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Race/ethnicity and marijuana use in the United States:Diminishing differences in the prevalence of use, 2006 to 2015*

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Abstract

Background—Marijuana use has been decreasing in the past several years among adolescents, though variation in the extent and rate of decrease across racial/ethnic groups is inadequately understood.

Methods—The present study utilized nationally-representative data in Monitoring the Future from 2006–2015 to examine trends over time in past 30-day marijuana use. We examine whether differences in trends over time by race and ethnicity also differ by individual-level, school-level, and state-level factors. Sample included 131,351 8th grade students, 137,249 10th grade students, and 123,293 12th grade students; multi-level models and difference-in-differences tests were used.

Results—In 10th grade, Black students had a positive linear increase in marijuana use (est=0.04, SE=0.01, p<0.001), and the magnitude of the increase was significantly greater than among non-

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Author Disclosure

Role of the Funders

Nothing to declare.

Contributors

Katherine M. Keyes drafted the manuscript and conceived of study aims; Melanie Wall and Tianshu Feng conducted all data analyses and drafted statistical sections of the paper; Magdalena Cerda drafted sections of the paper and provided critical feedback; Deborah Hasin obtained funding for the study, drafted sections of the manuscript and provided critical revisions.

Conflict of Interest

No conflict declared

Hispanic White students (est=0.38, SE=0.009, p<0.001). The increase trend among Black students was greater among those in large class sizes. In 12th grade, all racial ethnic groups except non-Hispanic Whites demonstrated a linear increase in prevalence across time. The magnitude of the increase among Hispanic students was greater among those in urban areas and large class sizes. The magnitude of the increase among Black students was greater in states with a medical marijuana law before 2006 (est=0.06, SE=0.03, p=0.02), among other state-level covariates.

Conclusion—Together these results suggest that the next stage of public health approaches to reducing the harms associated with adolescent drug use should attend to shifting demographic patterns of use among adolescents and ensure that services and programmatic approaches to adolescent prevention are applied equitably.

Keywords

marijuana; race; Monitoring the Future; African American; Hispanic; medical marijuana laws

1. Introduction

Overall, despite modest increases in marijuana use among adolescents in the earlier years of the 2000s, the prevalence of use has decreased for the past several years among adolescents (Center for Behavioral Health Statistics and Quality, 2016; Miech et al., 2015). However, the direction of the trend and its magnitude may be heterogeneous by race and ethnicity (Johnson et al., 2015; Miech et al., 2016). Past epidemiological studies of race/ethnicity and marijuana use have found that among adolescents, those who identify as White, American Indian or multiracial are more or equally likely to use marijuana than adolescents identifying as Black, Hispanic, or Asian adolescents (Johnson et al., 2015; Pacek et al., 2012; Wu et al., 2015; Wu et al., 2011). Considerable theory has been developed and an evidence base underlying these patterns has been established (Compton et al., 2004; Wallace, 1999; Wallace et al., 2003). Yet, there may be a confluence of reasons to investigate potential changes in these patterns. Studies of adults indicate that Black Americans surveyed in 2012–2013 had higher rates of cannabis use disorders than Whites (Hasin et al., 2017); previous surveys of the same sampling frame found that Whites has higher rates (Stinson et al., 2006). However, Whites in the US have evidenced increases in drug overdose and other substance-related mortality at higher rates than other racial/ethnic groups (Case and Deaton, 2015). While these morbidity and mortality trends have disproportionately been studied among adults, they could signal broader demographic changes in substance use that may extend to adolescents and be differential by race and ethnicity. Indeed, data from the National Youth Risk Behavior Survey indicates that despite historically lower rates of marijuana use among Black adolescents compared with White adolescents, marijuana use among Black youth exceeded that of White youth in 2013 (Johnson et al., 2015). Similar trends have been reported in Monitoring the Future, the data for the present report based on annual cross-sectional surveys of high-school attending adolescents (Miech et al., 2016).

Racial/ethnic differences in trends over time may themselves be heterogeneous by individual, school, and state-level predictors, based on socio-ecological models of health behavior and drug use (Bronfenbrenner, 1977, 1994). At the individual level, boys exhibit higher prevalence of marijuana use than girls (Pacek et al., 2012; Wallace, 1999; Wu et al.,

2015), and socio-economic status is often correlated with marijuana use, though studies are mixed on the direction of the association (Bachman et al., 2011; Patrick et al., 2012). Yet these relationships also differ by race (Bachman et al., 2010), and given shifts in race/ethnic differences in substance use across time, these relationships may differ over time (Keyes et al., 2015; Lemstra et al., 2008). At the school-level, marijuana use prevalence differs across schools even after accounting for individual-level risk factors (Ennett et al., 1997). Smaller class sizes, for example, are associated with higher achievement, less truancy and drop-out, and greater school connectedness (Leithwood and Jantzi, 2009), especially for disadvantaged students including racial/ethnic minorities, all of which may explain individual variance in drug use across schools. Further, marijuana use is more common in urban areas (Choi et al., 2005; Jiang et al., 2016; Warren et al., 2017), where Black and Latino adolescents are more heavily concentrated (U.S. Department of Health and Human Services, 2012), than in rural areas. While available evidence indicates that school context explains a portion of individual variance in marijuana use, and that the role of school context differs for minority studies, no studies to date have considered school context may also explain trends over time in racial/ethnic differences in drug use.

Finally, state-level factors need to be considered as well. The prevalence of adolescent marijuana use differs substantially by US state (Wall et al., 2011), and is correlated with state-level policies such as whether marijuana is allowed for medical purposes for adults (Cerda et al., 2012; Wall et al., 2011). While available evidence indicates little change in marijuana use overall among adolescents following these policy changes (Hasin et al., 2015; Keyes et al., 2016; Martins et al., 2016), examination of trends by race and ethnicity in the context of these policy changes is particularly important, given that racial/ethnic minorities including Black and Hispanic youth face more arrest and harsher punishment for marijuana-related offenses. For example, Blacks in the US are about four times more likely than non-Hispanic whites to be arrested for marijuana possession, especially in large metropolitan areas, despite comparable rates of marijuana use (American Civil Liberties Union, 2013; Wu et al., 2013). Such variation in arrest and punishment also varies by demographics across US states (e.g., racial/ethnic composition, average education), suggesting that variation by state-level demographics should also be considered. In summary, trends in racial/ethnic differences in marijuana use over time should be considered simultaneously with individual, school, and state level factors.

The present study utilized nationally-representative data from 2006–2015 to examine trends over time in marijuana use by race and ethnicity. Further, we examine whether differences in trends over time by race and ethnicity also differ by individual-level demographics such as parental education and gender, school-level factors such as class size and public/private status, and state-level factors such as medical marijuana policy (given that 15 states passed law authorizing medical use over this time period, and two states passed laws authorizing recreational use of marijuana in 2014) and state demographics.

2. Methods

2.1 Sample

MTF studies include yearly cross-sectional surveys of 8th, 10th and 12th grade students, sampled to be nationally representative (Miech et al., 2015). Approximately 400 schools are surveyed each year in the 48 coterminous U.S. states; students are assessed with self-administered questionnaires. We included data collected since 2006, as race options were changed in this year thus providing continuity in measurement for all included years. The study employs a multi-stage random sampling design with school replacement upon refusal. Up to 350 students per grade are included; only one grade (8, 10 or 12) is surveyed per school. Schools typically participate for two years. Non-participating schools are replaced with others closely matched on geographic location, size, and urbanicity. Of all selection sample units, 95%-99% obtained one or more participating school in all study years; lack of a time trend in school participation rates (Johnston et al., 2011b) suggests limited influence of school nonresponse on trend data. The total analyzed sample size was 131,351 8th grade students, 137,24910th grade students, and 123,293 12th grade students, which include all those with non-missing outcome and covariate data.

2.2 Measures

2.2.1 Past 30-Day Marijuana Use—Our main marijuana use variable was a dichotomous use variable, consistent with previous time-trend studies (Kepple and Freisthler, 2012; Keyes et al., 2011), consisting of any marijuana use (vs. no use) within the prior 30 days. The validity of MTF substance reports is supported by low question non-response; the high proportion of participants reporting illicit drug use; strong evidence of construct validity; and methodological studies using objective validation methods (Johnston et al., 2011b).

2.2.2 Race/Ethnicity—Beginning in the 2006 questionnaire, students were asked to select all options that best described their race/ethnicity. Terminology and designations generally correspond to Office of Management and Budget guidelines used for the US census (U.S. Census Bureau, 2010), though one difference is that Hispanic ethnicity was not assessed in a separate question from self-identified race. In MTF, respondents were asked “How do you describe yourself? (Select one or more response)”: Black or African American; Mexican American or Chicano; Cuban American; Puerto Rican; Other Hispanic or Latino; Asian American; White (Caucasian); American Indian or Alaska Native; Native Hawaiian or Other Pacific Islander. From these responses, we created five mutually exclusive groups: (1) Hispanic (Mexican American or Chicano; Cuban American; Puerto Rican; Other Hispanic or Latino 14.72%); (2) White (Caucasian) (59.00%); (3) Black or African American (11.59%); (4) Asian (4.07%); and (5) multi-racial (8.66%). A sixth group include those reporting American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander (1.96%) was too small and unstable for analysis and are thus excluded.

2.2.3 Individual-Level Covariates—Respondents were asked their gender (male [48.36%]) and the highest level of education for each parent. As a measure of socio-economic status, we used parental education (Goodman and Huang, 2002; Hanson and Chen, 2007; Miller and Miller, 1997). Following past epidemiological studies of adolescent

substance use, we categorized the highest level of parental education based on college and high school completion: (1) at least one parent college educated or higher (44.32%); (2) at least one parent more than high school but no college degree (26.22%); (3) at least one high school graduate, but no college graduate (20.32%); and (4) no high school graduate (8.85%).

2.2.4 School-Level Covariates—MTF collects information on whether the school is public (89.81%) or private, on the total number in each grade (referred to as "class size"), and whether the school is located in a Metropolitan Statistical Area (MSA). We categorized class size into <200 (33.64%), 200–499 (53.01%), and 500+ (13.36%).

2.2.5 State-Level Covariates—Two MML indicators were used. The first was a state-level binary variable indicating if a state ever passed a MML by the start date of our data analysis, 2006 (California, Washington, Oregon, Maine, Colorado, Nevada, Maryland, Montana, Vermont), regardless of the year it was passed. The second was a time-varying state-level binary MML variable for each year (2006–2015) and state indicating whether the state had a MML during that year or not. Consistent with our previous work (Hasin et al., 2015; Keyes et al., 2016), we also included a range of state-level demographic variables, given that there is substantial demographic heterogeneity by state, and these demographics are also associated with marijuana use (Compton et al., 2004). These variables included the proportion of the population in each state that was male, white, aged 10–24, and aged >25 years without high school education based on census data in the year 2010, and dichotomized each at the median.

2.3 Statistical Analysis

First, we modeled the prevalence of marijuana use, by year (linear) and grade, using a multilevel logistic regression model with adolescents nested within states. Results are presented stratified by grade given that the study was designed to be nationally-representative within grade, and that marijuana use prevalence differs across grade (Miech et al., 2016). The model included individual-, school-, and state-level covariates, and included an interaction term between parental education and race based on model fit. Not all states have MTF data available for every year and grade; the multilevel model addresses this by smoothing associations across missing years and grades with state-level random effects. We then estimated difference-in-difference models to estimate whether the change in the log odds ratio of the linear year slope differed by race/ethnicity. Finally, we estimated whether the differences in linear slopes by race also differed by individual, classroom, and state covariates. This was tested as a three-way interaction between the linear year trend, race, and each covariate, and indicates whether the magnitude of the difference between racial/ethnic groups regarding marijuana use across time differed by these covariates. All data analysis was done in SAS 9.4.

3. Results

Results for 8th grade students are provided in Online Table 1[1] and Figure 1. Among 8th grade students, there were no linear trends over time in marijuana use for any racial/ethnic

groups. Because there were no linear trends over time, we did not analyze differences in linear trends by race/ethnicity or difference-in-difference models by covariates.

Figure 1 provides estimates of the predicted prevalence of marijuana use among 10th and 12th grade students from 2006 through 2015, by race. Unadjusted estimates are provided in supplementary Figure 1[1]. Across all years, 10th grade students who identified as multiracial had the highest prevalence of marijuana use, peaking in 2012; Asian students had the lowest prevalence.

In 12th grade, students who identified as multiracial had the highest prevalence of use in most years, though there is convergence in rates in the most recent years, especially as rates among Black and Hispanic students increased over time. Specifically, in 12th grade, non-Hispanic whites were significantly more likely to use marijuana compared with Black students in each year from 2006 through 2008 ($p<0.001$); after 2008, there was no significant difference in use for any year except 2013, when Black students were more likely to use than White students ($p<0.01$). Non-Hispanic whites were significantly more likely to use marijuana than Hispanic students in each year from 2006 through 2010 ($p<0.001$ for 2006 through 2009; $p=0.02$ for 2010); after 2008, there was no significant difference in use for any year.

In Table 1 we estimate the linear slope of marijuana use across time by race, and test differences in the magnitude of the linear increase by race, comparing each group with non-Hispanic White students. In 10th grade, Black students had a positive linear increase in marijuana use (log odds ratio (Log OR)=0.044, SE=0.01, $p<0.001$), and the magnitude of the increase was significantly greater than among non-Hispanic White students (log OR=0.038, SE=0.009, $p<0.001$). The magnitude of the increase (i.e., the slope difference in Black vs White students) represents the increased log odds ratio of the difference between Black vs White students for every one year; for example, marijuana prevalence increased among Black students by 0.044 each year on the log odds scale (i.e., OR = exp(.044*10) = 1.55 across 10 years) while White students increased only 0.006 on the log odds scale each year (i.e., OR=1.06 across 10 years), the difference between these, i.e., 0.038=.044–.006, represents how much the gap between Black and White students is increasing each year (i.e., OR = 1.46 across 10 years).. In 12th grade, all racial ethnic groups except non-Hispanic Whites demonstrated a linear increase in prevalence across time. For all racial/ethnic groups except Asian students, the magnitude of the increase was significantly greater than among non-Hispanic White students.

For those groups with significant differences in the linear slope trend compared with non-Hispanic Whites, we estimated whether the difference in the linear slope trend also differed across study covariates, both at the individual and state levels. This is tested with a three-way interaction and represents the difference-in-difference of the slopes model.

Among the 10th grade students, these difference-in-difference tests were estimated for the linear slope contrast comparing Black to White students, as only Black students had a linear

[1]Supplementary material can be found by accessing the online version of this paper at http://dx.doi.org and by entering doi:…

increase that was significantly different than non-Hispanic White students (Table 2). The magnitude of the difference in the increase in marijuana use among Black students compared with White students was greater among those in class sizes of 500 or more compared with class sizes of 200 or less (log OR=0.06, SE=0.03, p=0.03). This interactive effect is found by taking the difference in the non-differential Black vs White slope effect in the small class size schools (logOR=0.0051, p-value=0.776) with the significant Black vs White slope effect in the large class size schools (logOR=0.067, p-value=0.0017). Hence across the 10 year period the Black vs White gap in increased prevalence was OR = 1.85 times higher in schools with class size 500+ compared to those with less than 200. No other difference-in-difference estimates were significant.

Among the 12th grade students, these difference-in-difference tests were estimated for the linear slope contrast comparing Black, Hispanic, and multi-racial race/ethnicity to non-Hispanic White students. Table 3 shows the results of difference-in-difference models for individual-level covariates. The increase in marijuana use for Hispanic students compared with non-Hispanic White students was greater among those in school located in an MSA (logOR=0.06, SE=0.03, p=0.03), and those in class sizes of 200–499 compared with less than 200 (logOR=0.05, SE=0.02, p=0.0097), and among those in class sizes of 500 or more compared with less than 200 (logOR=0.05, SE=0.02, p=0.029). The increase in marijuana among Black students compared with non-Hispanic Whites was greater among those whose parents had more than a college education (logOR=0.07, SE=0.03, p=0.04), and those in class sizes of 200–499 compared with less than 200 (logOR=0.05, SE=0.02, p<0.01).

When considering state-level covariates for 12th grade students (Table 4), the increase in marijuana use for Black students compared with White students was greater in states with a medical marijuana law before 2006 (logOR=0.06, SE=0.03, p=0.02), and those in states with the percentage of the population with less than a high school education above the median (logOR=0.05, SE=0.02, p<0.01). Conversely, the increase in marijuana use for Black students compared with non-Hispanic White students was less in states with the percentage of the population identifying as White above the median for all states (logOR=-0.04, SE=0.02, p=0.01). The increase in marijuana use among students identifying as multiracial was also greater in states with a medical marijuana law before 2006 (logOR=0.05, SE=0.02, p=0.03).

4. Discussion

The present study estimated trends over time in marijuana use among US students by racial/ethnic group, from 2006 through 2015, and whether racial/ethnic differences in trends over time vary across individual and state covariates. Three notable findings emerged. First, among both 10th and 12th grade students, Black students increased marijuana use in the last decade, whereas White students did not. Additionally, among 12th grade students, Hispanic and those identifying as multiracial also increased marijuana use. Indeed, whereas White students and those identifying as multiracial had significantly higher rates of marijuana use in 2006 than Black and Hispanic students, the differences in those rates/risks subsequently diminished to the point that they converged by 2015. Second, we found that for 10th grade students, the increase in marijuana use among Blacks was greater among those in large class

sizes. For 12th grade students, increases in marijuana use among Black and Hispanic students were greater among those in large class sizes, schools located in areas with larger population density, and among Black compared with White students, those with higher parental education. Third, we documented state-level modifiers of the trends in marijuana use among minority students. Among 12th grade students, increases in marijuana among Black and multi-racial students compared to White students were greater among those in a state with policies allowing medical use of marijuana passed before 2006. Increases among Black students were lower among those in states with a higher proportion of non-white residents. and higher among those in states with a greater proportion of residents with less than high school education. Of note, the convergence in cannabis use is historically unique in the 39-year history of the Monitoring the Future surveys.

The reasons underlying increased marijuana use among minority students are unclear. The prior decade has ushered in social change linked to race in the United States, coupled with a widespread recession that was worse economically for African American families (Kochhar and Fry, 2014), and ongoing political unrest due to high profile aggressive policing tactics (Jee-Lyn Garcia and Sharif, 2015). We can only speculate about whether and how these broader changes may affect minority students differently than White students, though we might expect recession and political unrest to increase perceived stress, discrimination, and vulnerability among disadvantaged minority students in particular, three risk factors for initiation and continued use of illicit substances (Clark, 2014; Clark et al., 2015; Sinha, 2008). Such stressors may not extend to adolescents attending school; continued research into motivations for use of marijuana and other substances, and how they might differ over time across race and ethnic groups with differential exposures to stress, is an evident next step in the progression of this research.

Changes in salient risk and protective factors for marijuana use that differ in prevalence between minority and White students may also underlie the observed increases, though there is no compelling evidence of changes over time in major risk factors. Of interest to developing policy efforts, we observed that increases in marijuana use among Hispanic and those identifying as multi-racial were greater in students living in states with medical marijuana laws. Existing studies have found little evidence of increased risk of cannabis use among adolescents after passage of medical marijuana laws (Hasin et al., 2015; Keyes et al., 2016; Martins et al., 2016); these results suggest that combining racial/ethnic groups in assessments of MML effects may obscure important heterogeneity. The reasons that MML would increase cannabis use among some minority students are unclear; introduction of more permissive marijuana laws may reduce barriers to use among students who would formerly have been targets of criminal enforcement. Social norms regarding the perceived permissiveness of marijuana are higher in these states as well (Keyes et al., 2016; Martins et al., 2016), thus we might speculate that as marijuana has become more socially acceptable in states with less restrictive sanctions against use, minority students in these states are increasingly more likely to use. However, use in these states did not increase for White students, who presumably are exposed to the same social norms and permissiveness. Regardless of the mechanism, these data indicate convergence in White/disadvantaged minority differences in marijuana use that were previously documented in Monitoring The Future and other studies (Pacek et al., 2012; Wu et al., 2015; Wu et al., 2011), while Asian

students remain at substantially lower prevalence than other racial/ethnic groups. Continued evaluation of policy interventions involving cannabis use remains important as the consequences of more permissive cannabis laws continue to be evaluated; special attention to the potential for disparities in cannabis use should be given.

The differences in the trends by demographic characteristics, school characteristics, and state level factors shed additional light on these changing trends in marijuana use. The trend among minority students in 10^{th} and 12^{th} grade was generally greater among those in urban areas, and those in larger class sizes. Further, Hispanic adolescents living in areas with high population density had a greater increase in marijuana use than Hispanics living in areas with smaller population densities. While Black and Hispanic individuals in the US are widely distributed over geographic areas, they are more concentrated in urban areas than rural (especially outside of the Southern region of the US). As such, the increase in marijuana use for minority adolescents concentrated in urban areas may be a reflection of population dynamics, availability of drugs,(Storr et al., 2004) and peer-to-peer transmission of substance use in areas (Rulison et al., 2015). This is underscored by the finding that increases in marijuana among minority students are greater among those in larger class sizes; while class size varies substantially across both advantaged and disadvantaged areas, available evidence indicates that smaller class sizes promote increased connectedness and achievement especially among students with disadvantaged status and those in urban areas (Leithwood and Jantzi, 2009). Overall, these results suggest that inequality in schooling and school resources may exacerbate growing disparities in drug use.

We also found racial composition and average education state-level effects: the trend over time among Black adolescents was higher in states with a higher proportion adults with less than a high school degree, and lower in states with a higher proportion of non-Whites. These effects may be explained in part by trends in educational inequality by state. In states with a higher proportion of adults with less than high school education, there may be more discrimination and marginalization of Black residents, and previous studies have demonstrated higher institutional forms of discrimination in states with lower than average levels of education (Lukachko et al., 2014). Such effects may be mitigated by greater density of Black social and kinship networks that may provide racial socialization and buffering of negative discrimination experiences (Weaver et al., 2015). Further analyses of the intersection of race and education at the state and individual level is an important future direction.

Limitations of the study are noted. We began our assessment of trends over time in marijuana use by race in 2006 as choices for race categories changed in that year, and thus comparable measures for trends over time by race prior to 2006 were unavailable. Further, some groups (e.g., American Indians) were too small for stable estimates by year; further research on trends in marijuana use in demographically smaller racial/ethnic groups is an important future direction. All measures are based on self-reported use by the adolescents, which may be subject to recall bias and error. However, MTF uses procedures that have been shown to enhance valid reporting, that is, school based (rather than in-home), self-completed questionnaires containing only close-ended responses, administered by non-school-associated university personnel, with convincing assurances of confidentiality (Harrison,

1995; Johnston et al., 2011a). Further, adolescents self-report their racial and ethnic background; however, adolescents are provided with options to choose multiple races, and racial/ethnic categories are congruent with options provided by the US census and other administrative sources. With regard to state-level covariates, MTF was not originally designed to be representative of specific U.S. states. Thus, the number of schools included in each state in each year varies, and adolescents in the schools were not selected to be representative of the state overall. However, data are drawn from a very large sample across diverse geographic areas in the 48 coterminous U.S. states, and thus the study is population-based. Finally, we did not have measures of cannabis use disorders; while available evidence does not suggest disparities between Black, Hispanic and White adolescents and adults in cannabis use disorders (Lopez-Quintero et al., 2011; Pacek et al., 2012; Wu et al., 2011), there is a paucity of evidence on disorder prevalence among adolescents. Literature on racial/ethnic differences in alcohol use versus disorder indicates, for example, that Black adolescents are less likely to consume but among those who do, there is evidence of higher rates of problems associated with use (Wallace, 1999). Further research on cannabis use disorders is needed.

In summary, these data indicate that marijuana use is increasing in the United States among Black adolescents in 10^{th} grade, and among all non-White adolescents in 12^{th} grade. While previous epidemiological studies indicated that marijuana use has traditionally been more common among White than non-White adolescents, such epidemiological patterns no longer hold true, as by 2015, there are no racial/ethnic differences in marijuana use except that Asian students remain at lower risk of use. The increase in use among Black, Hispanic, and multi-racial students co-varies with individual, classroom, and state level factors, including whether the adolescent is in an urban area, and whether state has a medical marijuana law prior to 2006. Together these suggest that the next stage of public health approaches to reducing the harms associated with adolescent drug use should attend to shifting demographic patterns of use among adolescents and ensure that services and programmatic approaches to adolescent prevention are applied equitably.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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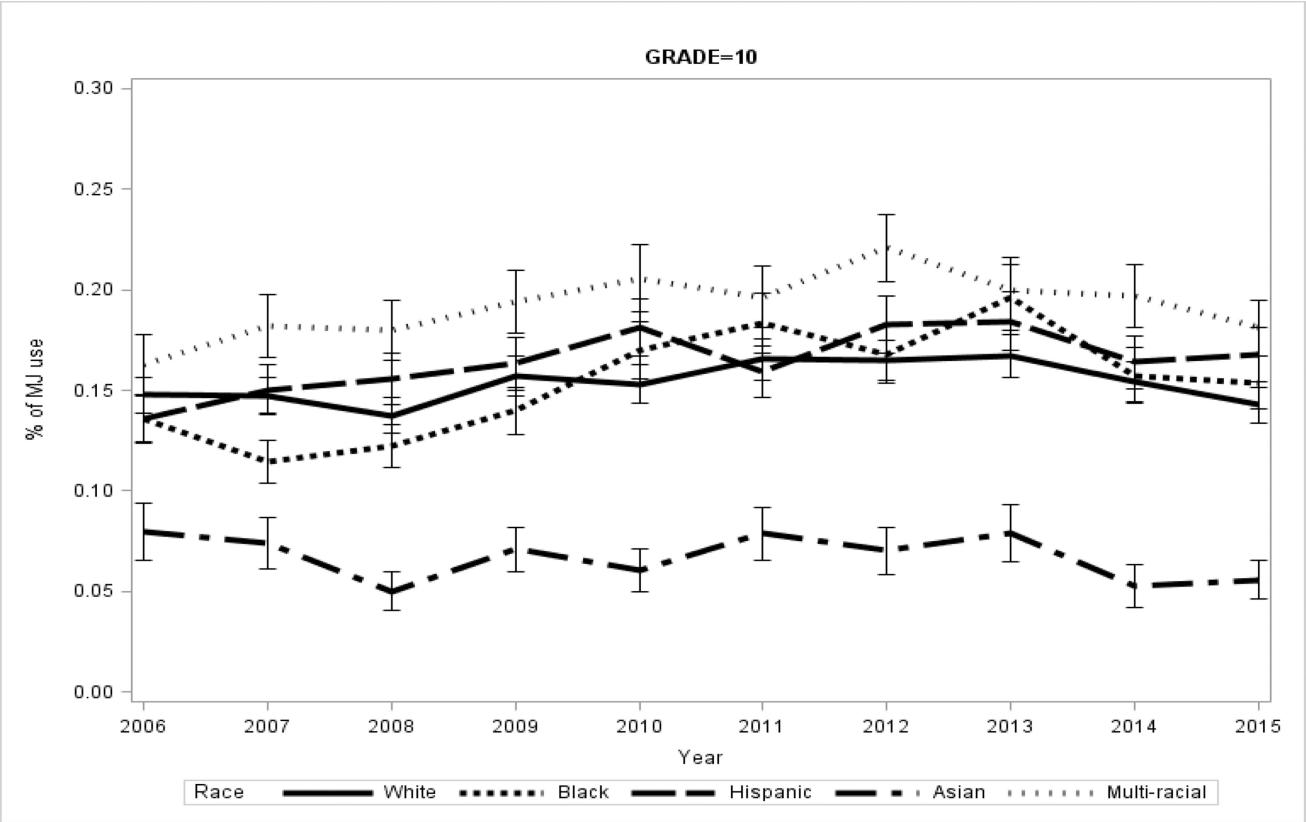
Highlights

- Racial differences in marijuana use diminished to convergence by 2015
- Increase in marijuana use for Blacks was greater in large classes (10th graders)
- State-level modifiers include presence of a law allowing medical marijuana use



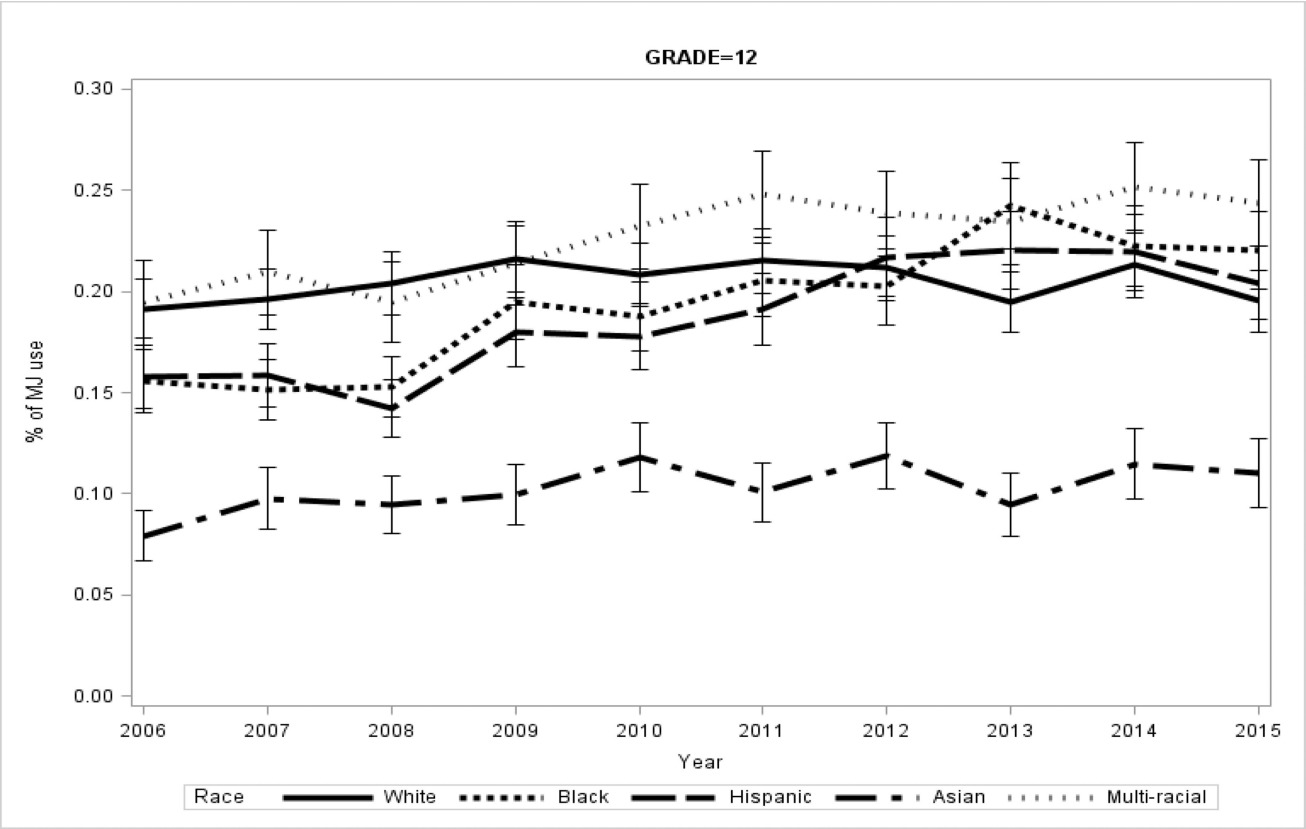


Figure 1.

Predicted prevalence based on model that controls for parental education, the interaction of parental education and race, gender, class size, public versus private school, and state level covariates including state passage of a medical marijuana law before 2006, state passage of a medical marijuana between 2006 and 2015, population density, percent male, percent white, percent in ages 10 to 24, and percent with no high school education.

Table 1

Test of the linear trend in marijuana use prevalence by race, and whether the slope of marijuana use prevalence significantly differs across race

Grade	Comparison	Estimate	Standard Error	t-Value	P-value
10	Year slope in White	0.006	0.007	0.940	0.348
	Year slope in Black	0.044	0.010	4.430	<0.001
	Year slope in Hispanic	0.016	0.009	1.670	0.094
	Year slope in Asian	−0.026	0.020	−1.280	0.201
	Year slope in Mixed	0.011	0.010	1.140	0.2545
	Slope diff, Black vs. White	0.038	0.009	4.230	<0.001
	Slope diff, Hispanic vs. White	0.010	0.008	1.180	0.240
	Slope diff, Asian vs. White	−0.031	0.019	−1.640	0.101
	Slope diff, Mixed vs. White	0.005	0.009	0.590	0.556
12	Year slope in White	0.008	0.008	1.000	0.315
	Year slope in Black	0.066	0.010	6.390	<0.001
	Year slope in Hispanic	0.055	0.010	5.450	<0.001
	Year slope in Asian	0.038	0.017	2.250	0.024
	Year slope in Mixed	0.037	0.011	3.320	<0.001
	Slope diff, Black vs. White	0.058	0.008	6.890	<0.001
	Slope diff, Hispanic vs. White	0.047	0.008	5.930	<0.001
	Slope diff, Asian vs. White	0.030	0.016	1.940	0.053
	Slope diff, Mixed vs. White	0.030	0.009	3.150	0.002

* Estimates based on model that controls for parental education, the interaction of parental education and race, gender, class size, public versus private school, and state level covariates including state passage of a medical marijuana law before 2006, state passage of a medical marijuana between 2006 and 2015, population density, percent male, percent white, percent in ages 10 to 24, and percent with no high school education.

Table 2

Difference in difference estimate of variation in linear slopes of marijuana use from 2006 through 2015 across individual-level covariates among 10th grade students, comparing Black to White students

	Estimate	Standard Error	DF	t-Value
Individual-level covariates				
Male versus female	−0.009	0.017	−0.560	0.574
Public versus private	−0.004	0.034	−0.120	0.907
SMSA versus non-SMSA	−0.00029	0.024	−0.010	0.991
Parent education high school versus no high school	−0.019	0.035	−0.560	0.578
Parent education some college versus no high school	−0.017	0.034	−0.480	0.628
Parent education college degree or higher versus no high school	0.004	0.034	0.130	0.898
Class size 200–499 versus less than 200	0.038	0.021	1.790	0.073
Class size 500+ versus less than 200	**0.062**	**0.028**	**2.220**	**0.026**
State-level covariates				
State MML before 2006 versus no state MML	0.020	0.029	0.690	0.493
State MML passed between 2006 and 2015 versus no state MML	0.003	0.021	0.160	0.872
% of the state that is male greater than the median versus less than the median	0.022	0.018	1.220	0.222
% of the state that is white greater than the median versus less than the median	0.024	0.018	1.330	0.183
% of population aged 10–24 greater than median of all states versus less than the median	−0.027	0.018	−1.510	0.130
% without high school degree greater than the median for all states versus less than the median	−0.020	0.018	−1.070	0.285

* Estimates are log odds ratios and are based on model that controls for parental education, the interaction of parental education and race, gender, class size, public versus private school, and state level covariates including state passage of a medical marijuana law before 2006, state passage of a medical marijuana between 2006 and 2015, population density, percent male, percent white, percent in ages 10 to 24, and percent with no high school education.

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Table 3

Difference in difference estimate of variation in linear slopes of marijuana use from 2006 through 2015 across individual-level covariates among 12th grade students

		Estimate	Standard Error	DF	t-Value
Male versus female	Black versus white	−0.009	0.016	−0.590	0.555
	Hispanic versus White	−0.023	0.014	−1.590	0.112
	Mixed race versus White	−0.007	0.019	−0.360	0.719
Public versus private	Black versus white	−0.028	0.038	−0.760	0.450
	Hispanic versus White	0.036	0.026	1.350	0.176
	Mixed race versus White	0.037	0.033	1.100	0.271
SMSA versus non-SMSA	Black versus white	0.042	0.022	1.850	0.065
	Hispanic versus White	**0.057**	**0.026**	**2.140**	**0.032**
	Mixed race versus White	0.010	0.027	0.360	0.720
Parent education high school versus no high school	Black versus white	0.042	0.032	1.310	0.191
	Hispanic versus White	0.007	0.024	0.270	0.785
	Mixed race versus White	0.011	0.040	0.280	0.779
Parent education some college versus no high school	Black versus white	0.050	0.032	1.570	0.116
	Hispanic versus White	0.021	0.025	0.840	0.402
	Mixed race versus White	0.009	0.038	0.230	0.819
Parent education college degree or higher versus no high school	**Black versus white**	**0.066**	**0.032**	**2.070**	**0.039**
	Hispanic versus White	0.033	0.026	1.280	0.201
	Mixed race versus White	0.028	0.038	0.730	0.466
Class size 200–499 versus less than 200	**Black versus white**	**0.050**	**0.019**	**2.670**	**0.008**
	Hispanic versus White	**0.050**	**0.019**	**2.590**	**0.010**
	Mixed race versus White	0.042	0.022	1.920	0.055
Class size 500+ versus less than 200	Black versus white	0.055	0.029	1.860	0.063
	Hispanic versus White	**0.052**	**0.024**	**2.180**	**0.029**
	Mixed race versus White	−0.015	0.028	−0.520	0.603

*Estimates are log odds ratios and are based on model that controls for parental education, the interaction of parental education and race, gender, class size, public versus private school, and state level covariates including state passage of a medical marijuana law before 2006, state passage of a medical marijuana between 2006 and 2015, population density, percent male, percent white, percent in ages 10 to 24, and percent with no high school education.

Table 4

Difference in difference estimate of variation in linear slopes of marijuana use from 2006 through 2015 across state-level covariates among 12th grade students

		Estimate	Standard Error	DF	t-Value
State MML before 2006 versus no state MML	Black versus white	**0.062**	**0.027**	**2.300**	**0.022**
	Hispanic versus White	0.022	0.019	1.160	0.246
	Mixed race versus White	**0.049**	**0.022**	**2.220**	**0.026**
State MML passed between 2006 and 2015 versus no state MML	Black versus white	0.008	0.021	0.380	0.707
	Hispanic versus White	−0.010	0.020	−0.470	0.635
	Mixed race versus White	0.036	0.024	1.520	0.129
% of the state that is male greater than the median versus less than the median	Black versus white	−0.020	0.017	−1.150	0.251
	Hispanic versus White	−0.017	0.017	−0.970	0.330
	Mixed race versus White	0.036	0.019	1.870	0.062
% of the state that is white greater than the median versus less than the median	Black versus white	**−0.043**	**0.017**	**−2.540**	**0.011**
	Hispanic versus White	−0.022	0.019	−1.170	0.241
	Mixed race versus White	0.006	0.019	0.310	0.754
% of population aged 10–24 greater than median of all states versus less than the median	Black versus white	0.010	0.017	0.590	0.555
	Hispanic versus White	−0.00017	0.017	−0.010	0.992
	Mixed race versus White	0.017	0.019	0.900	0.366
% without high school degree greater than the median for all states versus less than the median	Black versus white	**0.050**	**0.017**	**2.940**	**0.003**
	Hispanic versus White	0.032	0.017	1.870	0.061
	Mixed race versus White	−0.007	0.019	−0.360	0.722

*Estimates based on model that controls for parental education, the interaction of parental education and race, gender, class size, public versus private school, and state level covariates including state passage of a medical marijuana law before 2006, state passage of a medical marijuana between 2006 and 2015, population density, percent male, percent white, percent in ages 10 to 24, and percent with no high school education.