

Adolescents' Marijuana Use Following Recreational Marijuana Legalization in Alaska and Hawaii

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Abstract

Alaska and Hawaii, the only two noncontiguous states in the United States, have different marijuana policy environments. Alaska enacted recreational marijuana legalization (RML) in 2014, whereas recreational marijuana is still illegal in Hawaii. This study analyzed how RML affects adolescents' marijuana use (MU) by comparing two states. We used data from 2 states (Alaska and Hawaii) from the Youth Risk Behavior Survey, 2009 to 2019 years (N = 35 467). The trends of lifetime MU and current MU were examined. Using difference-in-differences analysis models, this study investigated whether RML increased lifetime and current MU in Alaska compared with Hawaii after adjusting for socioeconomic characteristics. Both lifetime and current MU prevalence among adolescents in Alaska increased after RML, while both rates in Hawaii gradually decreased. The rate of lifetime MU in Alaska was significantly increased after RML (odds ratio [OR] = 1.29) compared with Hawaii. Similarly, the current MU among adolescents in Alaska was significantly increased compared with that in Hawaii (OR = 1.34). Both lifetime and current MU were increased following RML in Alaska, suggesting that RML may affect the increase of MU among adolescents.

Keywords

recreational marijuana legalization, adolescents, lifetime marijuana use, current marijuana use

What We Already Know

- No obvious evidence that the legalization of medical marijuana legalization (MML) encourages marijuana use among adolescents, although MML increases adult marijuana use (MU).
- While recreational marijuana legalization (RML) is currently limited to adults, potential impacts of marijuana legalization on adolescent MU may still present areas for concern.
- Very little is known about the effect of RML on adolescent marijuana use, in particular in noncontiguous states including Alaska and Hawaii.

What This Article Adds

- This is the first study comparing marijuana use associated with RML enactment in the only noncontiguous states in the United States.
- Our results indicate that RML in Alaska is associated with an increase in MU among adolescents after it was legalized for recreational use.

- American Indian/Alaska Native was the leading group, followed by Black and Native Hawaiian/Other Pacific Islander groups in both lifetime and current MU among Alaska and Hawaii adolescents.

Introduction

Marijuana is one of the most commonly abused substances by adolescents aside from alcohol and cigarettes in the United States.¹ Over 1.6 million American adolescents aged between 12 and 17 years have reported current marijuana use (MU), which is equivalent to 6.5% of the US adolescent population.² Adolescence is defined as “a period of life with specific health and developmental needs and rights,” from

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ages 10 to 19. Adolescence is an important time as adolescents establish unique stage of human development and lay the foundations of good health in this period.³ In particular, marijuana is the second most commonly used drug among adolescents.⁴ MU among adolescents is a public concern due to its associated health and educational outcomes, as well as potential adverse effects.⁵⁻⁷ The negative health outcomes associated with MU are magnified with continued use, and the progression to chronic use typically begins during adolescence.⁸

MU by adolescents remains illegal under US federal law. However, marijuana laws are changing at a rapid pace across all 50 US states. Since California was the first to pass Medical Marijuana Laws (MML) in 1996, more and more states have established laws permitting MU for medical and/or recreational purposes.⁹ Colorado and Washington were the first two states to legalize the recreational use of marijuana for adults in 2012; Alaska, Oregon, and the District of Columbia voted to legalize recreational marijuana in 2014. As of 2020, a total of 33 states and the District of Columbia have established MML, and 13 of those states have also passed recreational marijuana laws for adult use.

While recreational marijuana legalization (RML) is currently limited to adults, potential impacts of marijuana legalization on adolescent MU may still present areas for concern.¹⁰ Overall, previous studies reported that there was no obvious evidence that the legalization of MML encourages MU among adolescents, although MML increases adult MU.¹¹⁻¹³ However, reported findings on the effects of RML among adolescents are emerging,¹⁴ and very little is known about the effect of RML on adolescent MU.

As findings on whether RML increases MU among adolescents is inconsistent, more research is needed to evaluate the effects of RML on MU in adolescents. Most previous studies were primarily based on comparing states without medical or RML to those, like Colorado and Washington, where RML was first enacted. However, there may be possible spillover effects of increased MU in neighboring areas around states that have passed RML. For example, Hao and Cowan compared the frequency of drug-related arrests in counties of neighboring states relative to nonbordering counties of Colorado and Washington.⁵ They found a significant increase of marijuana possession arrests for adults in those neighboring counties. Accordingly, we compared the two noncontiguous states of Alaska and Hawaii, to lessen any possibility of such geographical neighboring effects. Alaska legalized medical MU in 1998 and was the third state to legalize recreational MU in 2014. Hawaii, however, enacted MML in 2000, but RML is still pending. Therefore, using difference-in-differences analysis models, this study investigated whether RML increased lifetime and current MU in Alaska compared with Hawaii, after adjusting for socioeconomic characteristics.

Method

Data Source

We conducted secondary data analysis using the two states' 2009 to 2019 Youth Risk Behavior Survey (YRBS). The YRBS is conducted every two years to measure trends in substance use and other health risk behaviors among 9th to 12th grade students in the United States. To estimate the trends of lifetime and current MU, 34,467 adolescents were included between 2009 and 2019 years (Alaska = 8,156 and Hawaii = 27,336). To examine the association between the legalization of recreational MU and the lifetime MU as well as current MU among adolescents in Alaska and Hawaii, 27,305 biennial data from 2013 to 2019 was included in the difference-in-differences analysis (Alaska = 5,638 and Hawaii = 21,667). The study was reviewed by the institutional review board of a state university in the southeastern United States, which granted a waiver of institutional review board approval.

Measures

Lifetime MU. In the current study, we examined self-reported lifetime MU using the age of marijuana initiation question, "How old were you when you tried marijuana for the first time?" Those who reported positive responses to the question were coded as 1 (0 = no, 1 = yes).

Current MU. To measure current MU, we examined self-reported current MU using the question, "During the past 30 days, how many times did you use marijuana?" (0 = no, 1 = yes).

Sociodemographic Factors. Age, gender, and race/ethnic groups (White, Black, Hispanic, Asian, American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander, and multiple races) were included as covariates.

Data Analysis

The difference-in-differences statistical analysis was used to investigate whether RML increased lifetime MU and current MU in Alaska compared with Hawaii. The overall differences were compared between the pre- and post-RML periods in Model 1 (lifetime MU) and Model 2 (current MU) in Alaska and Hawaii. We divided the analysis timeline into pre-RML (2013-2015) and post-RML (2017-2019) in order to account for the full impact of the policy, as retail stores have consistently opened one or two years following actual policy implementation, which suggests the follow-up period need be at least one year following actual policy implementation.^{13,14} Confounders (age, gender, and race) were included using sampling weights provided by YRBS.

Table 1. Descriptive Statistics of the Sample, 2013 to 2019 (n = 27 305).

Variables	Hawaii (%)	Alaska (%)	P
Gender			
Male	49.95	51.72	.83
Female	50.05	48.28	
Race			
White	14.73	48.02	<.001
Black	0.61	2.55	
Hispanic	8.54	7.35	
Asian	40.05	8.17	
American Indian/Alaska Native	0.12	21.72	
Native Hawaiian/Other Pacific Islander	28.16	2.56	
Multiple races	7.78	9.62	
Age (years)	15.84 (SD = 1.22)	16.05 (SD = 1.25)	.09

Abbreviation: SD, standard deviation.

Result

Table 1 shows the descriptive statistics of this study. Figure 1 shows the prevalence of lifetime and current MU among adolescents in Alaska and Hawaii. After RML, both 2017 and 2019 lifetime and current MU in Alaska were significantly higher than Hawaii ($P < .05$), consistent with the results of the difference-in-differences analysis. In general, the rates of lifetime and current MU in Hawaii steadily decreased. However, the lifetime MU in Alaska increased to 41.9% in 2017 and then decreased back down to 38% in 2019. Current MU in Alaska sharply increased to 21.5% in 2017 and remained the same in 2019.

Table 2 presents weighted logistic regression estimates of how RML affected the changes in rates of adolescent lifetime and current MU, by comparing results before (2013-2015) and after the 2016 RML (2017-2019). The variable of *Legalized State* \times *After Marijuana Legalized* shows the main effect of our analysis. The rates of lifetime MU of adolescents in Alaska significantly increased after RML, compared with Hawaii (Model 1: odds ratio = 1.29, 95% confidence interval [1.10, 1.51], and pseudo $R^2 = 0.064$). Additionally, the current MU rates in Alaska significantly increased following RML (Model 2: odds ratio = 1.33, 95% CI [1.11, 1.61], and pseudo $R^2 = 0.041$).

Discussion

The current study examined whether RML increased lifetime and current MU in Alaska compared with Hawaii. Overall, Alaska and Hawaii were not often included in US national data analyses. For example, a longitudinal study examining US adolescent risk perceptions of marijuana through nationally representative surveys of 8th, 10th, and 12th graders reported that Alaska and Hawaii were omitted from the Monitoring the Future (MTF) sample.¹⁵ Considering very little is known about the effect of RML on adolescent MU in

Alaska and Hawaii, the findings of the study will provide valuable insight for understanding of potential impact of RML.

To our knowledge, this is the first study comparing MU associated with RML enactment in the only noncontiguous states in the United States. Our results indicate that RML in Alaska was associated with an increase in MU among adolescents after it was legalized for recreational use. This finding is consistent with previous studies based in Washington State¹⁰ or Oregon State.¹⁶ Furthermore, a recent systematic meta-analysis study examining 8 studies found a small increase in MU among adolescents and young adults following legalization of marijuana for recreational purpose.¹³ In contrast, researchers found no evidence of an association between RML and adolescent MU in Colorado.¹⁰ In fact, adolescent MU fell after RML.^{11,17} These inconsistent results may perhaps be related to different data sets capturing MU, differing methodological approaches, variations in state contexts and regulatory frameworks, or simply any potential lag between RML implementation and effects.¹⁸

This study shows higher lifetime MU levels prior to RML, indicating higher preexisting MU exposures among adolescents in Alaska. Researchers also reported that states with legalized marijuana already had relatively higher preexisting adolescent MU rates prior to legalization.¹⁹ Such high levels of preexisting MU may have further short-term increases following RML enactment, as indicated by the lifetime and current MU increases between 2015 and 2017, but the long-term effects of RML on adolescent MU in Alaska are still to be determined.¹⁰ According to Melchior et al,¹³ several assumptions speculate on the increase of MU or decreased age of initiation associated with RML: (1) changes in the reporting of MU, (2) a decrease in perceived harmfulness, (3) an increase in marijuana availability and access, and (4) a decrease in price (in legal outlets or on the black market). Since the impact of the previously mentioned factors on the increase of adolescent MU in Alaska is largely unknown,

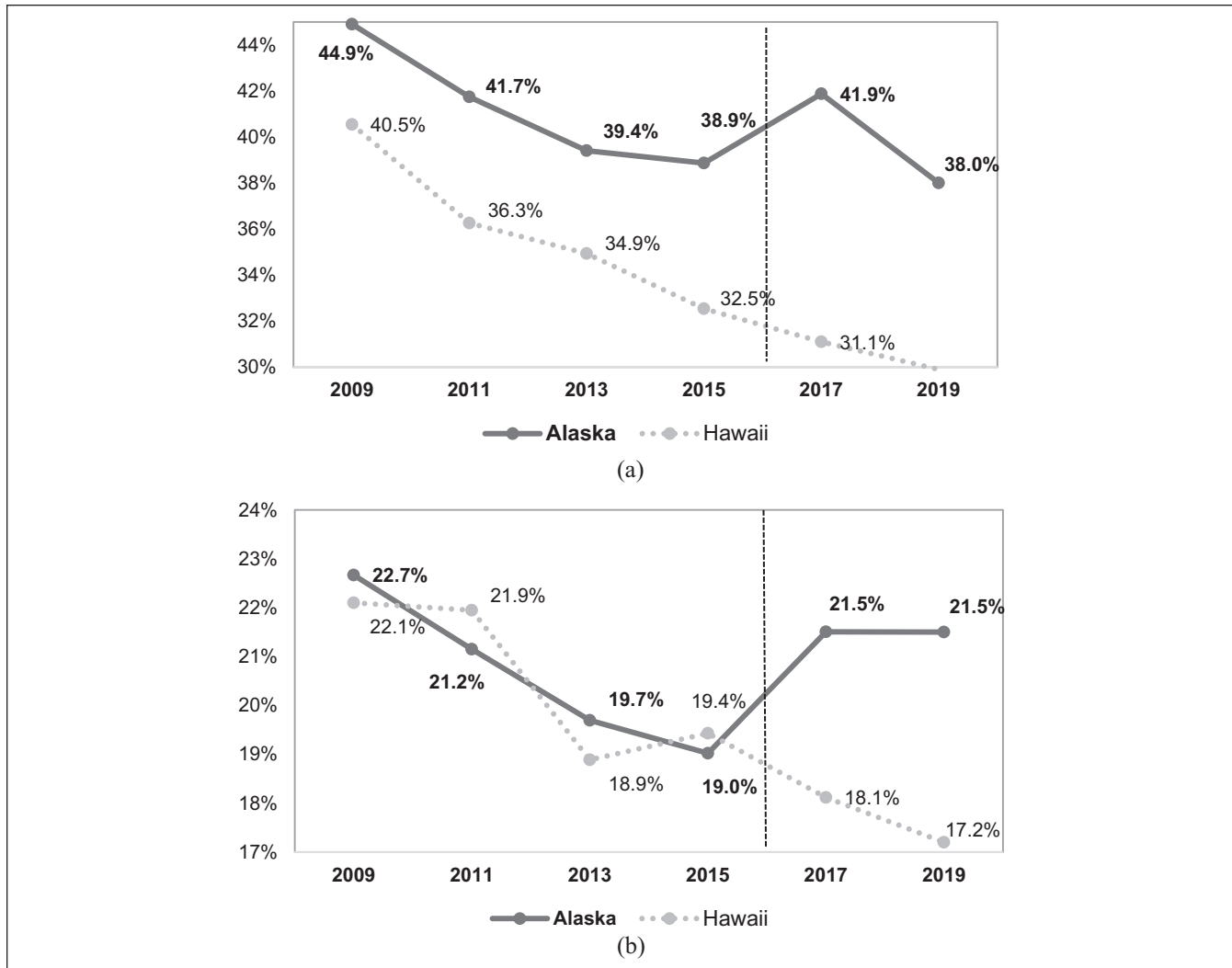


Figure 1. Trends of initiation and current marijuana use in Alaska and Hawaii, 2009 to 2019. (a) Initiation marijuana use. (b) Current marijuana use.

further study is needed to examine whether the changes in these factors actually occurred.

The findings of the current study were consistent with the previous research that MU varies by race/ethnicity, with non-White adolescents (except Asian) being more likely to use marijuana than White adolescents.^{20,21} In particular, the present study indicated that American Indian/Alaska Native was the leading group, followed by Black and Native Hawaiian/Other Pacific Islander groups in both lifetime and current MU. A supplementary analysis (available online) showed a significant racial difference between Alaska and Hawaii ($P < .001$). Hawaii is the most racially and ethnically diverse state in United States.²² Hawaii had the highest percentage of Asian (40%) followed by Native Hawaiian/Other Pacific Islander (28.2%). In contrast, Alaska had White (48%), American Indian/Alaska Native (21.7%), multiple races (9.6%), Asian (8.2%), Hispanic (7.4%), and Black (2.6%). Although many non-White groups have been noted for its

high prevalence of MU, very limited data are available regarding risk and protective factors specific to this high-risk population. Existing studies often pool Asian American, Native American, Native Hawaiian/Pacific Islander, and mixed race as “others,” or omitted them entirely.²³ Therefore, further studies are much needed to pay attention to figure out how those risk groups would differently respond to RML and how legalization policies may affect specific patterns of MU among those high-prevalent MU ethnic/racial groups.

Our study has several limitations that need to be acknowledged. First, in addition to the difference of RML enactment in the two states, variability in the specific policy provisions regulating marijuana (such as taxation, marketing restriction, or licensing for on premise) may have an impact on marijuana availability in these areas. For example, although recreational marijuana is not legal in Hawaii, the punishment for possessing small amounts (ie, up to 3g) of marijuana has been drastically reduced since 2019.²⁴ In March 2021, the

Table 2. Difference-in-Difference Estimates for the Marijuana Legalization Effect, 2013 to 2019 (n = 27 305)^{a,b,c,d,e}

	Model 1—Initiation of marijuana use	Model 2—Current marijuana use
Legalized State × After Marijuana Legalized	1.29** (1.10-1.51)	1.33** (1.11-1.61)
Legalized State: Alaska (Ref: Hawaii)	0.82** (0.73-0.93)	0.73*** (0.62-0.84)
After Marijuana Legalized	0.83*** (0.75-0.90)	0.87** (0.78-0.97)
Gender (Ref: Male)	0.95 (0.88-1.03)	1.04 (0.95-1.13)
Race (Ref: White)		
Black	1.83*** (1.39-2.40)	1.81*** (1.33-2.45)
Hispanic	1.39*** (1.23-1.58)	1.42*** (1.23-1.64)
Asian	0.45*** (0.39-0.51)	0.43*** (0.37-0.51)
American Indian/Alaska Native	2.56*** (2.14-3.05)	1.94*** (1.59-2.35)
Native Hawaiian/Other Pacific Islander	1.46*** (1.30-1.65)	1.43*** (1.25-1.65)
Multiple races	1.10 (0.97-1.25)	0.95 (0.81-1.12)
Age	1.32*** (1.28-1.36)	1.20*** (1.15-1.24)
Pseudo R ²	0.064	0.041

Abbreviation: Ref, reference group.

^a95% confidence intervals in parentheses.

^bLegalized State = Overall difference between Alaska and Hawaii.

^cAfter Marijuana Legalized = Overall difference between pre (2013-2015) and post (2017-2019) recreational marijuana legalization periods.

^dLegalized State × After Marijuana Legalized = Main effect of a difference-in-differences analysis.

^ePseudo R² values are presented for the probit regression analyses.

***P < .001, **P < .01, *P < .05.

Senate voted 20 to five to advance Senate Bill 767, which would legalize and regulate the commercial marijuana market in the state. The measure would allow adults aged 21 and older to purchase and possess up to one ounce of marijuana and grow up to six (up to three mature) marijuana plants for personal use.²⁵ Such changing laws are expected to influence adolescent MU, resulting in subsequent impacts to adolescent mental/physical health and education.

Nonetheless, policy change in and of itself can influence the perceptions of marijuana, which in turn affect the level of use,^{13,26} justifying the current study. Second, the present study included the past five years of data since 2014 RML enactment in Alaska, but there still remain issues about the best follow-up period for RML enactment. These issues include the difficulties in estimating long-run effects for mature markets to emerge and fully influence perceptions, norms, prices, and product choices,¹⁴ which is why further empirical studies on this issue are needed. Furthermore, media coverage surrounding marijuana legalization may be a confound in the current study that researchers were not able to account for within the dataset. Research has shown that positive attitudes toward marijuana legalization correspond with increasing marijuana-related media coverage.²⁷ Research has also shown that media coverage in the form of patient testimonials of the benefits of medical MU is indirectly associated with positive attitudes, beliefs, and increased intentions to use marijuana recreationally.²⁸ If media coverage began years before policy change, it may have affected views toward cannabis and/or use rates in a variety of ways beyond education, such as by normalizing or stigmatizing use.²⁹ Thus, there may be many factors that accompany the legalization of marijuana, such as increased

media coverage, that could partially account for the increased prevalence of lifetime and current MU among adolescents in Alaska after RML found in the current study. Thus, future research on the impact of marijuana policies on subsequent MU engagement should consider such factors. In addition, as the two states (Alaska and Hawaii) have not been studied yet while they share similar characteristics (noncontiguous area) but also lie in a different RML enactment status, this study focused on investigating whether RML increased lifetime and current MU in Alaska compared with Hawaii. However, due to the limitation of certain variables in the YRBS datasets, we were not able to examine other possible covariates influencing adolescents' MU (ie, socioeconomic characteristics such as income or urbanicity-metro or nonmetro area) in this study. Hence, other possible covariates may still affect the MU of the adolescents in these two states. As such, further study with other non-RML states controlling geographical factors is needed to investigate whether RML increased lifetime and current MU in these two states. Finally, this study focused on MU; future studies should examine the effect of RML on heterogeneous marijuana consumption behaviors including polysubstance use.

Considering the limited information on adolescent MU in Hawaii and Alaska, and the effects of RML, this study provides valuable insight despite the aforementioned limitations. Because of the lack of research on the racial/ethnic groups assessed in the current study, results have significant public health significance. For example, the current study found that American Indian/Alaska Native was the leading group in both lifetime and current MU, followed by Black and Native Hawaiian/Other Pacific Islander groups. However, little is known about the differential risk and

protective factors of MU associated with these racial/ethnic groups. Research has identified contributing factors among MU among other ethnic groups, such as parent-adolescent relationships among Hispanic adolescents,³⁰ thus supporting that there are differences among contributing factors to MU among adolescents of other ethnic groups. Identifying the racial/ethnic groups that have an increased prevalence of MU is the first step to assessing what factors may contribute to these differences and designing prevention and intervention programs that specifically apply to these vulnerable subpopulations. Additional research may also further explore the impact of unique socio/cultural characteristics in different states, and the subsequent impacts of RML on adolescent MU.

Conclusion

Both lifetime and current MU were increased following RML in Alaska, suggesting that RML may affect the increase of MU among adolescents. Considering how little is known about the effects of RML in Alaska, this study provides valuable insight despite the limitations noted above. Additional research may further explore the impact of unique socio/cultural characteristics in different states, and the subsequent impacts of RML on adolescent MU.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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