


## ORIGINAL RESEARCH

## Toxicology

# The perils of recreational marijuana use: relationships with mental health among emergency department patients

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## Abstract

**Introduction:** Marijuana is a commonly used drug in the United States. Many states have legalized the recreational use of marijuana. The effects of marijuana on mental health are unknown.

**Methods:** In this prospective survey study, eligible participants included ED patients age 18 and older, who had ever used recreational marijuana. A survey instrument was developed, piloted, and revised. Data collected included reasons for marijuana use, marijuana's perceived effectiveness, and history of mental health conditions, including depression, anxiety, and suicidal thoughts.

**Results:** Among 303 participants (86% response rate), the median age of first marijuana use was 16 ([IQR 14, 19], range 6–65). The most commonly cited reasons for marijuana use included recreational use (70%; n = 211), to treat anxiety (30%; n = 89), to treat pain (25%; n = 74), and to treat depression (17%; n = 51). Mental health issues were common in the study population. A majority of patients reported anxiety in the last 30 days (59%; n = 176), and a significant minority of patients reported serious depression in the last 30 days (46%; n = 137). Some patients reported suicidal thoughts in the last 30 days (9%; n = 29). Participants who used marijuana more frequently reported more days of anxiety (median 15.5, compared to 1;  $P = 0.001$ ). Among participants with mental health conditions, most began using marijuana before the onset of the mental health conditions (77%, n = 167). Earlier age of starting to use marijuana was correlated with higher number of years of anxiety or tension in lifetime ( $r = -0.11$ ,  $P = 0.05$ , n = 301). Perceived effects of marijuana use on mental health were variable. Most participants stated that marijuana improved their mental health (62%; n = 163), and some reported that marijuana did not improve their mental health (37%; n = 98).

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**Conclusions:** Many ED patients have used marijuana, either currently or in the past. Mental health conditions are also common, including anxiety, depression, and suicidal thoughts. Most participants reported marijuana use starting at an age under 18. Marijuana use preceded the onset of mental health conditions in the majority of participants.

## 1 | INTRODUCTION

### 1.1 | Background

Marijuana is an increasingly common recreational drug in the United States. An estimated 43.5 million people used marijuana in 2018, making it the most commonly used federally illegal drug in the United States. According to the 2018 National Survey on Drug Use and Health, almost half (48%) of American adults have used marijuana at least once in their lifetime, with 11% indicating use within the past month. Rates of marijuana use tend to be higher among men (53%) than women (44%), and as age increases, a decline in use is observed.<sup>1</sup> Individuals suffering from medical conditions, including mental health illnesses, report using marijuana more than healthy people, leading to questions regarding marijuana's perceived role in ameliorating symptoms of disease.<sup>1,2</sup> Many Americans believe that marijuana is a viable therapeutic option for pain management, the treatment of chronic conditions, and relief from mental health symptoms. Furthermore, approximately one-third of Americans agree that marijuana has preventive qualities when it comes to these health conditions.<sup>3</sup> In 2011, the Drug Abuse Warning Network (DAWN) reported that out of all drug-related emergency department visits, marijuana was implicated in roughly 456,000 visits, second only to cocaine use.<sup>4</sup>

Public attitude toward recreational use of marijuana has shifted in the recent past as a result of period effects including the liberalization of policy,<sup>5</sup> and support for the legalization of marijuana by Americans is growing.<sup>5,6</sup> Although marijuana remains illegal under federal legislation and retains a Schedule I classification, as of 2019, 11 states and Washington D.C. have approved its use for recreational purposes, and 33 states and Washington D.C. have public medical cannabis programs. Following this trend, 26 states and Washington D.C. have decriminalized the possession of small amounts of marijuana.<sup>7</sup>

### 1.2 | Importance

Marijuana has been associated with numerous clinical effects. Short-term intoxication side effects include confusion, dizziness, disorientation, hallucination, euphoria, agitation, and dry mouth.<sup>8,9</sup> Marijuana has been shown to stimulate appetite. For this reason, the synthetic tetrahydrocannabinol (THC) cannabinoid analogues dronabinol and nabilone have been approved by the Food and Drug Administration (FDA) for the treatment of chemotherapy-induced nausea and vomiting. Dronabinol has also been FDA-approved for the treatment of

anorexia-associated weight loss in patients with HIV/AIDS.<sup>10</sup> However, marijuana can also cause nausea and vomiting.<sup>11</sup> It has recently been demonstrated that the prevalence of cannabis hyperemesis syndrome has been increasing in EDs since medical marijuana liberalization.<sup>12</sup> The syndrome usually occurs in relation to chronic marijuana use but can also be seen with sporadic use.<sup>13</sup>

Many studies have shown adverse neurologic effects of acute and long-term regular cannabis use.<sup>14-16</sup> In utero exposure has been linked to permanent neurobehavioral and cognitive impairments.<sup>17</sup> In children acutely exposed to marijuana in sufficient quantities, severe central nervous system depression can present as profound depression, lethargy, and coma.<sup>8</sup> In addition, cannabis use has been associated with an increased risk of psychosis and earlier onset of psychosis in those who use daily and high-potency cannabis.<sup>9</sup> It has also been shown to interfere with executive cognitive functions acutely and for days after.<sup>10</sup> Some studies have even demonstrated an association between marijuana use and impaired short- and long-term driving ability.<sup>18,19</sup> Marijuana use has also been linked to a significantly increased risk of motor vehicle accidents.<sup>20</sup> There is little published data that define the physiologic effects of marijuana on depression, anxiety, and other mental health conditions.

### 1.3 | Goals of this study

This study was undertaken to identify any relationship between marijuana use and mental health among ED patients.

## 2 | METHODS

### 2.1 | Design and setting

This was a prospective survey study conducted at Miami Valley Hospital, an inner-city Level 1 Trauma Center with an annual volume of 95,000. The study was approved by the Wright State University Institutional Review Board.

### 2.2 | Selection of subjects

Eligible participants included ED patients age 18 and over, who had ever used marijuana. Consecutive patients were approached as a convenience sample when a research assistant was available, during the

time period May to September 2019. Patients who did not speak English, were in distress, or declined to participate were excluded. Subjects were approached with an invitation to participate while in the ED treatment area. Subject participation did not interfere with medical care or interrupt its delivery, and protected health information was not recorded.

## 2.3 | Exposures

The study design and the survey instrument were developed by a panel of emergency physicians and the Wright State University, Department of Emergency Medicine Research Committee, composed of emergency medicine faculty and residents. Questions regarding marijuana use and mental health were based on items in the Addiction Severity Index, a validated measurement tool to objectively assess addiction.<sup>21,22</sup> The survey instrument was piloted among eligible ED patients and modified for clarity and readability.

Data collected included: marijuana use in the last 30 days, age of first use, most recent use to time of survey, reasons for use, effectiveness on reasons for use, previous history of psychiatric care, the presence of anxiety, depression and suicidal thoughts, and whether marijuana use improves or worsens the subject's mental health. Reasons for marijuana use were the primary outcome measure. A pre-hoc sample size calculation demonstrated that a sample size of 96 was needed to establish a 95% confidence interval of  $\pm 10\%$  for the primary outcome measure, reason for marijuana use. Additional subjects were recruited to increase the study's power.

## 2.4 | Analysis

Spearman correlation coefficient was used to examine relationships between marijuana use and mental health. Differences between remote and current marijuana users were tested with Mann-Whitney Wilcoxon tests. Differences among mental health by frequency of marijuana use were tested with Kruskal-Wallis tests. *P* values  $< 0.05$  were considered statistically significant.

## 3 | RESULTS

Among 352 eligible participants, 303 consented to participate (86% participation rate). Among participants, 145 (48%) were males and 158 (52%) were females, with a mean age of 45 (range of 18–88). The most common ethnicities were White (55%) and African-American (42%) (Table 1).

The median age of first marijuana use was 16 ([IQR 14, 19], range 6–65). Age of first use was not significantly associated with years of serious depression ( $r = -0.08$ ,  $P = 0.16$ ,  $n = 301$ ) nor with years of serious thoughts of suicide ( $r = -0.03$ ,  $P = 0.65$ ,  $n = 296$ ). Age of first use was negatively correlated with years experienced serious anxiety or tension ( $r = -0.11$ ,  $P = 0.05$ ,  $n = 301$ ). No correlations were detected

### The Bottom Line

As marijuana is becoming more legalized in various states in the United States, many Americans use marijuana as a therapeutic option for pain and relief from mental health symptoms. This prospective study investigates the effect of marijuana on mental health and was found that marijuana use often preceded the onset of mental health conditions.

between the age of first marijuana use and days of depression in the past 30 days.

Marijuana use in the last 30 days varied among participants, both in the number of days used and the total number of times used. The majority, 183 (60.8%), reported no marijuana use in the last 30 days. Forty-one (13.6%) patients used marijuana 1–5 days, 36 (12.0%) used it 6–19 days, and 41 (13.6%) used it 20–30 days, which included 32 patients using marijuana every day of the last 30. The most commonly reported route of use of marijuana was smoking (98%;  $n = 297$ ), edibles (17%,  $n = 51$ ), and other (2%;  $n = 7$ ).

The most commonly cited reasons for marijuana use included recreational use (705;  $n = 211$ ), to treat anxiety (30%;  $n = 89$ ), to treat pain (25%;  $n = 74$ ), and to treat depression (17%;  $n = 51$ ). Perceived effectiveness of these effects is shown in Table 2.

**TABLE 1** Descriptive statistics for all quantitative survey questions

No. respondents	303
Patient age (y)	45 [32, 56] range 18–88
Patient sex	
Male	145 (47.9%)
Female	158 (52.2%)
Ethnicity	
African-American	127 (41.9%)
Asian	0 (0%)
White	167 (55.1%)
Hispanic	5 (1.7%)
Multiracial	4 (1.3%)
Mode of arrival in ED	
Walk-in	209 (69.2%)
Ambulance	93 (30.8%)
Triage level	
1	0 (0%)
2	70 (23.4%)
3	186 (62.2%)
4	42 (14.1%)
5	1 (0.3%)

Data are presented as frequency count (%) or median [interquartile range].

**TABLE 2** Perceived efficacy of marijuana<sup>a</sup>

"Does marijuana help you with this reason?"	1: no help (%)	2: little help (%)	3: moderate (%)	4: helps a lot (%)	5: great deal of help (%)
Recreational (n = 212)	52 (24.5)	11 (5.2)	34 (16.0)	31 (14.6)	84 (39.6)
To treat pain (n = 73)	3 (4.1)	2 (2.8)	4 (5.5)	18 (24.7)	46 (63.0)
To treat depression (n = 53)	1 (1.9)	2 (3.8)	2 (3.8)	12 (22.6)	36 (67.9)
To treat anxiety (n = 90)	1 (1.1)	6 (6.7)	7 (7.8)	14 (15.6)	62 (68.9)
To treat sleep disorder (n = 32)	1 (3.1)	0 (0)	2 (6.3)	2 (6.3)	27 (84.4)
Other (n = 64)	1 (1.6)	2 (3.1)	6 (9.4)	8 (12.5)	47 (73.4)

<sup>a</sup>Participants responses to the question: "Does marijuana help you with this reason?"

**TABLE 3** Comparison of timing of first use of marijuana with estimated onset of mental health issues

Comparison of age of first use of marijuana with estimated age mental health issue began	Mental health issue		
	Depression (%)	Anxiety (%)	Suicidal thoughts (%)
No. of patients with mental health issue (years in lifetime >0)	216 (71)	218 (72)	124 (41)
Marijuana use started before mental health issue	167 (77.3)	159 (72.9)	113 (91.1)
Mental health issue started before marijuana use	43 (19.9)	52 (23.9)	8 (6.5)
Marijuana use started same year as mental health issue	6 (2.8)	7 (3.2)	3 (2.4)

Mental health conditions were common in the study population. A majority of patients reported anxiety in the last 30 days (59%; n = 176), and a significant minority of patients reported serious depression in the last 30 days (46%; n = 137). Some patients reported suicidal thoughts in the last 30 days (9%; n = 29). Participants who used marijuana more frequently reported more days of anxiety (median 15.5, compared to 1;  $P = 0.001$ ).

Among participants with mental health conditions, most began using marijuana before the onset of the mental health conditions (77%, n = 167) (Table 3). Earlier age of starting to use marijuana was correlated with higher number of years of anxiety or tension in lifetime ( $r = -0.11$ ,  $P = 0.05$ , n = 301). Perceived effects of marijuana use on mental health were variable. Most participants stated that marijuana improved their mental health (62%; n = 163), and some reported that marijuana did not improve their mental health (37%; n = 98). Free text comments regarding effects of marijuana are summarized in Table 4.

Participants were offered consultation with Social Services for drug treatment. A minority (8%; n = 25) accepted this invitation.

## 4 | LIMITATIONS

This study was conducted at a single institution and results may not be generalizable to other settings. Data were self-reported, and the accuracy of the data is dependent on the accuracy of participant self-reports. It is possible that participants did not accurately diagnose the onset of mental health conditions. Although we identified a temporal relationship between marijuana use, which commonly preceded treatment for mental health, we cannot infer a causal relationship. Although many patients reported anxiety, the relationship of marijuana with the incidence of anxiety is unknown.

## 5 | DISCUSSION

As a result of increasing access, due to both medical use and recreational legalization, marijuana use has increased dramatically in the United States.<sup>23</sup> However, the ramifications of this increased exposure to the known psychoactive compounds present in marijuana are poorly understood. Cannabis is a heterogeneous mix of multiple psychoactive compounds, but the most extensively studied and prevalent are cannabidiol and  $\Delta$ -THC, which elicit psychoactive effects through interaction with the endocannabinoid system.<sup>24</sup> Effects on cognitive function have been evaluated in a number of studies and recently summarized to demonstrate both acute and chronic declines in verbal learning and memory, impaired attention, and psychomotor function. There does appear to be a dose-dependent effect, with higher frequency and higher THC potency resulting in more profound deficits. It is as yet unclear whether some or all of these functions recover after a period of prolonged abstinence. One study following prolonged exposure to THC from childhood through midlife found a 6-point decline in IQ points relative to non-marijuana users.<sup>25</sup>

In addition to cognitive effects, marijuana use has long been associated with increased frequency of psychosis and associated behaviors. In a large European study, a strong effect of daily use of high potency cannabis preparation was associated with 12% of first case psychosis events across Europe. Targeted populations in London and Amsterdam were found to have a 30% and 50% incidence, respectively, of heavy cannabis-associated psychosis.<sup>26</sup> Those who had started using high potency cannabis by age 15 years showed a doubling of risk.

This study identified a young age of first marijuana use (median 16, range 6–65). This finding is of concern, given a growing body of literature of the cognitive and emotional effects of marijuana on children and adolescents. A recent meta-analysis study identified increased

**TABLE 4** Responses to question: "Is there a relationship between marijuana use and the way you feel? This may include depression or anxiety. Explain."

Perceived positive effects of marijuana			Perceived negative effects of marijuana		
	n	% <sup>a</sup>		n	% <sup>a</sup>
Relaxes/calms me/reduce stress	65	21	Worsens focus/cannot think	11	4
Happiness/feels good	36	12	Worsen anxiety	9	3
Improve anxiety	24	8	Worsen paranoia	4	1
Improve depression	17	6	Worsen depression	3	1
Escape from problems/reality	17	6	Worsens guilt	1	<1
Improves performance/helps me think/focus	11	4			
Increase hunger	9	3			
Get high/intoxication	8	3			
Improve pain	8	3			
Improve sleep	8	3			
Improves sociability	5	2			
No effect	116	38			

<sup>a</sup>Percent of total participants; may be artificially low because of many participants who did not comment.

rates of major depression and suicidal ideation in young adult users of marijuana.<sup>27</sup> Several studies have indicated a link between adolescent cannabis use and the subsequent development of addictions to cocaine and alcohol.<sup>28</sup>

The most commonly cited reasons for marijuana use in this study included recreational use, treatment for anxiety, pain, and depression. Many participants believe there is a perceived benefit of treatment for these conditions. This may be due to physiologic effect, anxiolytic effect, cognitive effect, or placebo effect. There are limited published data regarding the physiologic benefit of marijuana in treating mental health conditions, such as depression and anxiety.<sup>29-31</sup>

Among participants with mental health conditions, most began using marijuana before the onset of the mental health conditions.

This study identified a high incidence of self-reported serious anxiety or tension over the last 30 days (59%), and a high incidence of self-reported serious depression (45%). Similarly, a recent study discovered that 55% of ED patients met criteria for generalized anxiety disorder.<sup>32</sup> We identified a positive correlation between days of marijuana use and self-reported days of serious anxiety or tension. A literature review by Shalit and Lev-Ran found similar results, stating that there are some data suggesting that heavy cannabis users are at a higher risk for anxiety disorders.<sup>33</sup> A previous research study by Sideli et al found associations between high THC content marijuana use and psychosis, mania, and suicide.<sup>34</sup>

Studies have shown that marijuana use has been linked to exacerbations of mental health disorders like schizophrenia, personality, mood, and anxiety disorders. Specifically, meta-analysis shows a dose-response association with the highest odds of psychotic disorder in those with the heaviest cannabis use and early cannabis use as a potential risk factor for diagnosis of psychotic disorders.<sup>35</sup> Although associations between marijuana with high doses of  $\Delta^9$ -THC and anxiety attacks or panic disorders have also been reported, it is unclear how cannabis use influence rates of mental health disorders.

These data add to the body of literature of the relationship of mental health and marijuana use. The young age of starting marijuana use (age 6 and up) should prompt education regarding the adverse effects of marijuana on the developing brain. Future research should aim to better elucidate physiologic mechanisms of marijuana and its effects on mental health conditions.

In conclusion, many ED patients have used marijuana, either currently or in the past. Mental health conditions are also common, including anxiety, depression, and suicidal thoughts. Most participants reported marijuana use starting at an age under 18. Marijuana use preceded the onset of mental health conditions in the majority of participants.

#### AUTHOR CONTRIBUTIONS

CAM is responsible for the study concept and design, data acquisition, data analysis, drafting of the manuscript, revision for intellectual content, and study supervision. CM, DM, JPD, ALF, JA, MH, RR, JZ are responsible for data acquisition, drafting of the manuscript, and revision for intellectual content.

#### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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