those who reported any past 30-day use, we included variables representing frequent use (i.e., > 20 occasions of marijuana use in the past 30 days) and any past 30-day use on school property. All substance use items come from the YRBS core questionnaire.

Marijuana-Related Perceptions—Items inquiring about marijuana-related perceptions had a 4-point Likert response set, which we dichotomized into high vs. low. Perceived accessibility, perceived wrongfulness, perceived parental disapproval, and perceived harmfulness were assessed with the following items (and response options), respectively: (1) "If you wanted to get some marijuana, how easy would it be for you to get some?" (sort of easy or very easy, vs. very hard or sort of hard); (2) "How wrong do you think it is for someone your age to use marijuana?" (very wrong or wrong, vs. a little bit wrong or not wrong at all); (3) "How wrong do your parents or guardians feel it would be for you to use marijuana?" (very wrong or wrong, vs. a little bit wrong or not wrong at all); and (4) "How much do you think people risk harming themselves (physically or in other ways), if they use marijuana regularly?" (moderate risk or great risk, vs. no risk or slight risk). These four items were based on questions from the Monitoring the Future survey and the National Survey on Drug Use & Health (Johnston et al. 2016).

Other Substance Use—Students were asked about other commonly used substances, including any past 30-day use of cigarettes or alcohol, any lifetime non-medical use of a prescription drug (such as OxyContin, Percocet, Vicodin, codeine, Adderall, Ritalin, or Xanax), and any lifetime use of cocaine (including powder, crack, or freebase).

Demographic Characteristics—Students were asked their sex, grade level, and race/ethnicity, i.e., non-Hispanic White, non-Hispanic Black/African American, Hispanic/Latino (any race), and Other. The "Other" group includes American Indian/Alaska Native, Asian, Native Hawaiian/other Pacific Islander, and Multi-Racial youth; these groups were too small to examine independently. Hereafter, we refer to the groups as White, Black, Hispanic/Latino, and Other.

School Characteristics—We included four social factors as stratification variables, each coded at the school level: (1) level of family poverty among students, (2) racial composition of students, (3) urbanicity of the school's municipality, and (4) whether the school's municipality permitted retail marijuana sales in 2015. We used percentage of students receiving subsidized meals as a proxy for level of family poverty among within schools; if 75% of students received subsidized meals schools were coded as high poverty, whereas < 75% were coded as low poverty (Snyder and Musu-Gillette 2015). If 40% of enrolled students were Black or Hispanic, schools were considered to have a high minority student population (< 40% was coded as low); this cutoff is standard and has been used in prior

reports (National Student Clearinghouse Research Center 2015). Urbanicity was based on district locale codes available from the Colorado Dept. of Education; schools were classified as urban (code 11–13), suburban (codes 21–23), or rural (codes 31–43) (National Center for Education Statistics 2017). Finally, schools were distinguished by whether they were in a municipality (i.e., city, town, or county) that permitted retail sales of recreational marijuana by the fall 2015. No municipalities had retail sales in 2013.

Analysis

We calculated prevalence estimates and 95% confidence intervals (CIs) for marijuana use, marijuana-related perceptions, and other substance use in 2013 and 2015, i.e., before and after retail sales of recreational marijuana. We conducted stratified analyses to examine past 30-day marijuana use by demographic and school factors. We used the Rao-Scott chi-square tests to assess the statistical significance of differences from 2013 to 2015 (two-sided test, $p < 0.05$). The Rao-Scott test is widely used to account for complex sample design when testing significance (Rao and Scott 1987). Interactions were tested in separate logistic models for each characteristic including year, the characteristic, and the interaction between the year and each characteristic.

Data were weighted to provide approximately unbiased estimates representing Colorado public high school students enrolled in the respective survey year. The weights account for sampling design, school and student non-participation and non-response, and discrepancies in grade, sex, and race/ethnicity between the sample and the population. We used survey procedures in SAS for all analyses (SAS version 9.4; SAS Institute, Inc., Cary, NC) to account for stratified and clustered design and weighted data.

Results

The demographic characteristics of the Colorado high school student sample, and characteristics of student population to which the sample is weighted, were similar in 2013 and 2015. At both time periods, one-half of the study sample were boys, more than one-half were White, and approximately one-third were Hispanic/Latino (Table 1). There was a similar distribution across grade levels. Also at both time periods, < 10% of schools were classified as having high levels of family poverty among students, more than one third had high Black/Hispanic student enrollment, similar proportions were urban, suburban, and rural in both years, and just under half were in communities that permitted retail marijuana sales in 2015.

There was an absence of statistically significant change in lifetime or past 30-day marijuana use from 2013 to 2015, respectively (35.8 vs. 38.0%, $p = 0.74$; 20.9 vs. 21.2%, $p = 0.79$; Table 2). Among those reporting past 30-day marijuana use, there was a significant decline in frequent use (i.e., > 20 occasions of use in the past 30 days) and use on school property.

With the exception of perceived harmfulness, we did not find a statistically significant change from 2013 to 2015 in marijuana-related perceptions. There was a significant decrease in perceived harmfulness (52.9–47.7%, $p < 0.01$), but there was an absence of a statistically significant change in perceived accessibility (55.8–55.7%), wrongfulness (59.3–

60.6%), and parental disapproval (85.3–85.4%; Table 2). We further examined changes in perceptions among only current users and found an increase in perceived wrongfulness (13.3–17.7, $p < 0.01$) and no other significant differences (data not shown).

There was a 28% decrease in cigarette smoking (12.1% in 2013 to 8.6% in 2015, $p < 0.01$), but an absence of a statistically significant change in past 30-day alcohol use, past 12-month non-medical prescription drug use, or past 12-month cocaine use.

We did not detect a statistically significant change in past 30-day prevalence of marijuana use from 2013 to 2015 for any demographic subgroup. There was a modest, but not statistically significant, increase in use among girls (18.7 vs. 21.0%, $p = 0.05$). Table 3 also presents change in current marijuana use from 2013 to 2015 by school characteristic including school poverty, proportion of student enrolment that was Black or Hispanic, urbanicity of the school, and local policy regarding retail marijuana sales in 2015 (Table 3). We did not find a statistically significant change in current marijuana use for any of these school characteristics. We further tested for interactions of time by demographic factors and school characteristics and none of these factors significantly affect the change of the current marijuana use between before (2013) and after (2015) legislation.

Discussion

Summary and Findings

A pre-post study among Colorado high school students did not detect a change in ever or current marijuana use rates after retail marijuana sales became legally available to adults. Specifically, we did not find an indication of change in past 30-day marijuana use from 2013 to 2015 (20.9 vs. 21.2%), or for any demographic group (i.e., by grade level, sex, or race/ethnicity). The time period of the study coincides with the 2014 implementation of retail marijuana sales in Colorado. Our findings are consistent with the larger body of research, including observational and quasi-experimental studies of adolescent marijuana use in the midst of policy change (Carliner et al. 2017; Fleming et al. 2016; Hasin et al. 2015; Keyes et al. 2016; Martins et al. 2016; Mauro et al. 2017; Rusby et al. 2017).

This study represents high school students in Colorado. Some evidence suggests there may be increases among youth in Washington State, which also passed an RML in 2012 (Cerda et al. 2016; R. M. Johnson et al. 2018). The reasons underlying different effects of RMLs among adolescents in Colorado and Washington are not yet clear and could be due to many factors including cultural norms relating to marijuana, specific provisions of state RMLs, or difference in timing between survey measurements and implementation of retail sales. Additional policy evaluation research on RMLs is needed to further our understanding of the impact of RMLs on marijuana use among adolescents (Carliner et al. 2017).

Even though we did not find changes in past 30-day or lifetime marijuana use following initiation of retail marijuana sales, there were statistically significant decreases in both frequent use and use on school grounds. It is not clear what accounts for this finding, but we suspect it may be related to the public discourse around marijuana policy leading up to and following the passage and enactment of the Colorado's RML in 2012. Media coverage,

school-based prevention programs, and public health and advocacy campaigns focused strongly on the potential negative impacts on youth during this time, and there was widespread agreement that the legal market should be inaccessible to adolescents (McGinty et al. 2017; McGinty et al. 2016). Therefore, it is possible that those adolescents who use marijuana had more received more attention from friends, parents, or school personnel and may have opted to use off-school grounds or less frequently. This interpretation may be further supported by the finding of an increase in perceived wrongness reported among current marijuana users.

We did not find evidence of differential changes in use by school and community characteristics, including urbanicity, availability of retail marijuana sales in 2015, school racial composition, or level of family poverty among students. In 2015, youth in schools located in municipalities that permitted retail sales were more likely to report marijuana use. However, they were equally as likely to report use prior to the initiation of retail marijuana sales. Therefore, local retail sales may reflect both local norms about marijuana use as well as the prevalence of use, unrelated to the policy change.

This study found a significant decrease in perceived harmfulness of marijuana use. Other recent studies have also found a decline in perceived harmfulness of marijuana use, corresponding to legal recreational marijuana (Cerda et al. 2016; Fleming et al. 2016; Miech et al. 2015; Salas-Wright et al. 2015; Schuermeyer et al. 2014). To the extent that attitudes and beliefs may precede changes to behavior, these consistent declines in the perceived harmfulness of marijuana among adolescent may be a bellwether for changes in the prevalence of use. Alternatively, there may be a secular trend toward lower levels of perceived risk associated with marijuana use reflecting social norms (Carliner et al. 2017; Terry-McElrath et al. 2017; Wu et al. 2015).

Limitations

The response rate in both years, and particularly in 2015, was not as high as desired, primarily due to school non-response. This is a limitation that may contribute to non-response bias and thus inference to the Colorado student population to the extent that weighting by grade, sex, and race/ethnicity may not fully adjust for non-response. Recent work using used simulation methods to examine the effect of non-participation in surveys found that even substantial school-level non-participation (up to 60%) has only small effects on prevalence rates and does not challenge the validity of resulting estimates (Thrul et al. 2016). Our survey includes a sample of high school students who attend public schools, including charter and alternative schools, but may not be representative of those attending private schools or those not in school.

Implications for Prevention Science

Marijuana use among US adolescents is common (22% of high school students and 28% of 12th graders report past 30-day use) and has been relatively stable over time, despite rapid policy changes. In fact, the past 30-day use decreased slightly from 27% in 1999 to 22% in 2015, a period during which several states passed MMLs and/or RMLs (Kann et al. 2016). Overall, we did not find a significant change in the prevalence of adolescent marijuana use

from shortly before to after the implementation of a recreational marijuana law in Colorado. Although this is positive news for public health practitioners, there was a limited passage of time since the start of commercial sale of recreational marijuana, on January 1, 2014, to the second wave of data collection in the fall of 2015. It is possible that increases in adolescent marijuana use related to these policy changes may occur in the future. Continued monitoring is warranted as there may yet be unintended and unanticipated consequences from legalization, and some populations may be differentially affected by those consequences. It is also important to track whether marijuana from the legal market is being diverted to adolescents. Our results suggest that adolescents' marijuana use may not increase immediately following initiation of retail marijuana sales, which seems plausible given that they cannot legally access marijuana from the retail market. Even in the absence of evidence for short-term increases in marijuana use, adolescent marijuana use should remain a key priority for prevention science practice and research.

Funding

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Table 1

Description of respondents and participating schools; Healthy Kids Colorado Surveys, 2013 and 2015

	2013	**2015**	**_p_ value**
Respondents	(_n_ = 26,019)	(_n_ = 15,970)	
Sex			0.83
Boys	51.2%	51.4%	
Girls	48.8%	48.6%	
Race/ethnicity			0.69
White	55.9%	55.6%	
Black	4.8%	4.9%	
Hispanic/Latino	33.3%	31.6%	
Other	6.0%	7.9%	
Grade			0.93
9th	26.2%	26.5%	
10th	25.2%	25.5%	
11th	23.8%	24.1%	
12th	24.9%	23.8%	
Schools	(_n_ = 114)	(_n_ = 127)	
Family poverty of students			0.63
High (> 75%)	8.8%	7.1%	
Low (< 75%)	91.2%	92.9%	
Black/Hispanic student enrollment			0.96
High (> 40%)	35.1%	35.4%	
Low (< 40%)	64.9%	64.6%	
Urbanicity			0.10
Urban	32.5%	24.4%	
Suburban	25.4%	19.7%	
Rural	42.1%	55.9%	
Retail marijuana sales in 2015			0.65
Yes	41.2%	44.1%	
No	58.8%	55.9%	

Data are weighted. Weighted _N_s are 250,651 (2013) and 242,756 (2015)

Table 2

Changes in marijuana use marijuana-related perceptions and substance use among Colorado high school students before and after implementation of retail marijuana sales

	2013 % (95% CI)	2015 % (95% CI)	The Rao-Scott X^2	p value
Marijuana use				
Any lifetime use	38.5 (37.0–40.0)	38.0 (36.0–40.0)	0.11	0.74
Any past 30-day use	20.9 (19.8–22.0)	21.2 (19.8–22.7)	0.07	0.79
Among those reporting past 30-day use				
Frequent use	33.2 (30.8–35.5)	26.8 (24.0–29.5)	8.46	<0.01
Use on school property	5.7 (05.1–06.3)	4.4 (03.6–05.2)	4.90	0.03
Marijuana-related perceptions				
High perceived accessibility	55.8 (54.1–57.4)	55.7 (53.6–57.8)	0.0	0.98
High perceived wrongfulness	59.3 (57.6–61.0)	60.6 (58.5–62.7)	0.61	0.44
High perceived parent disapproval	85.3 (84.0–86.7)	85.4 (84.0–86.8)	0.0	0.98
High perceived harmfulness	52.9 (51.4–54.4)	47.7 (45.5–49.9)	11.26	<0.01
Other substance use				
Cigarette use, past 30-day	12.1 (11.0–13.2)	8.6 (07.7–09.5)	17.48	<0.01
Alcohol use, past 30-day	31.9 (30.4–33.3)	30.2 (28.3–32.1)	1.33	0.25
Prescription drug misuse, lifetime	14.5 (13.6–15.5)	13.7 (11.8–15.5)	0.46	0.50
Cocaine use, lifetime	6.8 (06.0–07.5)	5.6 (04.8–06.4)	3.02	0.08

Table 3

Changes in past 30-day marijuana use among Colorado high school students before and after implementation of retail marijuana sales, stratified by demographic and school characteristics

	2013 % (95% CI)	2015 % (95% CI)	The Rao-Scott X^2	p value
Respondents				
Total	20.9 (19.8–22.0)	21.2 (19.8–22.7)	0.07	0.79
Sex				
Boys	23.0 (21.6–24.5)	21.4 (19.6–23.2)	1.38	0.24
Girls	18.7 (17.5–19.9)	21.0 (19.3–22.6)	3.77	0.05
Race/ethnicity				
White	18.2 (16.8–19.6)	19.5 (17.6–21.4)	0.81	0.37
Black	26.0 (22.2–29.7)	22.7 (18.8–26.6)	0.99	0.32
Hispanic/Latino	25.7 (23.9–27.5)	25.6 (23.7–27.5)	0	0.97
Other	16.7 (14.4–19.0)	15.7 (12.9–18.6)	0.20	0.66
Grade				
9th	14.2 (12.7–15.7)	12.4 (10.0–14.7)	1.07	0.30
10th	19.8 (18.5–21.2)	18.8 (16.3–21.3)	0.39	0.53
11th	23.6 (22.0–25.3)	26.3 (23.8–28.7)	2.21	0.14
12th	26.1 (24.1–28.0)	27.8 (24.2–31.5)	0.53	0.47
Schools				
Family poverty				
High (> 75%)	27.8 (23.2–32.4)	29.3 (25.2–33.4)	0.16	0.69
Low (< 75%)	20.2 (19.0–21.5)	20.6 (19.1–22.2)	0.12	0.73
Black/Hispanic student enrollment				
High (> 40%)	26.3 (23.6–28.9)	24.5 (22.4–26.5)	0.80	0.37
Low (< 40%)	18.2 (16.9–19.5)	19.6 (17.6–21.6)	0.94	0.33
Urbanicity				
Urban	21.1 (19.4–22.9)	22.4 (20.4–24.5)	0.62	0.43
Suburban	20.4 (18.0–22.8)	20.0 (17.2–22.9)	0.03	0.86
Rural	21.5 (18.0–25.0)	21.3 (19.2–23.4)	0	0.93

Retail marijuana sales in 2015

	2013 % (95% CI)	2015 % (95% CI)	The Rao-Scott X^2	p value
Yes	23.9 (22.1, 25.7)	23.4 (21.5, 25.3)	0.11	0.74
No	18.8 (16.9, 20.7)	19.3 (16.9, 21.8)	0.09	0.76

The mean prevalence of past 30-day marijuana use across schools was 22.1% in 2013 (SD = 11.4%) and 22.7% (SD = 14.1) in 2015