

Effect of marijuana legalization policies on youth marijuana use: A logistic model comparison analysis of demographic characteristics

Joshua Park*

UNLV Cannabis Policy Institute

Ji-won Yoo

*Department of Internal Medicine,
University of Nevada, Las Vegas*

Sinyong Choi

*Department of Sociology and Criminal Justice,
Kennesaw State University*

Abstract

During the last two decades, many U.S. states have legalized marijuana use, and the effect of this policy on youth marijuana use has emerged as a critical concern for policymakers and academic studies. However, the empirical findings from previous studies are not consistent and even conflict with each other. This study hypothesizes that these discrepancies should be caused by demographic differences in youth marijuana use. For the data analysis, we employed nationally representative survey data, “Continuing Study of American Youth - 12th-Grade Survey,” from 2012 to 2020 and examined the temporal changes in youth marijuana use by gender and race groups. We also introduced logistic regressions to clarify the effect of legalization after controlling for personal and contextual characteristics. The results show that as more states have legalized recreational marijuana, marijuana use among female youths has increased significantly, while that of males has not changed. Recreational marijuana use also positively influences white and black youths; however, its impact on Hispanic youths is negative. With these findings, we conclude that different attitudes, perceptions, and circumstances should cause distinctive

* Direct correspondence to the author(s): joshuapark.6022@gmail.com, <http://dx.doi.org/10.36889/IJCJ.2023.004>

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effects of marijuana legalization across gender and race groups. Future studies should consider these demographic differences in youth marijuana use for more effective intervention efforts.

Keywords: Recreational Marijuana Legalization, Youth Marijuana Use, Gender Difference, Racial Difference

Introduction

Over the last two decades, state legislatures have rapidly changed the legal aspect of medical and recreational marijuana consumption in the U.S. (Carnevale et al., 2017; Hinckley et al., 2022; O’Grady et al., 2022). As of July 2022, 18 states and the District of Columbia fully legalized both medical and recreational marijuana use, and the other 21 states have legally allowed the use of marijuana for medical purposes. Currently, only eleven states entirely prohibit marijuana consumption; however, eight of these states have initiated low-dose Cannabidiol (CBD) oil or Tetrahydrocannabinol (THC) use programs, leaving only three states without any public marijuana access (DISA, 2022). In sum, more than 40% of the American population resides in areas where both recreational and medical marijuana is publicly available, and an additional 36% have legal access to medical marijuana use, while marijuana is still classified as a Schedule I controlled substance¹ at the federal level (Carnevale et al., 2017; DEA, 2022).

One of the most critical concerns about this lawful availability of marijuana is the increase in youth marijuana use. (Lachance et al., 2022; O’Grady et al., 2022). Studies on marijuana consumption effect have revealed that early marijuana use is significantly associated with anti-social behaviors, lower academic achievement, and later involvement in other illegal drugs (Lynskey & Hall, 2000; Meier et al., 2015; Schaefer et al., 2021; Silins et al., 2014). For instance, Silins and colleagues (2014) have found that those who use marijuana daily before 17 retain significantly lower odds of high school completion and degree attainment while showing substantially higher odds of marijuana dependence, use of other illicit drugs, and suicide attempts. One recent study also showed that youths with heavy marijuana use retained unbalanced brain development, disrupted brain functions, and decreased intelligence functioning and IQ compared to those who do not consume marijuana (Lees et al., 2021). Therefore, it is crucial to examine and understand the effect of marijuana legalization on youth marijuana use.

¹ Substances that are not currently accepted for medical use and retain a high potential for abuse (DEA, 2022)

While many empirical studies have investigated this research question, their findings are not coherent and even conflict with each other (Lachance et al., 2022; O’Grady et al., 2022). In their meta-analysis of 32 academic studies (11 higher quality and 21 lower quality), Lachance and colleagues (2021) revealed that 40% of higher-quality studies presented an increase in youth/young adult marijuana use after legalization, while 55% did not report any change, and 5% reported a decrease. Another systematic review study examined 22 research articles on youth marijuana use after legalization and presented that seven studies identified an increase, ten found no change, and six reported a decrease (O’Grady et al., 2022).

The current study posits that these inconsistent findings should partially originate from distinctive marijuana use patterns across gender and race groups after marijuana legalization. Previous studies revealed that males and females, as well as different racial groups, retained significantly disparate behaviors, perceptions, and attitudes to marijuana use (Assari et al., 2019; Goncy & Mrug, 2013; Lac et al., 2011; Preston, 2006; Wallace et al., 2003). Therefore, different gender and race youth groups should experience the distinct effect of recreational marijuana legalization. However, the differentiating impact of marijuana legalization on youth marijuana use by gender and race has not been thoroughly examined in previous studies. This study intends to fill this gap by analyzing the representative youth survey data, the Monitoring the Future: A Continuing Study of American Youth (12-Grade Survey), from 2012 to 2020 with logistic model comparison analyses by gender and race groups. The findings and implications of this study, as well as limitations, are discussed for future studies.

Legalization Effect on Youth Marijuana Use

Theoretical Framework

As for the causal link between marijuana legalization and youth marijuana consumption, studies have presented two types of theoretical frameworks: (1) the increase in availability and accessibility and (2) the

change in youth attitude and risk perception (Lachance et al., 2022; Ousey & Maume, 1997). The argument about the increase in availability and accessibility posits that recreational marijuana legalization should enhance the availability and accessibility of marijuana products to youths even though it is still illegal for them to purchase or consume marijuana products (Lachance et al., 2022). The theoretical notion of “availability” indicates that marijuana is available in more diverse forms so that youths can consume marijuana products conveniently. The theoretical concept of “accessibility” means that marijuana products are more accessible at many locations; therefore, youths can obtain these products in an easier manner. Studies on youth cigarette and alcohol consumption have already proved that the density and proximity of retailers significantly impact youth consumption (Campbell et al., 2009; Henriksen et al., 2008). In the same vein, it is hypothesized that the availability of legal retailers of marijuana products should positively influence youth marijuana consumption (Orenstein, 2021). Furthermore, the availability of marijuana in diverse forms should also increase youth accessibility to marijuana products (Lachance et al., 2022). For example, recreational marijuana legalization has allowed various forms of marijuana products, such as edibles, drinkables, and vapes (Borodovsky et al., 2016). Some companies have introduced marijuana gummies, chocolate bars, and snacks, which should be more familiar to youths (Barker, 2022). These various forms should elevate youth accessibility to marijuana products and increase youth marijuana consumption (Lachance et al., 2022).

The other theoretical argument about marijuana legalization’s effect on youth consumption is the change in youth attitude and risk perception (Brooks-Russell et al., 2019; Danseco et al., 1999; Hughes et al., 2016; Keyes et al., 2016; Lachance et al., 2022). Studies have revealed that attitude and risk perception of marijuana use are significantly associated with marijuana consumption (Danseco et al., 1999; Hughes et al., 2016; Keyes et al., 2016). Based on these findings, studies have theorized that marijuana legalization normalizes marijuana use for youths and lowers their risk perception, as observed in cigarette and alcohol consumption (Friese & Grube, 2013; Khatapoush & Hallfors, 2004). Correspondingly, studies have posited that marijuana legalization policies should alleviate youth’s negative attitude and

risk perception, which, in turn, increase their use of marijuana. While some studies have found that medical marijuana legalization does not influence youth attitudes and perceptions (i.e., Friese & Grube, 2013; Khatapoush & Hallfors, 2004), other studies have empirically supported this theoretical argument (Danseco et al., 1999; Hughes et al., 2016; Keyes et al., 2016).

Gender Variation in Legalization Effect

Despite inconsistent findings across studies on the marijuana legalization effect on youths, one noteworthy and consistent finding is that the legalization policy has significantly increased females' marijuana consumption (Bae & Kerr, 2020; Brooks-Russell et al., 2019; Doran et al., 2021; Lachance et al., 2022; Miller et al., 2017; Paschall et al., 2021). In their analysis of National College Health Assessment Survey data, Bae and Kerr (2020) revealed that recreational marijuana legalization significantly impacted female students. Brooks-Russell and colleagues (2019) also examined youths' perceptions and use of marijuana and found a significant increase in marijuana use among female students, while male students reported a decrease. Through analyzing three-year panel data surveying 563 young adults in California, Doran and colleagues (2021) also showed that women reported increasing use of marijuana following legalization, but men reported a decrease. As for the theoretical explanation of these disparities between male and female youths, studies have suggested that the emergence of new marijuana products, such as candy bars, gummies, and chocolate snacks, should attract more diverse consumers, including female youths (Lachance et al., 2022). In general, women perceived a higher risk of using marijuana and consumed marijuana less than men (Park et al., 2022). However, these new types of marijuana products should reduce women's disapproval of marijuana use. Therefore, the effect of these marijuana products should be differentiated by gender in terms of intensity and psychoactive effect (Lachance et al., 2022).

Racial Variation in Legalization Effect

Contrary to the findings about gender disparities, studies on racial disparities have presented inconsistent effects of marijuana legalization. Some studies have found no significant difference across racial groups (Brooks-Russell et al., 2019), other studies have revealed a significant increase in Black and Hispanic racial groups (Miller et al., 2017), and other studies have presented the higher odds of using marijuana in White youths (Coley et al., 2021; Paschall et al., 2021). For example, Miller and colleagues (2017) analyzed the marijuana consumption of college students before and after recreational marijuana legalization and found that there is a relatively large increase in the likelihood of marijuana use for black and Hispanic students. In their study, the likelihood of marijuana use among Black and Hispanic students increased by 15.8 and 14 percentage points after legalization, respectively. This change represents an 88-percent increase in recent users for Black students and a 93-percent increase for Hispanic students (Miller et al., 2017). On the contrary, Paschall and colleagues (2021) analyzed the California Healthy Kids Survey from 2010–2011 to 2018–2019 and found a strong positive effect of recreational marijuana legalization on the marijuana use frequency of white students compared to other minority groups.

Hypotheses of Current Study

Based on these findings from previous studies, the current study hypothesizes that the effects of recreational marijuana legalization should show different temporal trajectories between gender and race groups. More specifically, this study intends to examine the following hypotheses.

1. As more states legalize the recreational use of marijuana, female youths show different trajectories of marijuana consumption from males after controlling for the change in their personal and contextual characteristics.
2. As more states legalize the recreational use of marijuana, African American youths show different trajectories of marijuana consumption from Whites after controlling for the change in their personal and contextual

characteristics.

3. As more states legalize the recreational use of marijuana, Hispanic youths show different trajectories of marijuana consumption from Whites after controlling for the change in their personal and contextual characteristics.

Methods

Data

For the examination of the proposed hypotheses, this study employs nine-year survey datasets, “Monitoring the Future: A Continuing Study of American Youth - 12th-Grade Survey (MFCSAY)” from 2012 to 2020. This MFCSAY survey is conducted by the Institute for Social Research at the University of Michigan and supported by the National Institute on Drug Abuse. Since 1975, this nationwide representative survey has investigated the trends of American youths’ illegal drug use and their perception of the drug use risk annually (Miech et al., 2020; Park, 2022). For the sampling process, the MFCSAY study selected geographical areas from the Sampling Section of the Survey Research Center and identified high schools in the selected geographical regions (Park, 2022). Individual senior students from the identified high schools are randomly selected and surveyed for their experience of illegal drugs, as well as their school experience and demographic backgrounds (Miech et al., 2020). We employed the MFCSAY datasets because these datasets provide nationally representative information about youth marijuana use by gender and race groups.

Variables

Marijuana Use. For the measurement of the main dependent variable, *youth marijuana use*, this study employs an MFCSAY survey question, “how many occasions (if any) have you used marijuana (grass, pot) or hashish (hash, hash oil) during the last 12 months?” Respondents were given choices of “(1)

0 occasions, (2) 1 – 2 times, (3) 3 – 5 times, (4) 6 – 9 times, (5) 10 – 19 times, (6) 20 to 39 times, and (7) 40 times or more.” For the purpose of analysis, this study dichotomizes these choices into a binary variable, such as (1) the respondent did not use marijuana during the last 12 months and (2) the respondent used marijuana during the last 12 months (= non-reference category) and introduces this variable into logistic regression. Therefore, the dependent variable in this study should indicate the likelihood of using marijuana.

Marijuana Legalization. To examine the effect of recreational marijuana legalization, this study operationalizes a variable, *Marijuana Legalization*, as the cumulative number of states that have legalized recreational marijuana each year from 2012 to 2020. Table 1 shows the list and the number of states in the U.S. that have legalized recreational marijuana from 2012 to 2020. When there is a time gap of more than a year between the enactment of legalization and the actual sales of recreational marijuana, this study introduces the year of the actual sales for the standard of recreational marijuana legalization. For example, The State of Vermont enacted the legalization of recreational marijuana in 2018; however, the sales of recreational marijuana are still illegal due to the absence of an administrative regulation process. The District of Columbia also legalized recreational marijuana in 2014; however, the sales of recreational marijuana are not legally allowed as of July 2022 because politicians prevent the District of Columbia from establishing an independent regulatory board. Therefore, the State of Vermont and the District of Columbia are excluded from the measurement of recreational marijuana legalization in this study.

Table 1. The List and Number of States Legalizing Recreational Marijuana (2012 – 2020)

Year	State	Number of States	Cumulative Number
2012		0	0
2013		0	0
2014	Colorado, Washington	2	2
2015	Oregon	1	3

Year	State	Number of States	Cumulative Number
2016	Alaska	1	4
2017	Nevada	1	5
2018	California, Massachusetts	2	7
2019	Michigan	1	8
2020	Illinois, Maine	2	10

Parental Control. Studies have revealed that youths are more likely to use marijuana when they perceive a lower level of parental control (Caldwell & Darling, 1999; Lac & Crano, 2009). For example, in their meta-analysis of 17 empirical studies, Lac and Crano (2009) found that the level of parental monitoring retained a significant negative effect on youth marijuana use. To reflect this finding in the analysis, the current study identified whether or not respondents lived with their father and/or mother with the questions in the MFCSAY survey. The variable, Parental Control, is coded as (1) 0 = living with no parent, (2) 1 = living with one parent, and (3) 2 = living with both parents. This study hypothesizes that youths living with more parents should be under a higher level of parental control.

Socio-economic Status. Socio-economic status has also been presented as a significant determinant of youth marijuana use in previous studies (Lemstra et al., 2008; Miller & Miller, 1997). In addition, Clendennen et al. (2021) revealed that the change of socio-economic change during the COVID-19 pandemic era significantly influenced youth marijuana use, and other studies argued that youth socio-economic status could be a possible confounding factor in the effect of marijuana legalization (Rogeberg, 2013). However, the employed data in this study, the MFCSAY survey, did not directly investigate the socio-economic statuses of respondents. Therefore, this study introduces a proxy measure of the variable, *Socio-Economic Status*, as the education levels of both parents. The MFCSAY survey included two questions, “What is the highest level of schooling your father/mother completed?” and provided choices of (1) 1 = Grade School, (2) 2 = Some Highschool, (3) 3 = Highschool Graduation, (4) 4 = Some College, (5) 5 = College Graduation, (6) 6 = Graduate School. This study adds both parents’

education levels and introduces the variable *Socio-Economic Status*.

Delinquency. Since the earlier studies, delinquent behaviors have been found to be significantly associated with youth marijuana use (D'Amico et al., 2008; Dembo et al., 1992; Huizinga & Elliott, 1981; Lynskey & Hall, 2000). To control for the effect of youth delinquency on marijuana use, the current study employs one proxy question from the MFCSAY survey, "During the last four weeks, how many whole days of school have you missed because you skipped or "cut"?" Respondents were given seven choices such as (1) 1 = None, (2) 2 = 1 day, (3) 3 = 2 days, (4) 4 = 3 days, (5) 5 = 4-5 days, (6) 6 = 6-10 days, (7) 7 = 11+ days. This study hypothesizes that the more students have missed school due to skipping or cutting, the more likely they are to be involved in delinquent behaviors (Yukse & Solakoglu, 2016).

School Achievement. Studies have shown that students' achievements at school are significantly related to their marijuana use (Meier et al., 2015; Silins et al., 2014). To consider the association between school achievement and marijuana use, the current study employs the question about respondents' grades at school. Respondents are given choices from D (= 1) to A (= 9) with nine categories; therefore, the higher value indicates better school achievement.

Demographic Variable. Two demographic characteristics of youths are introduced to examine the main research hypotheses in this study: gender and race. The gender of each youth is measured as a dichotomized variable (1 = Male), and the race is operationalized into three categories: white, black, and Hispanic. For the purpose of analysis, the *Race* variable is recoded into two dummy variables (0 = white). Table 2 shows descriptive statistics of all the variables in the current study, and Table 3 presents the gender and race frequency distribution.

Table 2. Descriptive Statistics of Variables

Variable	Valid N	Freq.	%	Mean	SD.
Marijuana Use (1 = Yes)	105,943	38,898	34.6		
Legalization	112,375			3.86	2.99
Parental Control	106,134			1.61	0.60
Socio-economic Status	94,500			7.93	2.46

Variable	Valid N	Freq.	%	Mean	SD.
Delinquency	100,359			1.69	1.30
School Achievement	103,805			6.68	1.89
Gender (1 = Male)	102,790	50,262	48.9		
Race	89,406				
White		57,684	51.3		
Blck		12,420	11.1		
Hispanic		19,302	17.2		

Table 3. Gender and Race Frequency Distribution

	White		Black		Hispanic		Total
	Freq.	%*	Freq.	%*	Freq.	%*	
Female	28,072	50.1/63.9	6,165	53.1/14.0	9,663	52.3/22.0	43,900
Male	27,914	49.9/66.2	5,454	46.9/12.9	8,799	47.7/20.9	42,167
Total	55,986	/65.0	11,619	/13.5	18,462	/21.5	86,097

* Column % / Row%

Analytical Plan

To clarify gender and racial disparities in the effect of recreational marijuana legalization on youth marijuana use, the current study employs logit-based logistic regression with model comparison approaches. In the first stage, this study conducts separate logistic analyses for each gender, race, and gender x race group and compares results to each other. In the second stage, this study runs the same analysis with the whole sample and compares it with the results from each group.

Results

Gender Variation in Youth Marijuana Use

First, this study has examined the annual changes in the numbers of marijuana-using youths by gender from 2012 to 2020 and presented the results in Table 3. Overall, the average number of marijuana-using youths is higher

for males (38.3) than for females (34.6). However, the temporal distributions show that the difference between males and females gets smaller as more and more states have legalized recreational marijuana. For example, the percentile differences between females and males are 32.7 vs. 41.2 in 2012 and 32.9 vs. 40.1 in 2013 when no state sold marijuana legally. But, these notable differences became 36.4 vs. 36.8 in 2019 and 35.3 vs. 36.4 in 2020 when around 20% of states sold marijuana legally. These descriptive findings indicate that the number of marijuana-using female youths has increased as more states legalize recreational marijuana use, while that of male youths decreases. Furthermore, the result from the Chi-square tests shows that these discrepant distributions are significant ($p < .001$).

Table 4. Annual Change in Marijuana-using Youths by Gender from 2012 to 2020

		2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Female	N	2,156	1,984	2,080	2,141	1,844	2,255	2,286	2,321	660	17,727
	%	32.7	32.9	34.1	34.4	33.7	37.0	35.5	36.4	35.3	34.6
Male	N	2,721	2,381	2,178	2,159	2,041	2,165	2,159	2,181	604	18,628
	%	41.2	40.1	38.7	37.2	37.0	37.9	37.8	36.8	36.4	38.3

Chi-square = 101.867 ($p < 0.000$)

In the second step, this study runs the full model by introducing the gender variable in the model. This model examines the effect of recreational marijuana legalization while controlling for the average difference between the two genders. The result from this full model analysis is presented in Table 4. The results from this analysis show that recreational marijuana legalization significantly increases the likelihood of youth marijuana use after controlling for gender differences ($b = 0.009$, $p < .01$). The gender difference in the likelihood of using marijuana is also significant ($p < 0.01$), and the slope of .111 indicates male youths retain the higher log odds of using marijuana by .111.

Table 5. Full Logistic Regression Analysis of Marijuana Use (N = 105,943)

	B	S.E.	Exp(B)
Legalization	.009**	.003	1.009
P. Control	-.221**	.015	.802
SES	.028**	.004	1.028
Delinquency	.322**	.007	1.380
Achievement	-.178**	.005	.837
Gender (1 = Male)	.111**	.017	1.118
Black	-.208**	.027	.812
Hispanic	-.179**	.024	.836
Nagelkerke R ²		0.097	

*p < .05. **p < .01

In the third step, the current study has run separate logistic regressions for male and female youths and examined the effect of legalization after controlling for individual characteristics. The findings from these analyses are presented in Table 5. These analyses have shown that recreational marijuana legalization significantly impacts female youth marijuana use positively ($b = 0.274$, $p < 0.01$), while it is not significant for males ($b = -.010$, $p > .05$). The exponential b value of female marijuana use (1.029) indicates that as one state legalizes recreational marijuana, the odds ratio of female marijuana use increases by 1.029. Besides this difference, the effects of other explanatory variables are consistent between male and female youths. Both genders are less likely to use marijuana as parental control and school achievement increase and more likely to consume when socio-economic status and delinquency involvement escalate. For the analysis of racial differences, both genders show that black and Hispanic youths are significantly less likely to use marijuana than white.

Table 6. Logistic Regression of Marijuana Use by Gender

	Female (N = 52,528)			Male (N = 50,262)		
	B	S.E.	Exp(B)	B	S.E.	Exp(B)
Legalization	.274**	.028	1.029	-.010	.004	.990
Parental Control	-.277**	.021	.758	-.162**	.022	.857
SES	.031**	.005	1.031	.025**	.005	1.026
Delinquency	.324**	.009	1.383	.320**	.010	1.377

	Female (N = 52,528)			Male (N = 50,262)		
	B	S.E.	Exp(B)	B	S.E.	Exp(B)
Achievement	-.192**	.007	.826	-.168**	.006	.846
Black	-.274**	.038	.761	-.139**	.039	.870
Hispanic	-.253**	.033	.777	-.104*	.033	.902
Nagelkerke R ²		0.100			0.089	

*p < .05. **p < .01

Racial Variation in Youth Marijuana Use

For the analysis of racial variation, this study has examined the annual changes in youth marijuana use by race from 2012 to 2020. The result from this analysis is presented in Table 6. As expected, this result shows racial variations in the effect of recreational marijuana legalization on youth marijuana consumption. As given in the full model, the total average marijuana use is found to be higher for white youths than for black and Hispanic youths. However, while marijuana consumption by white and black youths has shown increases from 2012 to 2020, those of Hispanic youths have decreased. The Chi-square test result shows that these racial disparities across given years are significant at the .001 significance level.

Table 7. Annual Change in Marijuana-using Youths by Race from 2012 to 2020

		2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
White	N	3,072	2,624	2,440	2,427	2,203	2,517	2,555	2,527	612	20,977
	%	37.3	36.0	37.4	36.0	35.6	39.2	38.5	36.9	35.4	37.0
Black	N	448	496	517	591	512	541	446	421	131	4,103
	%	33.5	37.5	36.0	33.1	35.6	35.2	36.9	36.3	37.8	35.5
Hispanic	N	738	754	783	773	703	854	947	842	248	6,642
	%	39.8	38.4	35.1	35.7	36.4	36.1	33.4	34.5	32.8	35.8

Chi-square = 170.170 (p < 0.000)

In the second stage of the racial disparity examination, this study has run three separate logistic regressions for each race and analyzed the effect of legalization. The results from these analyses are presented in Table 7. As observed in the examination of annual changes, there are significant positive

relationships between the number of states with legalization and marijuana use for white and black youths ($b = .014$, $p < .01$ and $b = .018$, $p < .05$ correspondingly). However, legalization negatively impacts Hispanic youth marijuana use ($b = -.016$, $p < .05$). The exponential b values of these analyses indicate that as one state legalizes recreational marijuana, the log odds of white and black youths decrease by .014 and .018 correspondingly, but that of Hispanic youth decreases by .016. In addition to these discrepancies, the socio-economic status of black youths is found to retain a non-significant influence on marijuana use, while those of white and Hispanic youths are significant. The effects of all other variables are consistent across races and also with those from the full model.

Table 8. Logistic Regression of Marijuana Use by Race

	White (N = 57,689)			Black (N = 11,570)			Hispanic (N = 18,549)		
	B	S.E.	Exp(B)	B	S.E.	Exp(B)	B	S.E.	Exp(B)
Legalization	.014**	.003	1.014	.018*	.009	1.018	-.016*	.006	.984
P. Control	-.238**	.019	.788	-.154**	.039	.857	-.191**	.033	.826
SES	.026**	.005	1.026	.007	.011	1.007	.042**	.007	1.043
Delinquency	.340**	.009	1.405	.29**	.019	1.336	.292**	.013	1.340
Achievement	-.182**	.006	.834	-.174**	.013	.84	-.164**	.010	.849
Gender (1=M)	.082**	.020	1.085	.162**	.049	1.176	.196**	.038	1.216
Nagelkerke R ²		0.098			0.087			0.101	

* $p < .05$. ** $p < .01$

Discussion

In this study, we intend to examine gender and racial disparities in youth marijuana use as more states have legalized recreational marijuana use. Previous studies on youth marijuana use have argued that different gender and racial groups should have distinctive attitudes and risk perceptions, which lead to distinguishing patterns of marijuana use across gender and racial groups (Brooks-Russell et al., 2019; Danseco et al., 1999; Hughes et al., 2016; Keyes et al., 2016; Lachance et al., 2022). Other studies also posit that the accessibility and availability of marijuana products after legalization influence

gender and racial groups in a distinctive manner and cause unique patterns across these groups (Lachance et al., 2022; Orenstein, 2021). Based on these theoretical frameworks, we have hypothesized that recreational marijuana legalization should impact youth marijuana use differently across gender and racial groups. To examine the hypothesis, we have employed the MFCSAY survey data from 2012 to 2020, which has investigated the trends of American youths' illegal drug use and their annual perception of the risk of drug use. For the data analysis, the logistic regression with model comparison approaches, as well as temporal descriptive examination, are introduced.

The results from these analyses support our hypothetical arguments. Each gender and race group shows a distinctive trajectory, which is significantly different from those of other groups. As for the gender difference, the overall average marijuana use is higher for male youths than for females. However, the temporal examination of annual frequencies presents that marijuana use by female youths has continuously increased while that by males has not changed prominently. Due to these different patterns, the annual frequency difference between female and male youths has decreased and become nearly identical to each other in 2020, when 20% of states have legalized the selling of recreational marijuana. In the following logistic regressions with model comparisons, we have found that the number of states legalizing recreational marijuana significantly influences the likelihood of using marijuana for female youths but not for males after controlling for other personal characteristics. This finding is consistent with the temporal examination and supports the argument that recreational marijuana legalization positively influences female youth marijuana consumption but not that of males.

This finding of gender difference supports the theoretical argument of “accessibility and availability” and “risk perception” (Lachance et al., 2022; Ousey & Maume, 1997). The theoretical argument of “accessibility and availability” postulates that the availability of diverse forms of marijuana products, such as edibles, drinkables, and vapes, allow female youths to access and use marijuana more easily, while males are relatively less influenced by these new forms (Borodovsky et al., 2016; Lachance et al., 2022). The

increase in female youth marijuana use in our findings is consistent with these theoretical arguments. The “risk perception” theory also postulates that marijuana legalization policies should alleviate youth’s negative attitude and risk perception about marijuana consumption. Our finding implies that the legalization of recreational marijuana has changed the attitude and risk perception of youths female youths more than those of male youths.

The distinctive trajectories of youth marijuana use are also found in the analyses by racial groups. The temporal analysis of youth marijuana use by racial groups has presented that the marijuana uses of white and black youths have increased as more states have introduced recreational marijuana use; however, that of Hispanic youths has decreased during the same periods. The logistic regressions by racial groups also showed that there are positive relationships between legalization and marijuana use for white and black youths after controlling for personal characteristics; however, this relationship is found to be negative for Hispanic youths. We propose that these discrepancies should be caused by different attitudes and cultural backgrounds across racial groups. We suggest that future studies should investigate these differences with a detailed investigation of distinctive cultural and social effects on youth attitude and risk perception by racial groups. Considering racial discrimination issues in marijuana-related law enforcement in the U.S., the consideration of cultural and social differences across racial groups can also provide appropriate and fair criminal justice policies on drug enforcement (Vitiello, 2019).

One noteworthy finding from the full model analysis is that legalization retains a significant positive effect on youth marijuana use when we have merged the data. This positive relationship is significant ($p < .01$); however, the exponential b value is 1.009, which indicates the odds of using marijuana increase only by 0.009 per one-state legalization. We posit that this limited overall change is caused by the offset across gender and racial group differences and provides a cue to understand the inconsistent findings from previous studies (see Lachance et al., 2022; O’Grady et al., 2022). That is, the differentiated effect of recreational marijuana legalization across gender and racial groups has generated inconsistent results in previous studies based on

the composition of respondents in the sample. Therefore, future studies should consider these discrepancies in their examination of the marijuana legalization effect and try to clarify the complex causal mechanism across different gender and race youth groups. Moreover, marijuana-related policymakers and law enforcement agencies should also consider these gender and racial discrepancies in the effects of marijuana legalization and introduce more tailored prevention policies for specific gender and racial groups. Our findings show that it is critical to reduce the accessibility and availability of marijuana for youths by regulating diverse forms of marijuana products and introducing educational approaches to perceive the risk of youth marijuana use properly.

Conclusion

The findings of this study support that the legalization of recreational marijuana influences youth marijuana use. Moreover, we have found that this influence should be distinctive across different gender and racial groups. While its impact on male youths is not significant, this legalization increases marijuana use among female youths significantly. We have also found that white and black youths are positively influenced by legalization; however, its effect on Hispanic youths is negative. These findings are coherent with the theoretical framework that posits the effects of different attitudes, perceptions, availability, and accessibility on youth marijuana use. Previous inconsistent findings on the legalization effect should have originated from these differentiating effects across gender and racial groups; therefore, it is critical to consider youths' demographic differences in the study of their marijuana consumption. We suggest future studies examine these differentiating effects across various youth groups so that our societies can initiate more effective intervention efforts against youth marijuana use.

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