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Original Research

Associations Between Major Depressive Episodes, Sociodemographic Factors, and Past-Year Marijuana Use Among U.S. Adolescents: A Cross-Sectional Study.

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Abstract

Background: The decriminalization of cannabis in multiple states within the United States and the increasing societal approval of its non-medical consumption has notable implications for public health, particularly among the youth population. This study aimed to examine the relationship between previous major depressive episodes (MDE) and sociodemographic factors with marijuana consumption in the past year among adolescents in the United States.

Methodology: Retrospective, cross-sectional design utilizing data from the 2021 US NSDUH report. The sample consisted of 10,315 adolescents aged 12-17. The primary outcome measure was past-year daily/near-daily marijuana use (≥300 days). Chi-square test explored relationships between exposure variables and marijuana use. Logistic regression identified predictors of marijuana use. Level of significance was $p<0.05$.

Results: About half were male (51.6%), middle schoolers (54.3%), and White (50.5%). Prevalence of marijuana use and MDE was 10.4% and 19.9%, respectively. Independent associations for marijuana use include MDE (adjusted OR = 2.05; CI: 1.54-2.73; $p < 0.001$), increasing age (adjusted OR = 3.19 – 6.52; $p = 0.001$), high school education (adjusted OR=1.70; 95% CI: 1.14-2.53; $p = 0.010$), worsening general health (adjusted OR = 1.58 – 2.11; $p < 0.001$) and income levels greater than two times below the poverty threshold (aOR = 2.30; 95% CI: 1.22 - 4.32; p=0.011).

Conclusion: The findings from this study are fundamental for health promotion efforts and intervention programs to reduce the occurrence of depression and marijuana use in adolescents. However, although the findings of the study may be generalized to the US population, the primary outcome measure of ≥300-day past-year daily/near-daily marijuana use may exclude occasional users with heavy cannabis consumption on a less frequent basis who are also at risk of developing adverse cannabis effects, including cognitive deficits and cannabis use disorder.

Keywords: Major Depressive Episodes; Marijuana Use; Sociodemographic Variables; Adolescents.

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Introduction

Adolescence is an important period that transitions children into adulthood, using new and old knowledge and skills, learning to manage new and old emotions and relationships, and acquiring qualities and talents that are essential for adulthood. Marijuana, which consists mostly of 9-tetrahydrocannabinol (9-THC), a psychoactive constituent of cannabis, is the most frequently used psychoactive narcotic among US adolescents who seek help for substance use [1]. Between 1937 and 1960, there was heavy regulation of marijuana, with the institution of federal laws that criminalized not only its possession, sale, use, and purchase, but also its cultivation, and put in place stiff penalties that were disproportionate in their impact on African American communities compared to White neighborhoods [2]. However, since the 1960s, there has been a steady trend to decriminalize marijuana use, with medical marijuana laws passed by 33 states of the USA and recreational marijuana laws in eleven states so far [3]. About three-fifths of first-time marijuana users are 12 to 20 years old [4]. Among the approximately nineteen million individuals who self-reported using marijuana in 2021, 5.25 million were adolescents (12–17 years old), making up 10.5% of the total. Among the fifty states of the USA, Rhode Island has the highest prevalence of past-month marijuana use at 18.7%, and Utah and Louisiana tied at the lowest prevalence of 6.3% [4]. Also, a third of recent marijuana users were of American Indian heritage, with around 20% of the affected population being White and 20% being African American [4]. Adolescent marijuana use is linked to short and long-term cognitive deficits, poor educational and vocational outcomes, mental health disorders (such as psychosis, suicide ideation, and depression), traffic accidents, emergency department visits, police arrests, and increased risk-taking such as unprotected sex and involvement in other psychoactive substance use [1,5]. Infrequent use of marijuana may not necessarily result in adverse effects, but the risk of harmful use still exists regardless of the frequency of marijuana use [6]. Public health concerns on marijuana use are not limited to the user but also to non-marijuana users harmed by the adverse effects of marijuana use, such as increased risk of traffic accidents, interpersonal violence, exposure to hazardous, potentially carcinogenic emissions in marijuana smoke (second-hand smoke), and adverse pregnancy outcomes, including preterm births and neurocognitive congenital disabilities [7].

During the period of mid-to-late adolescence, approximately fifteen percent of US teenagers experience at least one major depressive episode (MDE) [8]. The relationship between marijuana and the occurrence of MDE is complex. Reporting from a 5-year longitudinal study, Gukasyan et al. reported reduced rates of depression in adolescents aged 12-17 who used cannabis more frequently compared to those who used it less frequently [9]. Troup et al. also reported similar findings [10]. Gilder et al. reported that more frequent use of cannabis by adolescents aged 12 – 17 years, followed up over five years, was associated with higher rates of depression, in contrast to lower rates reported by Gukasyan et al and Troup et al [11]. Leadbeater et al, in their prospective study exploring the association between cannabis use and mental health disorders, concluded that the relationship was non-linear because of the episodic nature of mental health disorders in the sample population [12].

It is suggested that the shared underlying risk factors for MDE and marijuana use, including sociodemographic determinants, may be responsible for difficulties in assessing a direct linear relationship between MDE symptoms and marijuana use [13].

The first issue identified as a basis for this study is the question of marijuana use in 12 to 17-year-old adolescents and the relationship between marijuana use and depression and sociodemographic variables. Socioeconomic inequalities, gender-based discrimination, racial/ethnic discrimination, prejudice, bullying, victimization, and various forms of violence are all risk factors for adolescent depression and marijuana use [1,14]. Socioeconomic inequalities limit access to healthy recreational activities that provide the pleasure sought by adolescents in substance use [15]. Racial and gender differences are documented in the prevalence rates of MDE, with girls and African Americans showing the greatest increases in prevalence rates from 2009 to 2019 [8,14]. Reasons for gender and racial differences in

depression trends include bullying, gender-based discrimination, and violence, which are likely to impact girls more than boys. Also, African Americans have historically been subject to racial discrimination and systemic racism, which may account for their increasing rates of depression [8].

The second issue identified as the basis for this research study is the lack of large-scale studies assessing the association of major depressive episodes and socio-demographic variables on marijuana use among adolescents, especially those as young as 12 years old. Depression is a leading cause of disability worldwide, and the prevalence rates of MDE have been increasing in adolescents from 8.1 percent in 2009 to 20.1 percent in 2021 [4,14]. Reports on the association between marijuana use and depression is mixed, with some reports of marijuana use linked to the development of depression; in contrast, other reports suggest no association after adjustments for sociodemographic and economic indicators [16, 17].

There are indications that adolescents self-medicate with marijuana to reduce depressive symptoms. Adolescent (or earlier) onset depression has a more recurring course, with worse outcomes than adult-onset depression, including the persistence of significant psychological, social, and economic consequences throughout their lifetime [14].

The specific objectives of this study were to: Assess the prevalence of the use of marijuana on a daily or near-daily basis among US adolescents; determine associated factors such as major depressive episodes (MDE) and sociodemographic variables and assess the association of socio-demographic factors and major depressive episodes with marijuana usage among adolescents in the United States.

The three research questions for this study were as follows: What is, the prevalence of marijuana use on a daily or near-daily basis among US adolescents aged 12 to 17 years? Is there a relationship between MDE and marijuana use in adolescents? And what factors are associated with marijuana use among US adolescents aged 12 to 17 years?

For this study, the following hypotheses were assumed: There is a relationship between MDE and past-year marijuana use among US adolescents aged 12 to 17 years and There is a relationship between socio-demographic variables and economic indicators with past-year marijuana use among US adolescents aged 12 to 17 years.

Materials and Methods

Study Area

The United States of America is the third-largest country globally, both in population and land area. The country is situated in North America and is bound on the west and east by the Pacific Ocean and Atlantic Ocean, respectively. Canada lies along its northern border, while Mexico is on its southern border. In 2019, there were almost 42 million adolescents in the United States, and adolescents comprised almost 13 percent (12.8 percent) of the population [18].

Study Design

This retrospective descriptive study design used secondary data from the National Survey on Drug Use and Health (NDSUH) 2021 Survey [4].

Study Population

The population of interest extracted from the nationally representative 2021 NSDUH survey were individuals with stable residency in housing units, not in a disciplinary or institutional setting, and 12 to 17 years of age distributed throughout the 50 states and the District of Columbia. Data was collected using in-person and web interviews (due to the COVID-19 pandemic) following informed consent by the respondents. The NSDUH survey excluded individuals in institutional facilities, such as mental institutions or correctional facilities, and individuals without a permanent household address, such as homeless or displaced individuals not living in shelters [4].

Sample Size

The sample size for this study was 10,315 adolescents aged 12 – 17 years who had complete data during the 2021 NSDUH survey. They were extracted from the 16,876 adolescents participating in the 2021 NSDUH survey.

Sampling Technique

The NSDUH 2021 survey utilized an independent, multistage probability sampling technique coordinated throughout all the states in the US.

Data Collection

Secondary data extracted from the 2021 NSDUH for the present research included data from all adolescents 12 to 17 years of age with variables of interest. These variables were the occurrence of MDE, marijuana use, and sociodemographic characteristics, which include age, gender, education level, race, family income, poverty level, and perception of overall health. Data was checked for completeness, and the records for 10,315 adolescents with complete data for the variables of interest were extracted for data analysis.

Variable

The independent variable for the present study was marijuana use in the past year. An adolescent was considered to use marijuana if there was a daily or near-daily consumption of marijuana (≥300 days in the past year). The variable of interest for the present study was past year major depressive episodes (MDE). Past-year Major Depressive Episode (MDE) was defined as a participant reporting that they had experienced at least five out of nine symptom criteria for MDE in the same two-week period within the past year. These symptoms include difficulties with sleeping, loss of appetite, energy loss/fatigue, a sense of worthlessness, and recurrent suicidal ideations or thoughts of death. At least one of the criteria must be a depressed mood or a loss of interest/pleasure in daily activities during this period [4].

The present study further analyzed the prevalence of MDE, and marijuana use in the study sample as well as differences among three age categories: 12-13, 14-15, and 16-17. Other covariates were sociodemographic characteristics and economic indicators, including gender, education level, race, family income, poverty level, and perception of overall health.

Statistical analysis

The researcher analyzed data of 10,315 adolescents aged 12-17 years retrieved from NSDUH 2021 publicly available data using Stata 14. Frequencies and percentages summarized the categorical variables. The prevalence of marijuana use was calculated as the proportion of adolescents who used marijuana daily or near-daily marijuana use (≥300 days) in the past year. The prevalence of MDE was calculated as the proportion of adolescents with MDE using the DSM-IV criteria. Using the chi-square test of proportion, the relationship between marijuana use and MDE and sociodemographic characteristics was investigated. To identify predictors, a weighted binary logistic regression analysis was conducted to evaluate the association between marijuana usage and major depressive episode (MDE) within the previous year. In the univariate logistic regression analysis, the dependent variable was tested against the independent factors like past year major depressive episode (MDE), age, gender, race, education level, educational level, family income, and poverty level of participating adolescents. Variables whose relationship with marijuana use was significant statistically ($p< 0.05$) were introduced into a predictive model in the multivariate logistic regression analysis. Variables with p-value < 0.05 were identified as predictors. The level of significance in the study was $p< 0.05$.

Ethics

The author utilized data that was publicly available from NSDUH, which is the U.S. National Survey on Drug Use and Health. Collection protocols for NSDUH data were reviewed and approved by RTI International's Institutional Review Board (IRB). RTI International is the organization responsible for conducting the NSDUH survey on behalf of the Substance Abuse and Mental Health Services Administration (SAMHSA. CIPSEA, which is the Confidential Information Protection and Statistical Efficiency Act of 2002, authorizes the collection of data under strict confidentiality of participants' responses and prohibits data use for non-statistical purposes. Anonymity of public use files (PUFs) through disclosure avoidance methods was also utilized before de-identified data was released to protect

the privacy of the individual respondents. Therefore, the data used for this study, being publicly available secondary de-identified data, was determined as not constituting human subjects research and therefore did not require a separate IRB review and approval from the author's institution.

Results

Table 1 describes the sociodemographic characteristics, major depressive episodes, and marijuana use of the study sample. Among the total participants in this study, 1,054 adolescents (10.4%) reported marijuana use in the past year. 2,026 adolescents (19.9%) reported the occurrence of a major depressive episode in the past year. Over half of the sample comprised males (51.6%), middle schoolers (54.3%), and Whites (50.5%). About one in five participants (20.3%) were living at the poverty level, while most participants (46%) were from families with over seventy-five thousand dollars annually. Only 5% of the participants had poor or fair health conditions, while the rest reported either good (23.2%), very good (38.4%), or excellent (33.3%) health conditions.

Table 1. Descriptive statistics of the study sample, adolescents aged 12-17, National Survey on Drug Use and Health (NSDUH), 2021

Variables	Frequency n = 10,315	Percent
Dependent variable		
Marijuana use in the past year		
Yes	1,054	10.4
No	9,261	89.6
Independent variable of interest:		
Major depressive episode in the past year		
Yes	2,026	19.9
No	8,289	80.1
Demographic indicators:		
Gender		
Male	5,316	51.6
Female	4,999	48.4
Age		
12-13	3,465	34.3
14-15	3,451	32.4
16-17	3,399	33.4
Race		
Whites	5,248	50.5
Blacks	1,440	13.7
Hispanics	1,266	10.3
Others	2,361	25.4
Education		
Middle school student	5,619	54.3
High school student	4,696	45.7
General Health Condition		
Excellent	3,345	33.3
Very good	4,012	38.4
Good	2,374	3.2
Fair/poor	584	5.0
Family Income		
Less than $20k	1,489	14.1
$20,000-$49,999	2,585	26.5
$50,000-$74,999	1,397	13.1
$75,000+	4,844	46.3
Poverty level		
Living at the poverty level	2,047	20.3
Income up to two times below the poverty threshold	2,151	21.7
Income more than two times below poverty	6,117	58.0

Threshold		
Total sample	**10,315**	**100.0**

As shown in Table 2, the occurrence of major depressive episodes was significantly related to marijuana use ($\chi2 = 75.97$; $p<0.001$). One in every five adolescents (20.0%) who had a major depressive episode used marijuana in the past year, while less than a tenth (8.0%) of those without major depressive episodes used marijuana. Gender ($\chi2 = 6.87$; $p = 0.012$), age ($\chi2 = 237.16$; $p<0.001$), education ($\chi2 = 163.60$; $p<0.001$), and general health ($\chi2 = 29.35$; $p<0.001$) were also significantly related to marijuana use. A significantly higher number of female adolescents (594 – 11.6%) than male adolescents (460 – 9.2%) used marijuana. Six hundred and eighty-one late adolescents (20.6%) used marijuana compared to only 59 early adolescents (2.1%) who used marijuana. Family income ($\chi2 = 2.45$; $p = 0.508$), race ($\chi2 = 1.79$; $p = 0.635$), and poverty level ($\chi2 = 4.43$; $p = 0.125$), however, did not have a significant relationship with marijuana use.

Table 2. Bivariate relationship between past-year major depressive episode and demographic characteristics with marijuana use in the past year among youths aged 12-17, National Survey on Drug Use and Health (NSDUH), 2021

Variables	Marijuana use in the past year				Chi-square Test	p-value
	No		Yes			
	N	%	N	%		
Independent variable of interest:						
Major depressive episode in the past year					75.97	<0.001
Yes	1620	80.0	406	20.0		
No	7641	92.0	648	8.0		
Demographic indicators:						
Gender					6.87	0.012
Male	4856	90.8	460	9.2		
Female	4405	88.4	594	11.6		
Age					237.16	<0.001
12-13 years	3406	97.9	59	2.1		
14-15 years	3137	91.4	314	8.6		
16-17 years	2718	79.4	681	20.6		
Race					1.79	0.635
Whites	4690	89.2	558	10.8		
Blacks	1288	89.9	152	10.1		
Others	1138	88.9	128	11.1		
Hispanics	2145	90.6	216	9.4		
Education					163.60	<0.001
Middle school student	5399	96.1	220	3.9		
High school student	3862	81.9	834	18.1		
General Health Condition					29.35	<0.001
Excellent	3132	93.0	213	7.0		
Very good	3568	89.0	444	11.0		
Good	2080	87.3	294	12.7		
Fair/poor	481	83.1	103	16.9		
Family Income					2.45	0.508
Less than $20,000	1346	90.4	143	9.6		
$20,000-$49,999	2299	90.1	286	9.9		
$50,000-$74,999	1243	87.9	154	12.1		
$75,000+	4373	89.6	471	10.4		

Poverty level					4.43	0.125
Living at the poverty level	1854	91.3	193	8.7		
Income up to two times below the poverty threshold	1918	90.4	233	9.6		
Income more than two times below poverty threshold	5489	88.8	628	11.2		

As shown in Table 3, in the unadjusted model, adolescents with major depressive episodes had about three times the odds of marijuana use compared to adolescents without major depressive episodes (OR = 2.88; 95% CI: 2.30 - 3.60; p<0.001). The odds of reporting marijuana in the past year were about four times higher in youths aged 14-15yrs (OR = 4.34; 95% CI: 2.99 - 6.32; p<0.001) and nearly 12 times higher in youths aged 16-17 (OR = 11.98; 95% CI: 8.34 - 17.21; p<0.001) than adolescents in the reference category (12 – 13 years). The odds of reporting marijuana use in the past year were significantly higher among high schoolers compared to middle schoolers (OR = 5.48; 95% CI: 4.32 - 6.96; p<0.001). The female gender had 30% higher odds of marijuana use compared to males in the unadjusted model (OR=1.30; 95% CI: 1.07 - 1.58; p = 0.010), but this difference disappeared with the adjusted model. There is a significantly increasing odds (OR= 1.66 – 2.72; p<0.001) of marijuana use as the general health condition of adolescents worsens. Poverty levels, income categories, and race did not show a statistically significant relationship with marijuana use in the unadjusted model. The adjusted model (adjusted for major depressive episodes, age, gender, education, race, general health condition, family income, and poverty level) shows that MDE is an independent associated factor for marijuana use (aOR = 2.05; 95% CI: 1.54 - 2.73; p<0.001). Age (aOR = 3.19 - 6.52; p<0.001), high school education (aOR = 1.70; 95% CI: 1.14 - 2.53; p = 0.010), worsening general health conditions (aOR = 1.58 – 2.11; p<0.001), and income levels greater than two times below the poverty threshold were also independently associated with marijuana use (aOR = 2.30; 95% CI: 1.22 - 4.32; p=0.011). However, other income categories and race did not independently associate with marijuana use.

Table 3. Odds ratios with confidence intervals of the logistic regression estimates for the relationship between past-year major depressive episodes and past-year marijuana use among youths aged 12-17 years, National Survey on Drug Use and Health (NSDUH), 2021.

Covariates	**Model 1 (unadjusted)**		**Model 2 (adjusted)**	
	OR	**95% CI**	**aOR**	**95% CI**
Independent variable of interest:				
Major depressive episode in the past year				
No (RC)	1.00	-	1.00	-
Yes	2.88***	2.30 - 3.60	2.05***	1.54 - 2.73
Demographic indicators:				
Gender				
Male (RC)	1.00	-	1.00	-
Female	1.30*	1.07 - 1.58	1.06	0.84 - 1.34
Age				
12-13 (RC)	1.00	-	1.00	-
14-15	4.34***	2.99 - 6.32	3.19***	2.03 - 5.00
16-17	11.98***	8.34 - 17.21	6.52***	3.68 - 11.56
Race				
Whites (RC)	1.00	-	1.00	-
Blacks	0.93	0.67 - 1.29	1.04	0.73 - 1.49
Hispanics	0.86	0.63 - 1.17	1.08	0.63 - 1.26
Others	1.03	0.66 -1.61	0.89	0.69 - 1.71
Education				
Middle school student (RC)	1.00	-	1.00	-
High school student	5.48***	4.32 - 6.96	1.70*	1.14 - 2.53

General Health Condition				
Excellent (RC)	1.00	-	1.00	-
Very good	1.66***	1.28 - 2.15	1.58**	1.19 - 2.09
Good	1.94***	1.42 - 2.67	1.81**	1.28 - 2.57
Fair/poor	2.72***	1.64 - 4.51	2.11**	1.24 - 3.62
Family Income				
Less than $20k (RC)	1.00	-	1.00	-
$20,000-$49,999	1.03	0.70 - 1.52	0.78	0.49 - 1.25
$50,000-$74,999	1.29	0.90 - 1.86	0.63	0.30 - 1.30
$75,000+	1.08	0.74 - 1.60	0.48	0.22 - 1.00
Poverty level				
Living in poverty level (RC)	1.00	-	1.00	-
Income up to two times below the poverty threshold	1.11	0.79 - 1.56	1.31	0.83 - 2.07
Income more than two times below poverty threshold	1.32	0.97 - 1.79	2.30*	1.22 - 4.32

Notes: RC: reference category. Significance: * p<0.05; ** p<0.01; *** p<0.001

Discussion

The results of the present study show that 10.4 percent of 12 and 17-year-olds reported daily or near-daily consumption of marijuana ≥300 days within the previous year, similar to the NSDUH-reported prevalence of 10.5 percent for this age group of individuals [4]. NSDUH uses ≥300 days past-year daily/near-daily marijuana use to define high-frequency cannabis use. However, some studies define high frequency cannabis use as marijuana use for 20 or more days in the past 30 days, marijuana use 5 or more times daily, or marijuana use 10+ times a month [19-21]. The use of different standards for defining high frequency of marijuana use makes it difficult to compare the prevalence of marijuana use across different studies. In a study that assessed cannabis use in adolescents aged 12 to 17 years in sub-Saharan Africa, which is similar to the age group assessed in our study, found a prevalence of marijuana use of 4.39% in their sample population of over fifteen thousand (15,533) across 8 African countries (Ghana, Seychelles, Liberia, Benin, Mozambique, Namibia, Mauritius, and Tanzania), however, their criteria for marijuana use was past-month cannabis use which in comparison to our study's criteria of daily consumption of marijuana ≥300 days within the previous year, may have underestimated the prevalence rate in their study population [22].

The present study also found that the occurrence of MDE was significantly related to marijuana use. This finding is similar to previous cross-sectional studies that have shown a significant association between marijuana use and MDE [23]. An effort to relieve depressive symptoms may be the underlying reason for some adolescents who use marijuana [9, 24].

Findings of sociodemographic factors significantly related and independently associated with past-year marijuana use in the present study, such as late adolescence ($\chi2$=237.16, p<0.001; aOR = 3.19 - 6.52; p<0.001) and high school education ($\chi2$=237.16, p<0.001; aOR = 1.70; 95% CI: 1.14 - 2.53; p = 0.010), are similar to findings in previous studies and could be attributed to increased coping reasons (utilizing marijuana for coping purposes, e.g., to alleviate tension or diminish negative emotions) with older adolescents [25, 26]. The NSDUH 2021 data was collected post-COVID-19 pandemic, and the pandemic-related stress (isolation and economic hardship) has been associated with an increase in marijuana use by adolescents [27]. Parental use of tobacco, school bullying, and truancy have been associated with increased odds of marijuana use, emphasizing the importance of social support as a protective mechanism against marijuana use in adolescents [22]. Studies have shown that participation in school and community-based programs and activities decreases the likelihood of adolescents' marijuana use [28].
The study also showed a significantly higher number of female adolescents than male adolescents ($\chi2$=6.87; p=0.001) who used marijuana. This finding may be explained by the greater impact of bullying, both physical and online, on girls than boys, resulting in increasing gender disparities in the

occurrence of depressive symptoms [29]. Marijuana use may be a form of coping mechanism for adolescents with childhood trauma, and studies show gender specific mental health care is effective in addressing substance use, including marijuana use, in adolescents [30].

Also, in the present study, worsening general health was significantly and independently related to marijuana use ($\chi2$=29.35, p<0.001; aOR = 1.58 – 2.11; p<0.001). Previous research demonstrates that some adolescent's regard marijuana as a viable option for addressing challenging health issues in cases where conventional medical interventions have proven ineffective or when they encounter barriers to accessing suitable healthcare [1]. Although there is no federal legislation decriminalizing marijuana use in the US, the states that have legalized medical use of marijuana have allowed prescriptions of marijuana to treat adolescents for autism spectrum disorder, attention deficit hyperactivity disorder, bipolar disorder, and anxiety disorders [1]. However, studies show that adolescent use of medical marijuana is associated with poorer developmental outcomes than treatment with conventional medications [31, 32]. On bivariate analysis, family income ($\chi2$ = 2.45; p = 0.508), race ($\chi2$ = 1.79; p = 0.635), and poverty level ($\chi2$ = 4.43; p = 0.125) did not have a significant relationship with marijuana use but on multivariate analysis, our study found that income more than two times below poverty threshold were independently associated with marijuana use (aOR = 2.30; 95% CI: 1.22 - 4.32; p<0.05). The findings on bivariate analysis suggests that effects within the different income brackets varied or could have canceled each other out when they were lumped together; however, when adjusted for confounding variables, the study's finding of significant relationship between income more than two times below poverty threshold and marijuana use is consistent with findings from previous studies showing marijuana use is associated with living below poverty line [33,34].

The present study did not find an association between race and marijuana use. This finding is similar to a previous study that have shown that race is not always associated with frequency of marijuana use or problems associated with its use, such as cannabis use disorder [35]. Buckner et al [35] found that race was not associated with frequency of marijuana use or subsequent associated problems; however, they also found that motives for marijuana use differed along race lines [35]. On the other hand, another study has shown significant associations between race and marijuana use [36]

Conclusion

The prevalence of marijuana use and MDE is high among adolescents in the USA; significant associations exist between marijuana use among adolescents and factors such as increasing age, high school attainment, MDEs in the past year, worsening general health, and income more than two times below the poverty threshold. The strong associations between the above factors indicate the need for targeted preventive and prompt treatment interventions to break the vicious cycle of MDEs, depression, poverty, and poor heath especially in older adolescents. These interventions could include school-based resources to build coping skills, healthy habits, and mindfulness skills; increasing access to supportive resources in schools and communities for diverse recreational activities; building social support in schools, families, and communities through learning of social-emotional skills, family and community-based therapy; and increasing access to mental health care.

Limitations

First, the data relied on self-reporting. Self-reported data may not be in alignment with objective clinical evaluations. Cannabis use may have been under reported, as individuals regularly underreport their substance use. Similarly, the reliance on self-reporting of depressive symptoms may differ from clinical assessments and be susceptible to recall bias. Secondly, the NSDUH survey is cross-sectional; therefore, this survey design restricts the capacity to determine the causal relationship directionality of reported relationships in this study. Thirdly, the strict criteria for marijuana use definition of daily or near-daily consumption of marijuana ≥300 days in a year utilized by the NSDUH survey as a robust indicator for cannabis use disorder (CUD) has potential misclassification bias issues because studies have shown that

individuals with less frequent but heavy use of cannabis (e.g., ≥20 days in the previous month) or even consumes high potency cannabis in very large doses a few times in a month, would still be at risk for cannabis use disorders and it's other harmful effects [37,38]. Also, it limits the generalization and utility of the study's findings for individuals who still qualify as frequent users, but who use cannabis between 150 and 299 days in a year. This has public health implications, as policymakers may decide to focus public health interventions only on individuals who meet the narrow criterion and ignore the risk of harm to a large group of persons who use cannabis less than the 300-day threshold, but are also at risk of the harmful effects of cannabis use.

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