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Article

The effect of youth marijuana use on high-risk drug use: Examining gateway and substitution hypothesis

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SUMMARY

Youth high-risk drug use causes harm to individuals and raises social concerns in the United States (US). To prevent youth high-risk drug use effectively, it is crucial to identify and address the significant risk factors. Some view the use of low-risk drugs (e.g., marijuana) as one such risk factor, though studies posit conflicting arguments about the effect of youth marijuana use. Some argue that youth marijuana use is a gateway to high-risk drug use; therefore, youth marijuana use boosts the likelihood of high-risk drug use. However, others postulate that there is a substitution effect of youth marijuana use, in which youth marijuana use replaces and, therefore, reduces their high-risk drug use. Our study aims to clarify these two conflicting arguments by examining the following hypotheses: (i) there is a significant discrepancy in youth high-risk drug use between marijuana-using youths and non-marijuana-using youths, and (ii) youths who consume marijuana are significantly more likely to use high-risk drugs after controlling for individual and environmental characteristics. To test our hypotheses, we analyzed nationally representative youth survey data collected between 2010 and 2019, determining the annual average comparison and performing comparative multiple regression analyses. The results from these analyses show that there is a significant gateway effect of youth marijuana use, with youth marijuana use significantly increasing high-risk drug use after controlling for individual and environmental risk factors. Considering the recent marijuana legalization trends in the US, this finding suggests that policymakers should pay close attention to the gateway effect of youth marijuana use.

INTRODUCTION

Youth substance abuse is a serious social concern in the United States (US) (1, 2). In general, youths are defined as young persons between the ages of 15 and 24 years (3). However, we use the term "youth" to indicate high school-aged youths following the guidance of the Centers for Disease Control and Prevention (CDC) (4, 5). According to the National Center for Drug Abuse Statistics, around 8.33% of 12- to 17-year-old youths (2.08 million) in the US reported that they used illegal drugs during a one-month survey period, and 21.3% of the eighth graders in the US indicated that they had tried illicit drugs at least once in their lives (6). By the time they became 12th graders, 46.6% of those students stated they had used illicit drugs (6). Youth drug use in the US has been associated with a series of problems, including low academic achievement, health-related issues, mental health problems, and poor peer and family relationships (7, 8). Studies have also shown that youth drug use relates to delinquent and suicidal behaviors (9, 10). Furthermore, youths who frequently use drugs have a significantly higher chance of suffering from substance abuse disorder and addiction in their later lives (11). In a study conducted by Sheehan et al., more than 90% of adult drug addicts started their drug use when they were young (12).

To address these adverse effects of youth substance abuse in the US, the Centers for Disease Control and Prevention (CDC) has identified specific types of illicit substance use that cause a high risk of adverse outcomes, such as injury, delinquent behavior, school dropout, and suicide (13). The CDC designated this type of substance abuse as "high-risk drug use" (HDU) of youths and presented prescription drug misuse, use of cocaine, heroin, methamphetamines, inhalants, hallucinogens, or ecstasy, and injection drug use as examples of HDU (13). According to the CDC, youth HDU increases a youth's likeliness to engage in risky sexual behavior, experience violence, and suffer from mental health issues and suicide (4). Some studies have also reported that these drugs can cause severe physical and psychological damage to youths (14, 15). Therefore, it is critical to prevent youth HDU to help youths stay safe and healthy (13). While studies have revealed diverse individual, social, and environmental risk factors that contribute to youth HDU (16, 17), it is still unclear if non-HDU, such as marijuana and hashish use, exacerbates or reduces youth HDU. Some scholars argue the gateway hypothesis, postulating that youth marijuana use promotes HDU (18, 19). However, others posit that youth marijuana use should replace HDU, meaning that youths who use marijuana should be less likely to use high-risk drugs (20).

Studies on the gateway hypothesis present two possible causal mechanisms. First, youths who consume marijuana experience psychological and physical gratification, which is designated as the status of "euphoria" (18, 21). Youths who have experienced euphoria from marijuana use continue to seek the same level of gratification by getting involved in HDU (18,21). Second, individuals who have used marijuana may gain less apprehension and more curiosity about HDU; therefore, they are more inclined to use high-risk drugs after consuming marijuana (18, 22, 23). Multiple empirical studies have presented findings supporting the gateway hypothesis. For example, studies have frequently found that the majority of adult drug addicts used marijuana when they were teens or young adults (12, 18, 22).

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On the other side, the substitution perspective proposes that marijuana use provides a similar gratification or treatment effect to HDU, and youths will try to reduce the adverse effect of HDU by switching to marijuana consumption (14, 24). For example, Ishida and colleagues analyzed national survey data and found that 41% of opioid users decreased or stopped using opioids after using marijuana (24). Another study also found that increased marijuana consumption led to a significant decline in arrests for HDU (14). These findings suggest an individual-level correlation between marijuana use and HDU that may actually be caused by other individual characteristics and environmental factors, not marijuana use itself (18). Studies have also revealed that both individual factors (e.g., demographic characteristics and alcohol/cigarette use) and environmental factors (e.g., peer pressure and lack of parental control) retain significant effects on youth drug use (25, 26).

These conflicting arguments suggest that it is critical to examine the validity of the gateway hypothesis by controlling for other individual and environmental risk factors (27). Therefore, we sought to examine the effect of youth marijuana use on youth HDU by determining if there is a significant discrepancy in HDU between marijuana-use youths and non-marijuana users. Specifically, we sought to determine if youths who consume marijuana are significantly more likely to use high-risk drugs after controlling for individual and environmental characteristics. To test the effects of youth marijuana use on youth HDU, we employed nationally representative youth survey data from the "Monitoring the Future: A Continuing Study of American Youth" (MFCSAY) 12th-grade Survey from 2010 to 2019, which was administered by the Institute for Social Research (28). While the MFCSAY surveyed 8th, 10th, and 12th graders, we concentrate on the 12th graders as this group is between adolescence and young adult statuses. During these ten years, many US states have employed marijuana legalization policies, and studies have found that these policies have increased youth marijuana use (29, 30). In this study, we intend to clarify the gateway effect of marijuana use on youth HDU, as well as the effect of marijuana legalization policies on youth HDU. From these analyses, we found that youths who use marijuana are more likely to use high-risk drugs.

RESULTS

Descriptive Analysis of Data

In the first step of our analyses, we obtained descriptive statistics of variables (**Table 1**). Across all the variables, missing cases were observed; therefore, we reported the valid number of respondents for each variable. The analysis of the HDU variable showed that 4.6% of respondents consumed lysergic acid diethylamide (LSD), crack, cocaine, or heroin in the last 12 months. The mean of HDU was 0.29 times (sd = 2.88), with a maximum number of 86 times. This finding indicated that a small portion of high school seniors used high-risk drugs heavily, while the majority of them (95.4%) did not use high-risk drugs in the last 12 months. The analysis of *Marijuana Use* showed that 35.7% of respondents used marijuana in the last 12 months. The mean of *Marijuana Use* was 5.36 times (SD = 11.84), which showed that marijuana use was substantially more prevalent than HDU. We analyzed alcohol use among senior school students and found that more than 60% of senior high school students drank alcohol in the last 12 months. Their average alcohol drink frequency was 5.41 times (SD = 9.80), which was similar to that of *Marijuana Use*. This result indicated that almost twice as many students were involved in alcohol consumption as those using marijuana. Lastly, only 13% of senior students smoked cigarettes in the last 12 months, which was significantly lower than marijuana and alcohol use. The average number of cigarettes smoked was 0.23 times (SD= 0.71).

Variable	Valid N	N(Yes)	%	Mean	SD	Min	Max
High-risk Drug Use	21,637	998	4.6	0.29	2.88	0	86
Marijuana Use	21,702	8,185	35.7	5.36	11.84	0	40
Alcohol Drink	21,129	12,726	60.2	5.41	9.80	0	40
Cigarette Smoke	21,992	2,860	13.0	0.23	0.71	0	6
Peer Influence	21,977	5,440	24.8	0.58	1.33	0	9
Parental Control	21,915			1.60	0.60	0	2
No Parent		1,310	6.0				
Single Parent		6,079	26.4				
Both Parents		14,526	66.3				
Age	22,016						
Lower than 18		9,554	43.4				
18 or Higher		12,462	56.6				
Race	18,444						
Black		2,637	14.3				
White		11,984	65.0				
Hispanic		3,823	20.7				
Gender	21,135						
Female		10,771	51.0				
Male		10,364	49.0				

Table 1. Descriptive Statistics for the MCFSAY Dataset. A total of 23,064 respondents were surveyed in the 2010 to 2019 MFCSAY studies (28). The Valid N is the number of respondents who responded to each variable. N(Yes) indicates the number of respondents in each category, and the N(Yes) and % values for substance use variables (High-risk Drug Use, Marijuana Use, Alcohol Drink, Cigarette Smoke) show the number and the percentage of students who used the corresponding substances one or more times. For example, for the variable "High-risk Drug Use," a total of 21,637 out of 23,064 respondents answered the survey question, and 998 (4.6%) individuals reported that they used high-risk drugs. SD = standard deviation, Min = minimum values, and Max = maximum values.

Evaluating environmental factors, 24.8% of respondents reported that they were around other people who consumed cocaine, LSD, or heroin in the last 12 months. The analysis of *Parental Control* indicated that 6% of respondents lived without parents, and 26.4% resided with a single parent. Lastly, the analysis of demographic variables showed that 14.3% of respondents were black, 65.0% were white, and 20.7% were Hispanic—similar to 2021 population statistics (12.6% black, 63.8% white, 18.9% Hispanic) (31). As for the gender distribution, 51.0% were females. Finally, looking at age, 56.6% of respondents were 18 or older.

Higher HDU among Marijuana Users

To test our first hypothesis about the significant HDU discrepancy between marijuana-use youths and non-marijuana users, we analyzed the comparative distribution of HDU between marijuana users and non-users from 2010 to 2019 (**Figure 1**). For the comparison, we calculated the average HDU each year for both groups. The results from this comparative analysis showed that the HDU among marijuana users was much higher than that among marijuana non-users. For example, in the year 2015, the HDU average for marijuana users was 114 times higher than that for marijuana non-users (**Figure 1**). The biggest net difference was observed in

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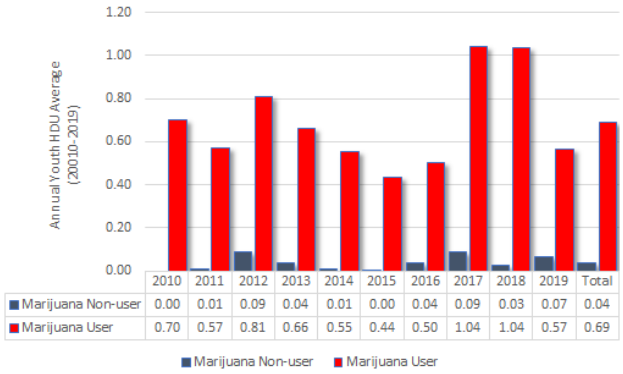

Figure 1. Annual Youth High-Risk Drug Use Average Comparison Between Marijuana Users and Non-Users From 2010 to 2019. The average annual youth high-risk drug use (HDU) which were calculated by dividing the total number of HDUs by the number of respondents yearly in each group. The overall mean difference between the two groups was statistically significant (t = 10.584, p < 0.001).

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Marijuana Use	0.025***	0.002	0.024***	0.002	0.014***	0.002
Individual Variable						
Alcohol Drink	0.020***	0.002			0.011***	0.002
Cigarette Smoke	0.400***	0.031			0.284***	0.030
Age	-0.009	0.039			-0.002	0.038
Black	0.024	0.061			0.084	0.061
Hispanic	0.201***	0.050			0.099*	0.049
Gender	0.087*	0.039			0.100**	0.038
Environmental						
Peer Influence			0.547***	0.015	0.488***	0.016
Parental Control			-0.123***	0.031	-0.015	0.034
Adjusted R-square	0.053		0.096		0.104	

Table 2. Comparative Multiple Regression of Youth HDU. Model 1 includes only individual control variables, Model 2 includes only environmental control variables, and Model 3 includes both individual and environmental control variables. Multiple linear regression models were introduced to analyze the given variables. The b values indicate the slopes in the regression equations, and the SE values are the standard error values. Significance of each slope indicated as:* p < 0.05, ** p< 0.01, *** p < 0.001.

2018, with an average difference of 1.01 in HDU. Overall, the average HDU for marijuana non-users was 0.04, while that for marijuana users was 0.69, which was 19 times greater than that of non-users (**Figure 1**). While the number of HDUs for non-users was substantially low, the HDU difference between non-users and users was large enough to be significant (p < 0.001).

The annual changes in average HDU from 2010 to 2019 showed similar temporal patterns between marijuana users and non-users (**Figure 1**). In 2017, both groups showed the highest HDU averages, and when the HDU average for marijuana users decreased, that of marijuana non-users also declined between 2012 and 2015. Contrary to our expectations, these temporal patterns did not show any consistent changes as more states legalized marijuana use.

Significant Youth Marijuana Use Effect on HDU

The limitation of the comparison of HDU averages is that these differences could be caused by other individual and environmental differences between marijuana users and non-users. To address this limitation and examine our second hypothesis about the effect of marijuana use on HDU after controlling for individual and environmental variables, we introduced individual and environmental variables and ran comparative multiple regressions with multiple models (**Table 2**).

We tested our second hypothesis by controlling for individual variables, such as *Alcohol Drink*, *Cigarette Smoke*, and demographic characteristics. By controlling for the effects of these variables, we account for their potential confounding effects. The results from the multiple regression showed that *Marijuana Use* increased youth HDU significantly after controlling for the individual variables (p < 0.001) (**Table 2**). The slope of 0.025 indicated that when marijuana use increased by one, the expected number of youth HDUs also increased by 0.025. In addition to *Marijuana Use*, *Alcohol Drink* and *Cigarette Smoke* also significantly elevated youth HDU (p < 0.001). The analysis of demographic variables showed that Hispanic youths retained a significantly higher average of HDU than white youths (p < 0.001), and male youths had a higher HDU average than females (p < 0.05) (**Table 2**).

Next, we examined our hypothesis by introducing only environmental control variables (**Table 2**). The results showed that *Marijuana Use* still significantly influenced youth HDU (p < .001). In addition, both *Peer Influence* and *Parental Control* variables were also found to have significant relationships with youth HDU (p < .001) (**Table 2**). The slope of peer influence showed that when the number of friends using high-risk drugs increased by one, the expected number of youth HDU increased by 0.547. On the contrary, the negative slope of *Parental Control* indicated that youths living with both parents had a significantly lower number of HDUs than those living with single or no parents (p < 0.001) (**Table 2**).

In the last step of our analysis, we introduced both individual and environmental variables to the analysis (**Table 2**). The results were consistent with the models using either individual or environmental variables alone, except for *Parental Control*. After controlling for individual variables, *Parental Control* was not significant at any given significance level (**Table 2**). The adjusted R2 value of the last model was 0.104, which was greater than those from Model 1 and Model 2 (**Table 2**). This result indicated that Model 3 explained the greatest amount of variance of HDU among all three analyses after adjusting for the number of variables.

DISCUSSION

In this study, we aimed to examine the effect of youth marijuana use on youth HDU. There are two main conflicting hypotheses as to the nature of this relationship: the gateway and substitution hypotheses. While the gateway hypothesis posits that youth marijuana use boosts their HDU (18, 19), the substitution hypothesis postulates the opposite effect of youth marijuana use on HDU (24). For our examination of these hypotheses, we proposed two hypotheses and analyzed nationally representative youth survey data from 2010 to 2019 by comparative analysis and multiple regression.

The comparative analysis of youth HDU between marijuana users and non-users demonstrated that youth HDU was significantly and consistently more prevalent among

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marijuana users from 2010 to 2019. These findings indicate that youth marijuana users are more involved in HDU, as predicted by the gateway perspective. These findings are consistent with previous studies on the effect of marijuana use (12, 18, 22).

As for the empirical findings supporting the gateway perspective, studies supporting the substitution hypothesis pointed out that the relationship between youth marijuana use and HDU can be spurious and influenced by other third factors (27). For example, the higher levels of marijuana use and HDU may be caused by individual characteristics, such as the inclination to use substances, and environmental characteristics, including peer influence and lack of parental control (32). To address this limitation of comparative analysis, the current study introduced three hypotheses and ran multiple regressions with individual and environmental variables.

The results from the comparative multiple regressions also strongly support the gateway hypothesis; youth marijuana use may significantly influence their HDU after controlling for individual and environmental variables. In addition to this finding, the current study finds that alcohol use, cigarette smoking, and peer influence also significantly increase youth HDU. These findings imply that youths under the influence of other substances and peer pressure are significantly more involved in HDU. Demographic variables are also associated with HDU, with male and Hispanic youths retaining significantly higher averages than their female and white youths.

While these findings of the current study are consistent with previous studies and the gateway hypothesis, some limitations should be noted. First, our analyses include only the data of 12th graders; therefore, our findings on gateway effects may be different in other age groups. Our analyses are also limited in the study scope; they include only the previous 12-month experience. Correspondingly, the lifetime gateway effect on HDU is not present in this study. Second, the MFCSAY data do not include other types of high-risk drugs, including prescription drugs, ecstasy, and methamphetamines (28). Therefore, the youth consumption of these high-risk drug use is not examined in our analyses. Third, the MFCSAY data are collected in the US; therefore, our findings may have limited external validity for other countries (28). Fourth, the analysis of this study employs a cross-sectional approach, which does not address the longitudinal effects of marijuana use on youth HDU. Therefore, the findings of the current study do not address the temporal order between youth marijuana use and their HDU. Lastly, while we introduce multiple control variables, there still exist other possible third factors that can influence both youth marijuana use and their HDU (32). For example, studies have found that individual personalities, such as poor self-control and higher risk-taking, are also associated with youth substance use (33). Moreover, additional social and cultural factors, such as the drug use of family members, can also influence their HDU (34). However, the current study does not control for these factors in the analyses. We expect future studies to extend our study by analyzing data with a broader age range, longer analysis period, more types of high-risk drug use, other countries' data, longitudinal collection, and more individual and social/cultural variables.

In conclusion, our findings support that youth marijuana use may have a gateway effect on youth HDU, with youths who experience marijuana use being more likely to use high-risk drugs. Moreover, our findings indicate that alcohol and cigarette use have the same gateway effects. Therefore, it is important to regulate both youth HDU and non-HDU to prevent youth HDU. Accordingly, our findings suggest that policymakers in the US should pay close attention to the possible direct and indirect effects of legal and administrative policies on youth marijuana, cigarette, and alcohol use and their gateway effects on HDU.

METHODS

Data

For the empirical examination of the hypotheses, this study analyzed ten-year nationwide representative youth survey data of the MFCSAY study from 2010 to 2019 (28). The MFCSAY study was administered by the Institute for Social Research located at the University of Michigan and supported by the National Institute on Drug Abuse (28). The MFCSAY study collected survey data about high school seniors' non-HDU and HDU experiences, as well as their lifestyles and behaviors, every year since 1975 (28). While the MFCSAY study did not employ a panel structure where the same students were repeatedly surveyed, this non-panel structure allowed us to identify macro-level descriptive changes in youth HDU (28).

For the sampling process, the MFCSAY study randomly selected geographical areas using the primary sampling units developed by the Sampling Section of the Survey Research Center (28). In the next stage, one or more high schools in each area were selected (28). In the final step, seniors in the selected high schools were surveyed. For those schools that retained fewer than 350 seniors, the MFCSAY included all the seniors (28). In larger schools, subsets of seniors were sampled for surveys (28). For this study, the datasets were secured from the Inter-university Consortium for Political and Social Research (ICPSR) database. From 2010 to 2019, a total of 23,063 students were surveyed.

Variables

High-risk Drug Use (HDU). According to the CDC, HDU is defined as any use of substances by youths with a high risk of adverse outcomes, such as injury, criminal justice involvement, school dropout, or loss of life (13). As examples of high-risk drugs, the CDC presented cocaine, heroin, methamphetamines, inhalants, hallucinogens, and ecstasy (13). Among these drugs, the MFCSAY investigated how many times respondents used LSD, crack, cocaine, or heroin in the last 12 months (28). Therefore, we operationalized youth HDU as the sum of the frequencies of using LSD, crack, cocaine, or heroin in the last 12 months.

Marijuana Use. To examine the effect of marijuana use on HDU, we measured two variables from one MFCSAY survey item: "how many occasions (if any) have you used marijuana (grass, pot) or hashish (hash, hash oil) during the last 12 months?" Respondents were given answer choices of 0 occasions, 1-2 times, 3-5X, 6-9X, 10-19X, 20-39X, or 40+ occasions (28). First, this study operationalized a binary variable, which showed whether or not a respondent used marijuana during the last 12 months. This variable was introduced to identify if there was any significant HDU difference between marijuana users and non-marijuana

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users. Second, we also introduced a scale variable, which determined the number of times a respondent used marijuana during the last 12 months. The lowest number of marijuana uses for each answer category was recorded for the analysis (i.e., "40" for "40+ occasions").

Alcohol Drink. Studies on the risk factors of youth drug abuse consistently report that youths who drink alcohol have a significantly higher likelihood of using illegal drugs (35). To control for alcohol as a risk factor, our study employed the MFCSAY survey item, "On how many occasions have you had alcoholic beverages to drink during the last 12 months?" Again, respondents were given answer choices of (i) 0 occasion, (ii) 1-2X, (iii) 3-5X, (iv) 6-9X, (v) 10-19X, (vi) 20-39X, and (vii) 40+ occasion, and the lowest number of each category was introduced for the analysis (28).

Cigarette Smoke. In addition to alcohol drink, cigarette smoking was also found to be a strong predictor of youth illicit drug use in previous studies (36). To measure respondents' cigarette smoking, we introduced the MFCSAY survey question, "How frequently have you smoked cigarettes during the past 30 days?" Respondents were given answer choices of (i) not at all, (ii) less than one/day, (iii) 1-5/day, (iv) ½ pack/day, (v) 1 pack/day, (vi) 1 ½ pack/day, or (vii) 2+ packs/day (28). Therefore, higher values in our model indicated heavier cigarette smoking.

Demographic Characteristics. The effect of demographic characteristics of youths, such as age, gender, and race, are frequently investigated in studies of youth drug use (37). We also introduced *age*, *gender*, and *race* demographic variables to address the differentiating effects of these characteristics. As all respondents in the data were high school seniors, *age* was measured as a dichotomous variable with (i) under 18 and (ii) 18 or older (0 = under 18). *Gender* was also introduced as a binary variable with a reference category of female. As for *race*, the MFCSAY identified only three categories: (i) black, (ii) white, and (iii) Hispanic (28). Therefore, we operationalized two dummy variables with a reference category of white.

Peer Influence. Peer influence has been identified as one of the most important risk factors for youth drug use (38). As there was no question about peer influence in the MFCSAY study, this study used three proxy questions: "During the last 12 months, how often have you been around people who were taking each of the following to get high? (i) Cocaine, (ii) LSD, and (iii) Heroin." For each question, a respondent was given answer choices of (i) Not at all (= 0), (ii) 1-2X, (iii) Occasionally, and (iv) Often (28). To operationalize the *peer influence* variable, we summed a respondent's answers for these three questions; therefore, the higher value indicated that the corresponding respondent was under greater peer influence.

Parental Control. Studies have presented that all types of parental controls retained negative effects on youth drug use significantly (39). The notion of parental controls indicated how much parents monitored and supervised their children (39). However, the MFCSAY study did not measure how much respondents were under parental control (28). Therefore, we employed proxy measures of parental control with two questions: "Which of the following people live in the same household with you? (i) Father and (ii) Mother." We summed up respondents' answers, and the attributes of parental control indicated (i) 0 = living with no parent, (ii) 1 = living with a single parent, and (iii) 2 = living with both parents. We hypothesized that this variable would show how youth HDU is influenced by the number of parents in the youth's household.

Analytical Approach

For the analysis of the data, we employed the comparative multiple regression. For the first two regression models, we only added either individual or environmental control variables. For the last regression model, we introduced all the variables to our analyses together (**Figure 2**). This comparative approach allowed us to examine which set of variables explained the HDU better. The multiple regression meant that we analyzed the effect of marijuana use while considering the effects of other control variables. All analyses were conducted using the IBM SPSS Statistics Ver.21 program.

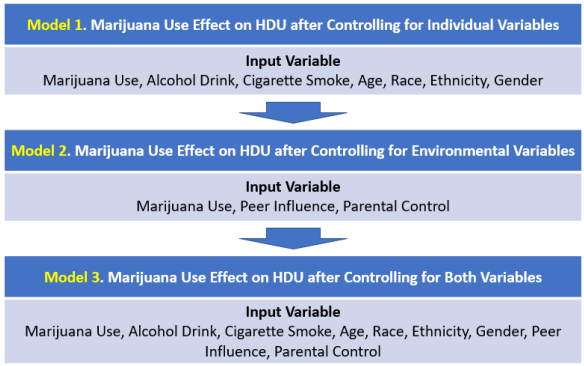

Figure 2. Comparative Multiple Regression Analysis. We introduced three models to clarify the marijuana effects on HDU after various control variables. In the first stage, we controlled for individual variables. In the second stage, we controlled for environmental variables. In the last stage, we introduced both control variables. The R^2 values are 0.053 for Model 1, 0.096 for Model 2, and 0.104 for Model 3, indicating that Model 3 explains the variation of HDU more than the other two models.

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REFERENCES

1. O'Connell, M.E. et al. "Preventing Mental, Emotional, and Behavioral Disorders Among Young People: Progress and Possibilities." National Academies Press, Washington DC, 2009.
2. Kim, S. et al. "Toward a new paradigm in substance abuse and other problem behavior prevention for youth: Youth development and empowerment approach." *Journal of Drug Education*, vol. 28, no. 1, 1998, pp. 1-17, https://doi:10.2190/5et9-x1c2-q17b-2g6d.
3. United Nations. "Global issues: Youth." United Nations. www.un.org/en/global-issues/youth. Accessed February 3, 2024.
4. CDC. "High-risk substance use among youth." www.cdc.gov/healthyyouth/substance-use/index.htm. Accessed February 3, 2024.
5. Underwood, J.M. et al. "Overview and methods for the youth risk behavior surveillance system—United States, 2019." *MMWR Supplements*, vol. 69, no. 1, 2020, p. 1, https://doi.org/10.15585/mmwr.su6901a1.

https://doi.org/10.59720/23-308

6. NCDAS. "Drug use among youth: Facts & statistics." drugabusestatistics.org/teen-drug-use/. Accessed 21 Oct. 2023.
7. Johnston, L.D. et al. "Monitoring the future national survey results on drug use, 1975-2021: Overview, key findings on adolescent drug use." Institute for Social Research, University of Michigan, Ann Arbor, 2022.
8. Skeen, S. et al. "Adolescent mental health program components and behavior risk reduction: A meta-analysis." *Pediatrics*, vol. 144, no. 2, 2019, https://doi.org/10.1542/peds.2018-3488.
9. Busby, D.R. et al. "Evidence-based interventions for youth suicide risk." *Current Psychiatry Reports*, vol. 22, 2020, pp. 1-8, https://doi.org/10.1007/s11920-020-1129-6.
10. Sharp, A. et al. "Relationship between substance use, bullying, and other delinquent behaviors among high school students: A secondary analysis of the Florida youth substance abuse survey." *The Journal of Behavioral Health Services & Research*, vol. 46, 2019, pp. 570-585, https://doi.org/10.1007/s11414-019-09649-5.
11. Nelson, J. et al. "Facing addiction in America: The surgeon general's report on alcohol, drugs, and health: A commentary." *Alcoholism Treatment Quarterly*, vol. 35, no. 4, 2017, pp. 445-454, https://doi.org/10.1080/07347324.2017.1361763.
12. Sheehan, M. et al. "Who comes for treatment: Drug misusers at three London agencies." *British Journal of Addiction*, vol. 83, no. 3, 1988, pp. 311-320.
13. CDC. "Youth high-risk drug use." www.cdc.gov/healthyyouth/substance-use/hrsu.htm. Accessed Dec 12, 2023.
14. Chu, L.Y.-W. "Do medical marijuana laws increase hard drug use?" *Journal of Law & Economics*, vol. 58, no. 2, 2015, pp. 481-517, https://doi.org/10.1086/684043.
15. Johnson, B.D. et al. "Drug abuse in the inner city: Impact on hard-drug users and the community." *Crime and Justice*, vol. 13, 1990, pp. 9-67, https://doi.org/10.1086/449172.
16. Swadi, H. "Individual risk factors for adolescent substance use." *Drug and Alcohol Dependence*, vol. 55, no. 3, 1999, pp. 209-224.
17. Lloyd, C. "Risk factors for problem drug use: Identifying vulnerable groups." *Drugs: education, prevention and policy*, vol. 5, no. 3, 1998, pp. 217-232.
18. DeSimone, J. "Is marijuana a gateway drug?" *Eastern Economic Journal.*, vol. 24, no. 2, 1998, pp. 149.
19. Cleveland, H.H. et al. "Understanding the association between adolescent marijuana use and later serious drug use: Gateway effect or developmental trajectory?" *Development and Psychopathology*, vol. 20, no. 2, 2008, pp. 615-632, https://doi.org/10.1017/S0954579408000308.
20. Bachhuber, M.A. et al. "Medical cannabis laws and opioid analgesic overdose mortality in the United States, 1999-2010." *JAMA Internal Medicine*, vol. 174, no. 10, 2014, pp. 1668-1673, https://doi.org/10.1001/jamainternmed.2014.4005.
21. Kleiman, M.A.R. "Against excess: Drug policy for results." BasicBooks, 1993.
22. Kandel, D.B. "Stages and Pathways of Drug Involvement: Examining the Gateway Hypothesis." Cambridge University Press, 2002.
23. Melberg, H.O. et al. "Is cannabis a gateway to hard drugs?" *Empirical Economics*, vol. 38, no. 3, 2010, pp. 583-603, https://doi.org/10.1007/s00181-009-0280-z.
24. Ishida, J.H. et al. "Substitution of marijuana for opioids in a national survey of us adults." *Plos One*, vol. 14, no. 10, 2019, p. e0222577, https://doi.org/10.1371/journal.pone.0222577.
25. Aspy, C.B. et al. "The influence of assets and environmental factors on gender differences in adolescent drug use." *Journal of Adolescence*, vol. 37, no. 6, 2014, pp. 827-837, https://doi.org/10.1016/j.adolescence.2014.05.006.
26. Novak, S.P. et al. "How beliefs about substance use differ by sociodemographic characteristics, individual experiences, and neighborhood environments among urban adolescents." *Journal of Drug Education*, vol. 32, no. 4, 2002, pp. 319-342, https://doi.org/10.2190/gj7d-n0kf-nw64-klw0.
27. Jorgensen, C. et al. "Is marijuana really a gateway drug? A nationally representative test of the marijuana gateway hypothesis using a propensity score matching design." *Journal of Experimental Criminology*, vol. 18, no. 3, 2022, pp. 497-514, https://doi.org/10.1007/s11292-021-09464-z.
28. Miech, R.A. et al. "Monitoring the future: A continuing study of American youth (12th-grade survey)." Inter-university Consortium for Political and Social Research, 2020.
29. Bailey, J.A. et al. "Marijuana legalization and youth marijuana, alcohol, and cigarette use and norms." *American Journal of Preventive Medicine*, vol. 59, no. 3, 2020, pp. 309-316, https://doi.org/10.1016/j.amepre.2020.04.008.
30. Ammerman, S. et al. "The impact of marijuana policies on youth: Clinical, research, and legal update." *Pediatrics*, vol. 135, no. 3, 2015, pp. e769-e785, https://doi.org/10.1542/peds.2014-4147.
31. USAFACTS. "How has the population changed in the US?" usafacts.org/data/topics/people-society/population-and-demographics/our-changing-population/. Accessed Dec 21, 2023.
32. Tucker, J.S. et al. "Predictors of opioid misuse during emerging adulthood: An examination of adolescent individual, family, and peer factors." *Drug and Alcohol Dependence*, vol. 214, 2020, https://doi.org/10.1016/j.drugalcdep.2020.108188.
33. Leimberg, A. et al. "Unstructured socializing with peers, low self-control, and substance use." *International Journal of Offender Therapy and Comparative Criminology*, vol. 66, no. 1, 2022, pp. 3-27, https://doi.org/10.1177/0306624X20967939.
34. Nawi, A.M. et al. "Risk and protective factors of drug abuse among adolescents: A systematic review." *BMC Public Health*, vol. 21, no. 1, 2021, pp. 1-15, https://doi.org/10.1186/s12889-021-11906-2.
35. Kirby, T. et al. "Alcohol as a gateway drug: A study of us 12th graders." *Journal of School Health*, vol. 82, no. 8, 2012, pp. 371-379, https://doi.org/10.1111/j.1746-1561.2012.00712.x.
36. Lewinsohn, P.M. et al. "Level of current and past adolescent cigarette smoking as predictors of future substance use disorders in young adulthood." *Addiction*, vol. 94, no. 6, 1999, pp. 913-921, https://doi.org/10.1046/j.1360-0443.1999.94691313.x.
37. McDermott, M.J. et al. "Prevalence and sociodemographic correlates of lifetime substance use among a rural and diverse sample of adolescents." *Substance Abuse*, vol.

https://doi.org/10.59720/23-308

34, no. 4, 2013, pp. 371-380, https://doi.org/10.1080/08897077.2013.776000.
38. Henneberger, A.K. et al. "Peer influence and adolescent substance use: A systematic review of dynamic social network research." *Adolescent Research Review*, vol. 6, no. 1, 2021, pp. 57-73, https://doi:10.1007/s40894-019-00130-0.
39. Fagan, A.A. et al. "Differential effects of parental controls on adolescent substance use: For whom is the family most important?" *Journal of Quantitative Criminology*, vol. 29, no. 3, 2013, pp. 347-368, https://doi.org/10.1007/s10940-012-9183-9.