Clouded Minds: A Systematic Review on the Link Between Cannabis Use and Depression in Young Adults

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Abstract:
Introduction: Cannabis use is most prevalent among young adults, a time of critical brain development during which cannabis may disrupt neurological processes. Such disruptions may lead to cognitive impairments or increase susceptibility to mental health conditions, including depression. While prior research has identified a correlation between cannabis use and depression, this relationship may also stem from self-medication. Despite the developmental significance of this life stage, no comprehensive review has been written that focuses on the association between cannabis use and depression solely in young adults. The present review aims to address this gap by investigating whether cannabis use is linked to depression in this population.
Methods: Studies that examined the association between cannabis use and depression among young adults using a cross-sectional or cohort design were selected. To find these articles, literature searches were performed using the databases: PsychINFO, ProQuest Theses and Dissertations Global, MEDLINE, Pubmed, and Academic Search Complete. A total of nine articles satisfying the inclusion/exclusion criteria were found.
Results: There was a consistent positive relationship observed between cannabis use and depression. Out of the 11 measures examined, only one failed to report a positive association. However, many of these relationships were relatively weak, with only six of the eleven demonstrating both a positive and statistically significant connection.
Discussion: We observed a weak but consistent relationship between cannabis use and depression, indicating a subtle yet consistent correlation. This suggests that young adults who use cannabis tend to exhibit a higher prevalence of depression compared to their non-using same age counterparts.
Conclusion: Young adults who use cannabis appear to have higher rates of depression compared to their non-using peers. However, the cross-sectional nature of the selected studies limits findings to correlation rather than causation. Limitations also arise from the present study not fully meeting the criteria for a systematic review, such as the absence of a risk of bias assessment. Despite these limitations, further research is urgently needed due to the significant public health implications of this topic.

Keywords: young adult; cannabis; depression; self-medication; cross-sectional; cohort

Introduction

In both Canada and the U.S., cannabis consumption is more prevalent among young adults than any other demographic [1]. According to Canada's 2023 National Cannabis Survey, over a third (38.4%) of young adults between 18 and 24 reported using cannabis within the past year [2]. Additionally, this age demographic tends to perceive the lowest amount of risk from regular cannabis use [3]. Given this combination of low perceived risk and elevated usage rates, a discussion regarding the potential psychological effects of cannabis use during young adulthood is of utmost importance, especially when considering the ongoing development of young adults' brains.

These neurological developmental processes are particularly significant, as they play a crucial role in adult functioning, and cannabis use has the potential to disrupt or impair these processes. These processes include when key brain structures are pruned, myelinated, or otherwise developing [4]. Notably, the prefrontal cortex continues to experience synaptic pruning until around age 25, while the development of white matter—essential for enhancing neural efficiency through myelination— extends until one's early 30s [5]. The maturation of these structures is vital for various functions, including decision-making, impulse control, and emotional regulation [5]. Disruptions to these natural developmental processes could place individuals on a trajectory that may lead to irreversible consequences for cognitive functioning and behavioral health [6].

Cannabis has the potential to disrupt normal brain development due to its wide-ranging effects on neural structures. Cross-sectional studies frequently report

abnormally large grey matter volume among cannabis users, likely reflecting disrupted synaptic pruning [5]. While findings on hippocampal volume and activation have been somewhat mixed, evidence appears to indicate that meaningful changes are likely occurring in this area [5-7]. These neurobiological changes in chronic cannabis users appear to be linked to worse performance in various tasks [6]. For example, one study found that chronic cannabis users were less able to learn from mistakes, which the researchers concluded was due to decreased activity in the hippocampus and anterior cingulate cortex [7]. Overall, the evidence points to cannabis potentially impacting brain structure and function during the critical developmental periods of youthhood [5-7].

There is substantial evidence supporting the existence of these deficits, as demonstrated through numerous neuropsychological tests [8]. These impairments span a wide range of cognitive domains, including attention, memory, inhibition, and other executive functions [8]. Regular cannabis use is tied to lasting cognitive impairments in some of these domains as well as lower overall intelligence [6]. Studies also show that when chronic cannabis use is discontinued, cognitive performance often improves. In the short term, cannabis can have acute negative effects on cognitive performance [6]. These neurobiological changes may also serve to increase negative emotionality, which potentially links cannabis to mental illness [7].

Generally, evidence suggests that there is a link between cannabis and mental illness. Many studies have examined this link, looking at diverse disorders, including anxiety, schizophrenia, bipolar disorder, and depression [10]. Most of these studies found a positive association between cannabis and mental illness, but any conclusions are tentative [11]. This uncertainty arises from the possibility that individuals suffering from, or predisposed to, mental illness may be more likely to use cannabis—a hypothesis supported by existing evidence [12]. Additionally, the relationship may be bidirectional, with cannabis use potentially contributing to mental illness and mental illness, in turn, encouraging cannabis use. For example, one longitudinal study found that cannabis use disorders often predicted depression and depression often predicted a cannabis use disorder [13]. Ironically, cannabis users often state that they use the drug to alleviate depression [13], and the drug does have short term anxiolytic effects on mood [14].

Over time, however, cannabis use may be more likely to cause symptoms of depression than alleviate it. Cannabis use often precedes psychosocial difficulties [11]. Cannabis use has been shown to disrupt later occurring socialization processes in young people, such as pursuing education, building a career, establishing one's identity, or forming meaningful relationships [11]. Specific to depression, the link with cannabis use is not fully conclusive, but most reviews still suggest a link between cannabis use and an increased risk of depression [11]. Among younger individuals, early cannabis use has been shown to significantly elevate the likelihood of developing depression in longitudinal studies [9]. This effect is likely due in part to the impacts on brain development [7,13].

The present study focuses on this relationship between depressive symptoms and cannabis use specifically in young adults. It aggregates findings from cross-sectional and cohort studies, providing a comprehensive review of this demographic. While previous reviews have primarily focused on adolescents (13-17), young adulthood (18-30) represents a distinct developmental stage, where the factors influencing mental health may differ significantly. While several review articles address the relationship of depression and cannabis use, no review article focuses solely on young adults. This is despite their high rates of cannabis use, the unique developmental processes occurring during this period, and the ambiguous link between cannabis use and depression. This demonstrates the need for the present review to address this gap in the research literature.

Methods

Search Strategy

We identified studies through systematic computer searches across databases, including PsychINFO, ProQuest Theses and Dissertations Global, MEDLINE, Pubmed, and Academic Search Complete. Key search terms used included: "cannabis OR cannab* OR marihuana OR THC AND depression OR depressive AND cross?sectional OR cohort AND young adult* OR youth OR teen*." These searches were all completed on September 21, 2024. The searches yielded 40 studies which appeared relevant to the research question based on their titles and abstract. These studies were retrieved to fully assess eligibility.

Eligibility Criteria

These 40 studies were then carefully screened using inclusion and exclusion criteria to determine their relevance to the research question. To be included, the study had to focus on young adults aged 18-30 and measure mood and/or depression levels. Included studies had to use a cross-sectional or cohort design that compared cannabis users with a control group of non-users. Only studies published within the last 20 years were considered to ensure relevance to current cannabis use patterns and potency. Reviews, editorials, commentaries, letters, and conference abstracts were excluded from this review. Studies that did not specifically assess mood or anxiety levels as primary or secondary outcomes, such as those focused solely on cognitive function or physical health, were excluded. Studies not published in English were also excluded, as well as those examining CBD oil specifically since it does not usually contain THC (delta-9-tetrahydrocannabinol). Each record was independently screened by the author using these criteria. Ultimately, nine studies met the inclusion and exclusion criteria for this review.

Data Collection

Subsequently, data collection was conducted for the nine included studies. Effect sizes quantifying the correlation between cannabis use and depression were extracted directly from each study. To ensure a comprehensive analysis, all effect size measures and definitions of cannabis use were included. When studies provided multiple measures or definitions of cannabis use (e.g., frequency of use and lifetime use), both were extracted. No effect size conversions or syntheses were performed for this correlation; effect sizes are presented in this paper exactly as reported in the original article. Additionally, key study characteristics, including the author and year of publication, participant age, and the measure of depression used, were documented as reported in the studies. Studies were classified as either cross-sectional or cohort-based and the definition of cannabis usage was classified into distinct groups. All included articles provided complete data for these variables, eliminating the need to make assumptions about missing information. In addition, all extracted data was represented in a table. No protocol was prepared for this process, and this review is not registered.

Results

The findings generally indicate a positive association between cannabis use and depression (see Table 1 and Table 2). Although correlations tend to be weak and frequently fall short of statistical significance, the overall trend remains positive. Definitions of cannabis use vary across studies: 3 studies assess it as "ever used," while 8 measure usage frequency (e.g., uses per week), with 5 categorizing it into discrete groups (e.g., weekly, monthly), and 3 measuring it as current use (e.g., a binary metric for use in the last month). Three studies applied multiple approaches to assess cannabis use. Among studies using the "ever used" metric, 2 out of 3 indicated a positive association, with only one reaching statistical significance. For studies examining usage frequency or current use, all eight showed a positive association; three of five studies on frequency achieved statistical significance; and 2 out of 3 studies measuring current use achieved statistical significance. Importantly, even when statistical significance was not met, nearly all correlations—except for one "ever used" metric ($b = -0.01$, $p = .993$) [15]—remained positive, with p-values often approaching 0.05. Collectively, these findings indicate a subtle but consistent trend across different measures of cannabis use and depression.

Table 1. Characteristics of Included Studies

Authors and Year	Controlling other Substances (How)	Age of Participants	Measure of Depression	Study Design
Rougemont-Bücking et al., 2019 [15]	YES (examines those who only use cannabis)	M 25.4 years (SD = 1.2 years)	Major Depression Inventory	Cohort
Wang et al., 2022 [16]	NO	18-34 (Mage = 24.56 [SD = 4.72])	Patient Health Questionnaire-2 Item	Cohort
Do et al., 2024 [17]	NO	Reports 18-20 and 21-24	Depression, Anxiety and Stress Scale - 21 (Depression Subscale)	Cohort
Pedersen, 2008 [18]	NO	Cannabis measured at 21, depression at 27	Johns Hopkins Symptom Checklist (Depression items)	Cohort
Seaman et al., 2019 [19]	YES (For cigarettes only)	21-30	Patient Health Questionnaire (PHQ-9)	Cross Sectional
Baggio et al., 2014 [20]	NO	20.0 years (SD: 1.23)	The Major (ICD-10) Depressive Inventory (WHO-MDI)	Cross Sectional
Bataineh et al., 2023 [21]	NO	2 years post high school	Patient Health Questionnaire	Cohort
Blair et al., 2023 [22]	NO	19.4 (SD: 3.23)	20-item Center for Epidemiologic Studies Depression (CESD) scale	Cross Sectional
Degenhardt et al., 2011 [23]	NO	27 (at wave 9)	Major depressive episode as defined according to ICD-10	Cohort

Table 2. Results of Included Studies

Authors and Year	Definition of Cannabis Usage	Findings
Rougemont-Bücking et al., 2019 [15]	Binary ever used and frequency of use	Not Significant: Binary cannabis use: $b = -0.01$ $SE = 0.09$ $p = .993$; Frequency of use $b = 0.01$ $SE < 0.01$ $p = .012$
Wang et al., 2022 [16]	Frequency of use in the past 30 days; number of days of use in the last 30 (continuous)	Significant: $r^2 = 0.16$ $p < 0.001$
Do et al., 2024 [17]	Binary use in the last 30 days	Significant: $OR = 8.21$, CI: [5.73,11.75]
Pedersen, 2008 [18]	Frequency of use in past 12 months organized into discrete groups; no use, 1-10 times, or 11+ times during last 12 months	Significant: Never: OR = 1.0OR; 1–10 times: $OR = 1.9$ CI: [1.2, 2.9]; 11+ times: OR = 2.0 CI: [1.1, 3.8]
Seaman et al., 2019 [19]	Binary use in past month	Not Significant: $OR = 1.18$, CI: [0.72,1.93]
Baggio et al., 2014 [20]	Binary use in past month	Significant: $b = 0.114$, $p < .0001$
Bataineh et al., 2023 [21]	Binary lifetime use	Not Significant: $OR = 1.22$, CI: [0.95,1.56]
Blair et al., 2023 [22]	Binary lifetime ever use of Cannabis vaping and a measure for current use (monthly, weekly, or daily)	Significant: Ever cannabis use: $b = 0.024$, $SE = 0.04$ $p < .001$ Current cannabis use: $b = 0.024$, $SE = 0.006$, $p < .001$
Degenhardt et al., 2011 [23]	Frequency of use in 6 months, organized into discrete groups; no use, occasional, weekly, or daily	Not Significant: No use: OR = 1.0OR; Weekly use: $OR = 1.2$, CI: [0.43, 3.3]; Daily use: $OR = 1.2$ CI: [0.72, 1.9]

Discussion

The results of this review suggest a subtle but consistent trend: young adults who use cannabis exhibit a higher prevalence of depression compared to non-users. This aligns with previous research, as most recent reviews on the topic, with few exceptions, have consistently identified a link between cannabis use and depression [11]. Some of these sources highlight that cannabis use may disrupt brain development in young adults, a critical period during which key neurological structures undergo significant growth and maturation [4]. Cannabis use during this developmental phase may interfere with these neurological processes, potentially leading to cognitive changes that could explain the association between cannabis and mental health issues, particularly depression [24-26].

Additional evidence comes from the identification of potential neurobiological mechanisms. When cannabis enters the brain, its active compounds—such as THC—mimic the action of natural endocannabinoids by binding to cannabinoid receptors, primarily CB1 and CB2 [25]. The endocannabinoid system, which dates back evolutionarily and is present in some of the most primitive animals with a nervous system, plays a crucial role in regulating mood, stress, and reward [6,25]. Therefore, animal studies can provide useful converging evidence for cannabis's effect on the brain, and most importantly, animal studies allow for controlled conditions to explore these effects more precisely [25].

Studies done on rats appear to show differing results depending on the age of rats that were studied. Studies exposing adult rats to THC show inconclusive associations with depression [27]. However, a review by Realini and colleagues concluded that when juvenile rats are exposed to THC, these rats show reduced CB1 receptor density and functionality in adulthood as well as a significant increase in depressive symptoms [24]. This difference between effects in adult and juvenile rats highlight the complexity of cannabis's long-term impact on the endocannabinoid system. This pattern of results indicates that THC may be safe or pose minimal risk after a certain age, potentially once brain development has reached maturity, as some researchers have proposed [5].

Public Health Implications

Addressing this potential link between depression and cannabis use would is essential, given the profound impact of depression on young adults. Depression among this population has increased significantly, with recent research indicating a greater than 50% rise in its prevalence among young adults (18-22) between 2017 and 2021 [28]. The effects of depression can be severe and long-lasting, with nearly 15% of those diagnosed ultimately succumbing to suicide—a rate nearly 30 times higher than the general population [29]. During the formative period of young adulthood, depression can disrupt significant developmental milestones, including education, career progression, and social relationships [30]. Missing these milestones often leads to broader challenges in daily life, as depression is associated with increased social difficulties, reduced educational attainment, and lower rates of partnership formation [30-31]. Additionally, once one has a depressive episode, future depressive episodes and comorbid disorders are much more likely to occur [31].

Given the serious, often lasting impacts of depression and its link to cannabis use, the need for effective public health interventions among youth and young adults is clear. Historically, campaigns like the DARE program reached approximately 90% of U.S. schools but were ultimately found to lack effectiveness in significantly reducing drug use [32]. In contrast, evidence-based programs have shown more promising results [33]. The "keepin' it REAL" program, for example, uses social learning principles to teach life skills, decision-making, and peer resistance [34]. It teaches students to Refuse, Avoid, Explain, and Leave (REAL) to competently communicate and avoid peer pressure [34]. The program demonstrated a substantial impact with an impressive $72 return for every dollar invested [32].

Research on reducing cannabis use specifically among young adults remains limited, though some studies indicate the potential of brief interventions [35]. These interventions use motivational interviewing (MI) techniques to encourage behavior change, teach coping skills, and connect individuals with further support when needed. For example, a study by Stein and colleagues applied an MI-based intervention tailored to young adults' developmental phase to a non-treatment seeking population [36]. The sessions emphasized themes relevant to early adulthood, such as identity exploration, instability, and self-focus. In the initial session, participants were asked to envision their lives in five years, reflecting on their current behaviors, including risk-taking, and considering the impact these might have on their future. The counselor highlighted any discrepancies between participants' goals and their current behaviors, suggesting adjustments. Follow-up sessions revisited any new "emerging adulthood" experiences, providing further opportunities to reassess and adjust behaviors. A meta-analysis on these brief interventions among non-treatment seeking young adults found decreased symptoms of cannabis use disorder and an increased likelihood of cannabis abstinence [33]. This evidence shows that there is some promise among interventions dedicated to this population.

Limitations

The cross-sectional design of the studies found introduced several important limitations. Cross-sectional designs capture a "snapshot" at a single point in time, comparing characteristics between groups, such as cannabis users and non-users [37]. This method allows for observation of correlations, and in this case, it highlights that individuals who used cannabis, particularly those who used it more frequently, tended to report higher rates of depression. However, the design restricts us from drawing causal conclusions about this relationship.

Additionally, certain aspects of the review process may limit its applicability. While systematic PRISMA guidelines were followed, some key items remained unaddressed [38]. Notably, risk of bias and heterogeneity were not assessed, meaning study characteristics may have influenced the results without our awareness. Furthermore, sensitivity analyses and methods to evaluate certainty were not conducted, introducing some uncertainty regarding the robustness of the findings. Moreover, because this was a systematic review rather than a meta-analysis, a pooled effect size was not calculated. Although the evidence consistently trends in the same direction, the absence of a quantitative synthesis makes the conclusions less definitive particularly in terms of the magnitude of effect.

Conclusions drawn from the review may be limited because of a lack of control of other substance use. Only two studies controlled for the use of other substances, even though individuals who use cannabis are often more likely to use other substances as well [39]. This lack of control means that the cannabis-using group may have differed significantly from the non-using group beyond cannabis use alone. Other substances could have acted as third variables, potentially influencing the observed relationship between cannabis and depression. Additionally, cannabis's effects can vary when combined with other substances, potentially altering outcomes in ways not accounted for in this analysis [40]. If the selected studies addressed this issue, it would have provided more definitive insights into the unique effects of cannabis on depression.

Future Directions

To reach more conclusive results, future studies should address several important directions. Randomized controlled trials (RCTs) could help overcome the limitations of cross-sectional designs by studying depression in controlled cannabis-use settings where it is ethical to assign cannabis usage [10]. For example, RCTs examining the impact of cannabis for chemotherapy relief could include depression assessments across participant groups to capture potential differences over time. In addition, future meta-analyses could compute an aggregate effect size; this review found a consistent directional trend that might yield a statistically significant positive correlation when combined across studies. Finally, identifying a specific neurobiological mechanism linking cannabis to depression would provide robust evidence. Animal studies, which allow experimental control, have already offered insights due to evolutionary similarities in endocannabinoid systems.

Conclusion

This study identified a consistently positive association between cannabis use and depression, with only 1 of 11 measures showing a divergent result. While many studies did not reach statistical significance individually, the repeated positive trend across studies indicates a subtle but reliable effect: cannabis users are more likely to report symptoms of depression. Emerging evidence hints at a potential causal relationship, supported by findings on neural mechanisms and results from animal

studies. However, further research is needed to confirm these findings. Given the public health implications, especially considering cannabis's impact on young adult brain development, more evidence is essential. Cannabis exposure may have adverse effects especially when brain development is not complete, illustrating the importance of effective interventions. Programs like motivational interviewing, which have shown promise among young adults, could represent a valuable direction for public health efforts aimed at reducing cannabis use and mitigating its mental health impacts [33].

List of Abbreviations
RCT: randomized controlled trial
MI: motivational interview

Conflicts of Interest
The author declares that they have no conflicts of interest.

Ethics Approval and/or Participant Consent
The present study did not require ethics approval. The present study was a review, and therefore only examined preexisting data which was publicly available. Therefore, there was no need for ethics approval.

Authors' Contributions
GMF: designed the study, collected and interpreted the data, wrote and revised the manuscript critically, and gave final approval of the version to be published.

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