



A Panel Study of the Effect of Cannabis Use on Mental Health, Depression and Suicide in the 50 States

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Executive Summary

Recent epidemiological research has demonstrated an association between adolescent cannabis use, the use of high potency cannabis products, and increased risk of psychosis (DiForti et al., 2009; Penzel et al., 2022). These studies potentially validate the existence of cannabis-induced psychosis (CIP), a disorder of which the existence has been debated for more than 80 years. In the absence of quality measures of cannabis potency and cannabis-induced disorders, the research presented in this report considers recent literature regarding the increase in THC potency in US states with more highly permissive cannabis legalization (Cash et al., 2020) and analyzes population prevalence data to determine whether growth in cannabis use is correlated to growth in mental health disorders, such as depression, severe mental illnesses, and suicidal thoughts.

A difference-in-means test demonstrates that cannabis use is higher among all age groups in more highly permissive states, with 47 percent more monthly cannabis use among adolescents (ages 12-17) and 81 percent more monthly cannabis use among young adults (ages 18-25) in US states with fully legalized recreational cannabis programs than states where cannabis use has not been legalized. While cannabis use grew, subsequent raises in mean averages for major depressive events, severe mental illnesses, and suicidal thoughts all increased in more highly permissive US states.

Relevant scholarly literature advises this increase in cannabis use intersects with a dramatic rise in THC potency. Since the 1960s, the average THC potency in cannabis products has increased from 2 percent during the Woodstock Era to 4 percent in 1995, 12 percent in 2012, and over 17 percent in 2017 (ElSohly et al., 2016; Murray et al., 2016; Sabet, 2021), with a recent study showing average THC levels over 20 percent in nine highly permissive states (Cash et al., 2020).

Using fixed effects panel regression models with government data from the National Surveys on Drug Use and Health (NSDUH) and US Census reports, this research establishes a correlative link between monthly cannabis use among adolescents and young adults and self-reported major depressive

events with both statistical significance and strong explanatory power. Additionally, positive correlation is shown between monthly cannabis use by young adults and the prevalence of self-reported severe mental illnesses and suicidal thoughts. Similar data for adolescents for prevalence of these mental health disorders is, unfortunately, not available.

The research results presented in this study demonstrate that for each one percent increase in overall monthly cannabis use, self-reported major depression increased by 0.45 percent for adolescents and 0.21 percent for young adults. For every one percent increase in overall monthly cannabis use by young adults, severe mental illnesses increased by 0.12 percent and suicidal thoughts increased by 0.11 percent. Panel regression models included control variables for gender, marital status, educational attainment, veteran status, unemployment status, race, and ethnicity.

While epidemiological studies including smaller samples of hospital patient data suggest a causal link between cannabis use, higher potency THC levels, and the risk of mental health disorders such as cannabis-induced psychosis (CIP), measurements on population data are more elusive. Through consideration of state legal status, differences-in-means testing, and panel regression, research results suggest the existence of cannabis-induced mental health disorders within federally reported population survey data that validates the similar epidemiologically explained connection. This research is significant in that it represents the first nationwide correlative regression data linking monthly cannabis use and self-reported mental health disorders among adolescents and young adults over 51 geographical variations and 8 time periods. These research results strongly support the federal and state policy considerations for caps on high potency THC products.

Introduction

The trajectory of cannabis legalization continues to rise in the United States. Despite its continued status as a Schedule I substance under the federal Controlled Substances Act, as of February 2022, cannabis has been legalized for recreational use in 18 states and the District of Columbia and legalized for medical use in 37 states and the District of Columbia (NCSL, 2022). The State of Mississippi most recently changed their cannabis laws to include legalization for medical purposes in February 2022 (Guzman & Sanderlin, 2022). As more states have increased availability of cannabis, growing scholarly research – more than 20,000 peer-reviewed articles – has shown higher rates of cannabis-related driving fatalities, emergency hospitalizations, and crimes (Sabet, 2021).

An equally growing trend is not just the increase in availability of cannabis products, but also the potency of cannabis products, in the United States. One landmark cannabis potency study showed a tripling in the percentage of Tetrahydrocannabinol (or THC, the main psychoactive compound in cannabis) – from 4 percent to 12 percent – in illicit cannabis products seized by the US Drug Enforcement Administration between 1995 and 2012 (ElSohly et al., 2016). A more recent study by the University of Mississippi, and supported by the National Institute on Drug Abuse (NIDA), found a near-doubling of THC percentages in cannabis products – from 8.9 percent to 17.1 percent – between 2008 and 2017 (Chandra et al., 2019). The potency of modern cannabis products is substantially more powerful than the "Woodstock Weed" of the 1960s and early-1970s, which contained THC levels of 1 to 3 percent (Murray et al., 2016; Sabet, 2021).

What is High Potency Cannabis?

Several major authors have defined high potency cannabis as products containing greater than 15 percent THC (Cash et al., 2020; Stuyt, 2018). Products marketed in many state-regulated medicinal and recreational cannabis programs in the United States far exceed this 15 percent level potency level

and are considered highly potent. In fact, one study of more than 8,500 cannabis products marketed online by more than 650 cannabis dispensaries in four western (CA, CO, NM, WA) and five northeastern (ME, MA, NH, RI, VT) states found the average medicinal cannabis product was advertised with a 19.2 percent THC concentration and the average recreational cannabis product was advertised with a 21.5 percent THC concentration (Cash et al., 2020). Despite evidence showing lower potency cannabis (less than 5 percent THC) is more highly effective in pain management, marketed medicinal cannabis potency levels were only slightly lower than recreational cannabis potency levels (Cash, 2020; Wallace et al., 2015; Wilsey et al., 2013).

The potency of cannabis products is a highly relevant policy topic due to the rapidly evolving medical study of negative outcomes associated with higher potency cannabis. States that have legalized cannabis use have higher rates of cannabis use (Sabet, 2021). Accessibility to higher potency cannabis is growing as commercialization of the industry has grown – as cannabis "retail locations outnumber all McDonald's and Starbucks locations" in states like Colorado, where cannabis retailers (1,016) outnumbered the two retailers (600 combined) in 2018. This growth in use and availability of cannabis products in Colorado, for example, has tracked with similar increases in cannabis-related emergency hospital visits, with such activity increasing by 54 percent between 2013 and 2017 (Sabet, 2021).

Meanwhile, several recent studies have documented the associated mental health risks of high potency cannabis use. The first of these notable studies includes a British study that found a link between use of high potency cannabis and initial episodes of adult psychosis (DiForti et al., 2009). A decade later, a similar group of researchers found an association between high potency cannabis use and psychotic disorders across eleven sites in Europe (DiForti et al., 2019). Even more recently, a 2020 British medical study of more than 1,000 participants found that use of high potency cannabis increased the likelihood of anxiety and mental health disorders (Hines et al. 2020).

In the United States, the link between cannabis use and mental health hospitalization has only been studied in the limited geographic region of the Pacific Northwest. Moran et al. (2022) recently reported a higher level of psychosis-related hospital discharges in regions with higher levels of cannabis legalization, with a significant correlation between a cannabis legality score and psychosis hospitalizations. This study utilized the National Inpatient Sample database and considered 129,000 hospital discharges in 2017.

Research Question

This study expands on the research linking cannabis use and cannabis legality, and mental health hospitalizations, to explore the potential connection between cannabis legality, cannabis use, high potency cannabis, and mental health disorders, depression, and suicide. The study seeks to answer the research question: "**Is there a positive relationship between cannabis use by adolescents (ages 12-17) and young adults (ages 18-25) and corresponding mental health disorders, depression, and suicide in the United States?"** The study utilizes the geographic diversity of cannabis legality within the 50 states and the District of Columbia (n=51), the rates of cannabis use by these age groups by state as reported over time in the National Surveys on Drug Use and Health (NSDUH) over eight (t=8) annual time periods (2012-2019) and compares these datasets to mental health disorders, major depressive episodes, and suicidal thoughts, as reported over time in the NSDUH reports.

Additionally, consideration is given to constructing a legality index for state cannabis legalization (and subsequent corresponding access to high potency cannabis) and comparing this ordinal scale to mental health disorders, major depressive episodes, and suicidal thoughts. Results will determine whether correlation exists between the growing use of cannabis and the rising trend of mental health disorders, major depressive episodes, and suicide prevalence in the US.

What is Cannabis Induced Psychosis (CIP)?

A concept of psychosis caused by cannabis is at least 80 years old. Allentuck and Bowman (1942) denied the existence of cannabis-induced psychosis (CIP) in the 1940s. Professor H.B.M. Murphy (1963) reintroduced the idea in his review of literature in the 1960s. The Blum (1967) report stated, "[i]n the United States neither cannabis psychosis nor cannabis dependency has been described" and "inadequate data available today indicate that risk of crime, accidents, and suicide (and of undesirable physiological side effects) are not likely to be greater than those associated with alcohol" (pp. 24-25).

However, in the past 15 years, scholarly research has indicated a breakthrough in scientific data linking cannabis and psychosis. Copeland (2007) reintroduced the possibility of a connection, citing literature on the links between cannabis and schizophrenia, delusional thoughts, hallucinations, and impaired reality testing. The DiForti et al. (2009) study compared 280 British patients with first-episode psychosis to a control group of 174 patients and considered the duration, frequency, and types of cannabis use, controlled by age, gender, ethnicity, education achievement, and employment status. The DiForti et al. (2009) study concluded that increases in all three factors caused a greater likelihood in psychosis.

Figure 1: List of Longitudinal Studies Examined by Murray et al. (2016)

Study	Country	Design	No. participants	Follow-up (years)	OR (95% CI) (adjusted risk)
Tien & Anthony[52]	US	Population based	4,494	1	2.4 (1.2-7.1)
Zammit et al[53]	Sweden	Conscript cohort	50,053	27	3.1 (1.7-5.5)
Manrique-Garcia et al[54]				35	1.8 (1.3-2.3)
van Os et al[55]	The Netherlands	Population based	4,045	3	2.8 (1.2-6.5)
Weiser et al[56]	Israel	Population based	9,724	4-15	2.0 (1.3-3.1)
Fergusson et al[57]	New Zealand	Birth cohort	1,265	3	1.8 (1.2-2.6)
Arseneault et al[58]	New Zealand	Birth cohort	1,034	15	4.5 (1.1-18.2)
Ferdinand et al[59]	The Netherlands	Population based	1,580	14	2.8 (1.79-4.43)
Henquet et al[60]	Germany	Population based	2,437	4	1.7 (1.1-1.5)
Wiles et al[61]	UK	Population based	8,580	1.5	1.5 (0.55-3.94)
Rössler et al[62]	Switzerland	Community survey	591	30	1.8 (0.96-3.2)
Gage et al[63]	UK	Birth cohort	1,756	2	1.1 (0.76-1.65)
Rognli et al[64]	Sweden	Cohort of discharged prisoners	6,217	5	2.6 (1.40-5.0)

Murray et al. (2016) examined the results of 13 additional longitudinal studies comparing cannabis and psychosis (see Figure 1). These studies included almost 92,000 individuals from the US, UK, Sweden, New Zealand, the Netherlands, Germany, Switzerland, and Israel. The authors concluded: "Irrespective of whether use of cannabis is decriminalized or legalized, the evidence that it is a component cause of psychosis is now sufficient for public health messages outlining the risk, especially of regular use of high-potency cannabis and synthetic cannabinoids" (p. 195). Colizzi and Murray (2018) asserted the link between cannabis use and risk of psychosis is "now incontrovertible" with "dose-response relationship and high potency preparations" the most harmful, citing the need to investigate the "different models of legalization […] being introduced in North America" (p. 195).

In the United States, recent studies have confirmed the trends of the European studies. For example, Arterberry et al. (2019) conducted a Cox regression analysis of more than 500 Michigan patients, finding a 41 percent increase in likelihood of first-episode psychosis for every one percent unit increase in THC potency over the national average (4.9 percent THC). Additionally, a very recent study by Roehler et al. (2022) studied emergency department (ED) visits at US hospitals and found rising rates for both ED visits and cannabis use between 2006 and 2018. Meanwhile, Hines et al. (2020) completed the first population-evidenced study of cannabis use and mental health risk, concluding that limitations on the availability of high-potency cannabis could be associated with reductions in mental health disorders and addiction.

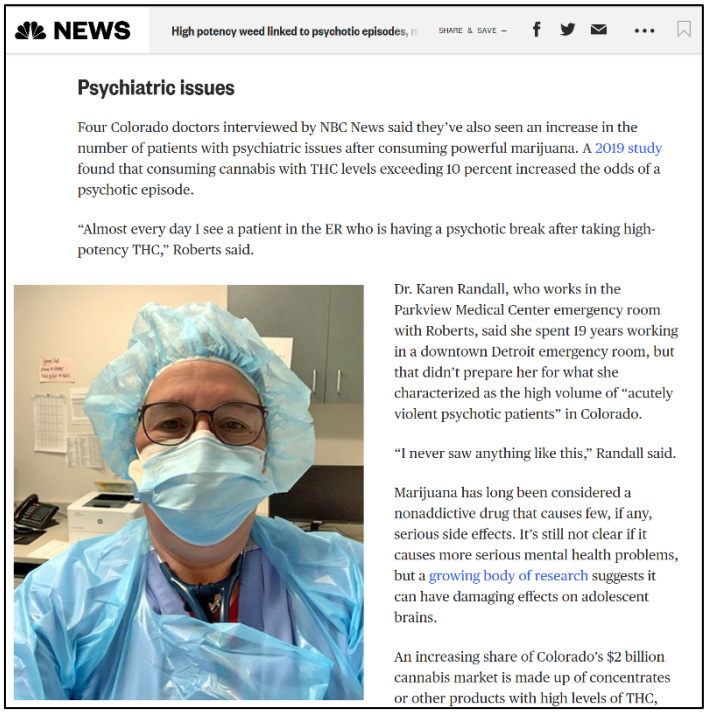
Research Context

Anecdotal validation of many of these studies exists, but is more exhaustive in discovery, yet likely more impactful to those affected. NBC News recently examined multiple reports of issues involving youth cannabis use and psychiatric issues in Colorado (Strickler & Patterson, 2021). Citing four interviewed doctors, including two doctors from Parkview Medical Center in Pueblo, CO, NBC News

reported “an increase in the number of patients with psychiatric issues after consuming powerful marijuana,” a trend that tracks with the research results of the DiForti et al. (2019) study.

One emergency room doctor in Pueblo told NBC News: “Almost every day I see a patient in the ER who is having a psychotic break after taking high-potency THC” (Strickler & Patterson, 2021). Another doctor from Parkview, who had previously worked in downtown Detroit, stated that she wasn’t prepared for “high volume of ‘acutely violent psychotic patients’ in Colorado.” She further stated to NBC News: “I never saw anything like this” (Strickler & Patterson, 2021).

Figure 2: NBC News Report on High Potency Cannabis



NEWS

High potency weed linked to psychotic episodes,

SHARE & SAVE

Psychiatric issues

Four Colorado doctors interviewed by NBC News said they’ve also seen an increase in the number of patients with psychiatric issues after consuming powerful marijuana. A 2019 study found that consuming cannabis with THC levels exceeding 10 percent increased the odds of a psychotic episode.

“Almost every day I see a patient in the ER who is having a psychotic break after taking high-potency THC,” Roberts said.

Dr. Karen Randall, who works in the Parkview Medical Center emergency room with Roberts, said she spent 19 years working in a downtown Detroit emergency room, but that didn’t prepare her for what she characterized as the high volume of “acutely violent psychotic patients” in Colorado.

“I never saw anything like this,” Randall said.

Marijuana has long been considered a nonaddictive drug that causes few, if any, serious side effects. It’s still not clear if it causes more serious mental health problems, but a growing body of research suggests it can have damaging effects on adolescent brains.

An increasing share of Colorado’s $2 billion cannabis market is made up of concentrates or other products with high levels of THC,

Aside from psychiatric disorders, an additional disorder – called cannabinoid hyperemesis syndrome, or “scromiting” for its combination of screaming and vomiting – has seen a rapid increase in several Colorado hospitals. One interviewed doctor told NBC News that he had personally seen a nine-year rise from five cases in 2009 to more than 120 cases by 2018. An unlucky 17-year-old victim of the disorder told NBC News: “It felt like Edward Scissorhands was trying to grab my intestines and pull them out” (Strickler & Patterson, 2021). A study of Colorado cannabis-induced cyclic vomiting disorders, which examined more than 2,500 hospital visits and included qualitative interviews with 36 patients, showed the prevalence nearly doubled after more liberal regulations increased cannabis use through the Colorado medical program in 2009 (Kim et al., 2015).

Cannabis has been legal for medical use in Colorado since the passage of a state constitutional amendment in November 2000. In 2012, again by constitutional amendment, voters established Colorado as the second US state to legalize cannabis for recreational use, just four days after the State of Washington legalized recreational use. As stated earlier, the geographic diversity of state regulations in the United States provides a unique opportunity to compare different levels of legality with a nationwide state-by-state database of cannabis use and mental health outcome statistics.

The State of the States: Cannabis Legalization in the US

If the review of literature is certain on one aspect of scholarly research on cannabis liberalization, more scrutiny needs to be given, as Colizzi and Murray (2018) summarized, to the increase in high potency cannabis products, cannabis-induced psychosis, and the differing models of American legalization. This study adopts aspects from multiple studies cited earlier. A descriptive look at use and mental health outcomes is borrowed from Roehler et al. (2022). Yet, a greater level of geographic variety is implemented from the methodology of Moran et al. (2022), such as the development of an ordinal scale. Finally, consideration of the effect of legalization on high-potency cannabis products is modeled similarly to the methodology of Cash et al. (2020).

For purposes of modeling legality in the United States, an ordinal scale (see Figure 3) that considers the following regulator conditions by state has been consolidated for use in this study: full illegality, decriminalization only, medicinal

Figure 3: Ordinal Scale for State Legality

Legality Index
1 = Fully Illegal
2 = Decriminalized Only
3 = Medicinal Program (Low THC), No Decriminalization
4 = Medicinal Program (Low THC), Decriminalized
5 = Medicinal Program, Decriminalized
6 = Recreational & Medicinal Program

Sources:

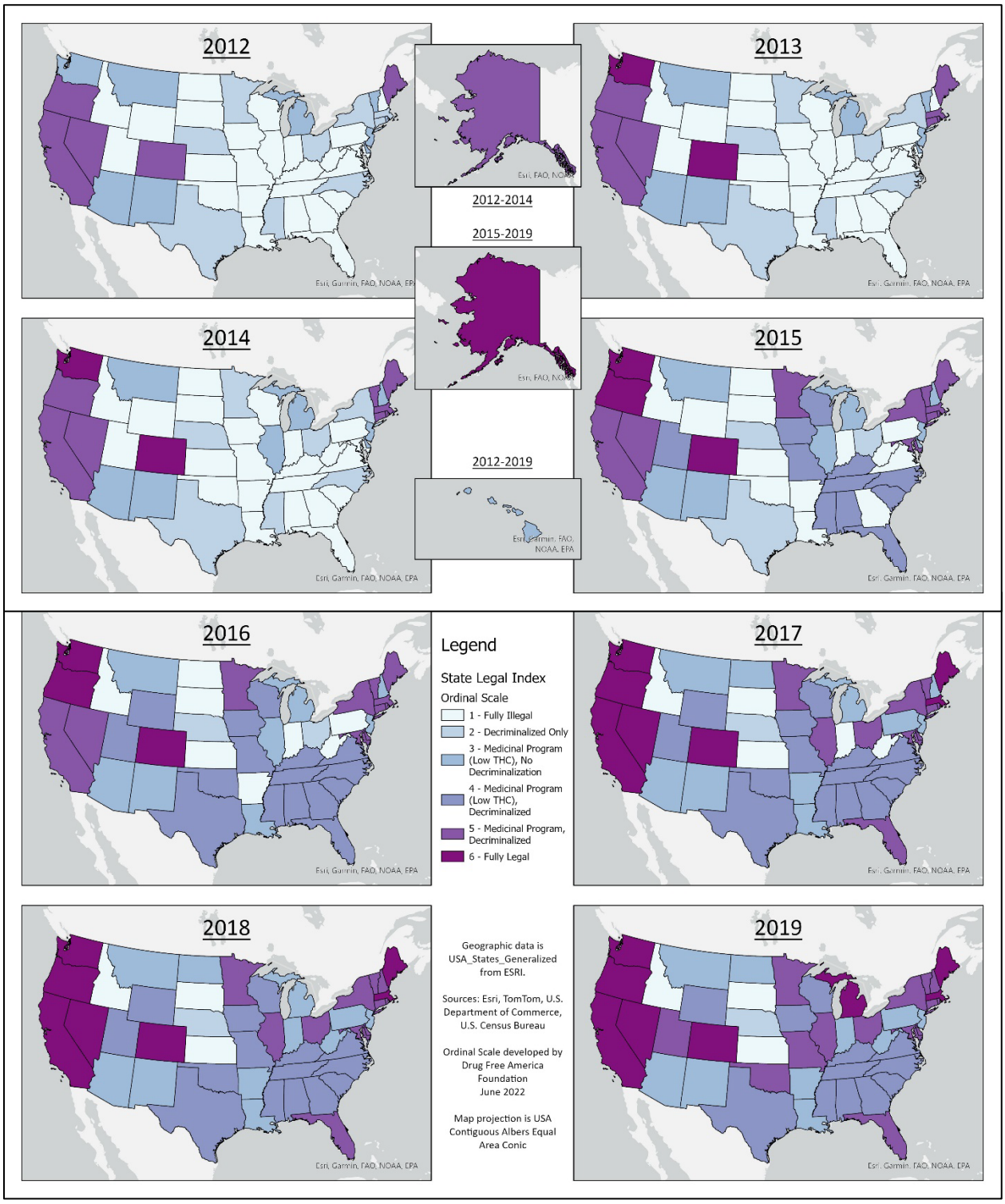
National Conference of State Legislatures. (2022, April 19). State medical cannabis laws.

DISA Global Solutions. (n.d.). Map of marijuana legality by state.

Legality of cannabis by U.S. jurisdiction. (n.d.). In Wikipedia.

Timeline of cannabis laws in the United States. (n.d.). In Wikipedia.

Figure 4: Visualization of Ordinal Scale for State Legality (Legal Index) 2012-2019



programs with low-THC without decriminalization, medicinal programs with low-THC with decriminalization, full medicinal programs with decriminalization, and full legalization. This six-level scale expands on the three-level scale recently utilized by Moran et al. (2022) and incorporates reflections of state legality from three different sources, including the National Conference of State Legislatures (NCSL), a private contractor (DISA Global Solutions), and a crowd-sourced website database (Wikipedia). The scale was applied for the eight-year period of study (2012-2019) and a one-year lag was applied to any legislative or constitutional change to allow for program implementation (a time-series visual depiction of the legality index is displayed in Figure 4).

Framework for Study: The Bradford Hill Criteria

The evolving story from association between high-potency cannabis and psychosis and causation continues to be a complicated endeavor (Colizzi & Murray, 2018). As Ganesh and D-Souza (2022) suggested, even several frameworks potentially exist in tandem for consideration: epidemiological, genetic, and criterion-based. This third framework, as the authors note as "establish[ment] of a causal relationship between a cause and an observed effect", refers to a set of criteria outlined by Bradford Hill that includes strength of the association, consistency, specificity, temporality, biological gradient, plausibility, coherence, experiment, and analogy (Ganesh and D-Souza, 2022, p. 9; and illustrated in Figure 5). One newly reported US study of the prevalence of self-reported

Figure 5: Recent Studies Rated for Bradford Hill Criteria by Ganesh and D-Souza, 2022

Study Authors	Year	Hill Criteria
Di Forti et al.	2015	Strength, biological gradient
Di Forti et al.	2019	Strength, biological gradient
Hjorthøj et al.	2021	Strength, biological gradient
Myles et al.	2016	Temporality
Marconi et al.	2016	Consistency, biological gradient
Hjorthøj et al.	2019	Strength, specificity, biological gradient
Bechtold et al.	2015	Absence of association
Kelly et al.	2016	Strength, specificity, temporality, biological gradient
Kraan et al.	2016	Strength, consistency, temporality, biological gradient
Lasenikan et al.	2016	Strength
Libuy et al.	2018	Specificity
Maloney-Hall et al.	2020	Biological gradient
Mustenon et al.	2018	Strength, specificity, temporality
Neilson et al.	2017	Specificity, temporality
Starzer et al.	2018	Specificity
van Os et al.	2021	Specificity
Freeman et al.	2015	Experiment
Ganesh et al.	2020	Biological gradient, experiment
Guy et al.	2020	Experiment
Bloomfield et al.	2015	Plausibility, coherence
Bossong et al.	2016	Plausibility, coherence
D'Souza et al.	2020	Plausibility, coherence
Jose-Cortes et al.	2015	Plausibility, coherence, experiment
Sherif et al.	2017	Plausibility, coherence
Ryan et al.	2020	Absence of association after inclusion of covariates
Schoeler et al.	2016	Biological gradient
Fakhoury et al.	2017	Plausibility
Morgan et al.	2018	Experiment

psychotic disorders using the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) used proxy measures to test the strength of association between factors (Livne et al., 2022).

This study largely seeks to utilize differing US population-based datasets to investigate a similar question of strength of association – utilizing panel data model as opposed to a differences-in-differences model. The foundation that Livne et al. (2022) provides for this US-based, longitudinal view of the population data is significant for several important and nuanced reasons. Notably, the Livne et al. (2022) findings first report a significant change in the prevalence of self-reported US psychotic disorders. Additionally, Livne et al. (2022) included medical and recreational cannabis regulations within their study design. Finally, the corresponding results, including an increase in prevalence of self-reported psychotic disorders by cannabis users and an overall increase in psychosis prevalence in the US, should be noteworthy to researchers, policymakers, cannabis-users, and the American public alike.

This study, however, is both descriptive and exploratory in nature, seeking to better detail the variations between US states, the effect of their regulatory approaches to cannabis use, and the effect of population-adjusted cannabis use upon the prevalence of self-reported depressive events, mental health disorders, and thoughts of suicide. This research framework fits within both the strength of association and temporality criteria, although applications to specificity should also be considered. Trend results, as well as a panel analysis of data, will provide both trends for use and associations to the dependent variables, in line with recently identified gaps in current research (Hamilton & Sumnall, 2021). It cannot be understated that perceived risks between cannabis use and psychosis have been trumpeted by researchers more loudly over the past decade and are not new revelations (Shapiro & Buckley-Hunter, 2010), and despite the warnings, attention is only now spreading to the potential effects of high-potency THC cannabis. Filling these potential gaps in both research and knowledge can provide better information to policymakers and, more specifically for adolescents considering cannabis use, can ultimately lead to better policymaking and more informed life choices for future Americans.

Data and Methodology

Two main data sources guide this study: the National Survey on Drug Use and Health (NSDUH) survey from the Substance Abuse and Mental Health Services Administration (SAMHSA) and the American Community Survey (ACS) from the US Census Bureau. NSDUH data has a rich history within the debate over causation between cannabis use and use disorders (Azofeifa et al., 2016; Compton et al., 2016). For example, Carliner et al. (2017) studied the growth of cannabis use during the period of the Great Recession using NSDUH data, finding an increasing gender gap that skewed towards use among lower income men.

These studies provided early looks at the evolution of cannabis use at the infancy of changes to state legalization schemes. In recent years, SAMHSA has standardized its annual NSDUH reporting, providing state tables for 26 different drug-related topics. In this study, the dependent variables include data from NSDUH Tables 23 (Serious Mental Illness), 25 (Serious Thoughts of Suicide), and 26 (Major Depressive Episode), which include population-adjusted survey response estimates to self-reported mental health outcomes within these three topic areas. According to the annual guides for the NSDUH State Tables and Summary of Small Area Estimation Methodology (2013), SAMHSA uses survey-weighted hierarchical Bayes (SWHB) estimation methodology to produce state-level estimates (p. A-1). SAMHSA employs a 50-state survey design that includes 3,600 targeted annual responses from 8 large states (CA, FL, IL, MI, NY, OH, PA, and TX) and 900 targeted annual responses from the remaining 42 smaller states and the District of Columbia. The design oversamples youth to allow for the age breakouts (12-17, 18-25, and 26+).

NSDUH data for cannabis youth among the various age groups represents the independent variable of interest. As with the dependent variables, data represents estimates of cannabis use within the past year or month, based upon the SAMHSA model design (see the Guide to State Tables and Summary of Small Area Estimation Methodology for greater detail). Cannabis use within the past month

was chosen as the independent variable of interest due to the previous literature focus on frequency, duration, and potency.

Several control variables were chosen to better model the estimation. These variables include various data from the 1-year estimates of the American Community Survey from the US Census Bureau. Tested variables include controls for gender, race, ethnicity, marital status, educational attainment, military service, and employment status. These control variables are consistent with those utilized in DiForti et al. (2009) and are designed to increase the accuracy of the panel data model estimation.

Descriptive Statistics and the Legal Index

An initial interest in whether mean data varies differing legal regulatory statuses shows that recreational cannabis programs increase cannabis use among all three age groups (see Figure 6). Among those ages 12-17, the use of cannabis per 100 persons increased 47 percent in states with a fully legal recreational cannabis program. The increase among persons ages 18 to 25 was substantially higher, with almost 81 percent more persons using monthly in fully recreational states over states where cannabis is fully illegal. Almost 30 percent of young adults (18-25) use cannabis on a monthly basis in states with recreational cannabis programs. Although the overall percentage of monthly use of cannabis was lower among persons

Figure 6: Mean Statistics for Cannabis Use in Past Month by Legal Index Status (by Age Group)

Age 12-17 Marijuana Use in the Past Month

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**6.26**	6.08	4.33	10.56	1.1377	0.1818	1.2876	2.4414
2	31	**6.72**	6.47	5.11	10.87	1.2348	0.1837	1.3777	2.3719
3	79	**7.66**	7.62	4.93	14.03	1.8699	0.2441	0.8496	1.0429
4	69	**5.82**	5.91	4.22	7.69	0.7196	0.1237	-0.0967	-0.2606
5	79	**8.53**	8.52	4.44	13.65	1.8426	0.2159	0.4851	0.0457
6	42	**9.20**	9.29	5.63	12.07	1.2623	0.1372	-0.2913	0.6351

Age 18-25 Marijuana Use in the Past Month

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**16.19**	15.89	9.68	26.58	3.2129	0.1985	1.0338	1.6397
2	31	**17.47**	17.49	13.11	25.07	2.9929	0.1713	0.4611	-0.4076
3	79	**20.54**	20.04	14.13	31.35	4.0186	0.1956	0.6326	-0.1993
4	69	**16.69**	17.11	10.76	20.91	2.2183	0.1329	-0.4742	-0.3684
5	79	**24.71**	24.05	14.13	39.10	5.1079	0.2067	0.7357	0.6418
6	42	**29.24**	30.21	21.39	37.36	4.0406	0.1382	-0.2028	-0.9534

Age 26+ Marijuana Use in the Past Month

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**4.63**	4.54	2.41	9.49	1.2168	0.2626	1.0531	1.9428
2	31	**4.79**	4.89	3.11	7.06	1.0896	0.2275	0.1717	-1.1391
3	79	**7.35**	7.06	3.52	12.66	1.9687	0.2680	0.4687	-0.2491
4	69	**5.51**	5.59	3.18	8.32	1.1405	0.2069	0.1257	-0.4864
5	79	**8.68**	8.10	4.71	16.61	2.5259	0.2910	1.1066	0.9881
6	42	**12.76**	13.40	8.68	17.39	2.3330	0.1829	0.0322	-0.9530

26 years or older, the rate of use between fully illegal states and recreationally legal states represented the highest growth rate (175 percent), with 12.76 percent of the population using cannabis monthly in fully recreational states as opposed to 4.63 percent in fully illegal states.

Mean statistical differences in major depressive events increased with legal status, as well, but only among the two younger age groups. There was little difference in major depressive events among persons ages 26 and older, regardless of the state legal index (see Figure 7). Among persons

Figure 7: Mean Statistics for Major Depressive Events by Legal Index Status (by Age Group)

Age 12-17 Major Depressive Events (MDE)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**10.63**	10.01	6.15	17.51	2.2619	0.2128	0.8912	0.5980
2	31	**10.24**	10.19	7.50	15.02	2.0504	0.2002	0.6493	-0.4327
3	79	**12.21**	12.04	7.67	18.84	2.4370	0.1995	0.5478	-0.3334
4	69	**13.26**	13.19	10.16	17.11	1.7317	0.1306	0.3411	-0.7233
5	79	**12.99**	13.08	7.53	18.00	2.2176	0.1707	-0.2014	-0.1772
6	42	**13.91**	14.40	7.98	18.59	2.7648	0.1988	-0.5701	-0.3382

Age 18-25 Major Depressive Events (MDE)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**9.36**	8.92	6.03	16.32	1.9915	0.2128	1.3813	1.8614
2	31	**9.10**	8.49	6.72	15.39	1.9829	0.2179	1.4189	1.8403
3	79	**10.82**	10.01	7.32	17.23	2.4359	0.2251	0.5220	-0.8737
4	69	**11.37**	11.24	7.59	16.32	2.0883	0.1837	0.3228	-0.5708
5	79	**11.74**	11.25	7.86	17.35	2.5075	0.2136	0.4898	-0.7475
6	42	**13.42**	13.53	8.00	17.17	2.3784	0.1772	-0.3524	-0.5071

Age 26+ Major Depressive Events (MDE)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**6.29**	6.26	4.64	8.33	0.7372	0.1172	0.3043	0.3608
2	31	**6.14**	5.97	4.94	7.31	0.5898	0.0960	0.1473	-0.9400
3	79	**6.17**	6.15	4.44	8.08	0.8308	0.1348	0.0640	-0.3724
4	69	**6.21**	6.17	4.67	8.16	0.7350	0.1184	0.2390	0.0437
5	79	**6.22**	6.15	5.00	8.16	0.7769	0.1248	0.4239	-0.8083
6	42	**6.45**	6.53	5.12	8.10	0.6728	0.1043	0.0586	-0.3428

Figure 8: Mean Statistics for Severe Mental Illness and Suicidal Thoughts by Legal Index Status (by Age Group)

Age 18-25 Serious Mental Illness (SMI)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**4.83**	4.41	3.15	9.68	1.4014	0.2904	1.7805	2.8609
2	31	**4.64**	4.24	3.19	8.86	1.3567	0.2922	1.5617	1.9762
3	79	**5.95**	5.34	3.17	9.36	1.7592	0.2954	0.3525	-1.1780
4	69	**6.38**	6.32	3.66	9.80	1.4923	0.2339	0.3893	-0.6579
5	79	**6.23**	5.86	3.49	10.79	1.7961	0.2883	0.5211	-0.8174
6	42	**7.36**	7.27	4.17	11.54	1.7870	0.2429	0.0823	-0.4177

Age 26+ Serious Mental Illness (SMI)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**4.15**	4.11	2.93	5.47	0.5848	0.1408	0.2160	-0.5589
2	31	**4.03**	4.01	3.01	4.89	0.5320	0.1322	-0.0352	-0.9799
3	79	**4.04**	4.05	2.73	5.50	0.6459	0.1599	-0.1343	-0.6902
4	69	**4.21**	4.21	2.83	5.31	0.5504	0.1306	-0.0942	-0.4557
5	79	**4.01**	3.88	2.66	5.48	0.6350	0.1584	0.4206	-0.5262
6	42	**4.22**	4.20	3.17	5.15	0.5122	0.1214	-0.2433	-0.8133

Age 18-25 Suicidal Thoughts (SuT)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**7.61**	7.23	6.12	13.69	1.4707	0.1932	2.0070	4.1793
2	31	**7.33**	7.04	5.35	12.12	1.4859	0.2027	1.4292	2.2538
3	79	**9.02**	8.62	6.35	13.79	1.8961	0.2102	0.4992	-0.6733
4	69	**9.31**	8.99	6.50	13.47	1.7361	0.1864	0.3067	-0.8620
5	79	**9.24**	8.86	6.26	14.56	1.9392	0.2098	0.6009	-0.5159
6	42	**10.52**	10.32	6.85	14.15	1.9920	0.1894	0.0069	-0.7399

Age 26+ Suicidal Thoughts (SuT)

Legal Index	Observations	Mean	Median	Minimum	Maximum	SD	C.V.	Skewness	Ex. Kurtosis
1	108	**3.32**	3.30	2.71	4.58	0.3600	0.1084	0.5740	0.5203
2	31	**3.22**	3.19	2.60	3.85	0.3111	0.0966	0.2034	-0.5547
3	79	**3.35**	3.33	2.47	4.22	0.3880	0.1158	0.2420	-0.2464
4	69	**3.35**	3.37	2.48	4.59	0.4515	0.1347	0.4251	0.0692
5	79	**3.32**	3.24	2.57	4.56	0.4549	0.1370	0.8007	0.3262
6	42	**3.66**	3.63	2.95	4.54	0.4080	0.1114	0.1739	-0.7976

12-17 years of age, the mean average of major depressive events increased from a mean of 10 percent to mean of almost 14 percent in states with fully legal recreational cannabis programs. Among persons ages 18-25, the results were similar, with growth from approximately 9 percent to almost 13.5 percent as the legalization status increased.

While statistics for serious mental illness (SMI) and suicidal thoughts (SuT) are not available for the 12-17 age group, differences in means for prevalence within the 18-25 age group were starkly different than for those persons 26 years of age and greater. As seen in Figure 8, prevalence of serious mental illness and suicidal thoughts increased as legalization of cannabis increased amongst the younger age group but were static for older persons. The prevalence of serious mental illness (SMI) in persons ages 18-25 grew by nearly 52 percent (or 2.5 percent points) as legalization increased and the prevalence of suicidal thoughts (SuT) grew by almost 38 percent (or nearly 3 percentage points).

Panel Data Models

While a difference-in-means provides a descriptive visualization of prevalence, it does not provide a more correlative view of the linkage between cannabis use and incidences of major depressive events, serious mental illness, and suicidal thoughts. However, model estimation through panel methods such as pooled ordinary least squares (OLS), fixed effects of random effects models consider how correlation between independent and dependent variables might explain linkages between data.

In this study, observations from the 50 states and DC (n=51) and survey years 2012 to 2019 (t=8) provide the opportunity to estimate a model for data with 408 points of observation. Panel data is a combination of cross-sectional and time-series regression, where data is observed over multiple geographic and time periods, which helps to control bias from unobserved independent variables (Brugger, 2021). Again, other variables, generated from US Census American Community Survey 1-Year Surveys from 2012-2019, were populated into the panel data to control for gender, race, ethnicity,

marital status, educational attainment, and employment status, and are consistent with the control variables chosen in DiForti et al. (2009) (see Figure 9).

Figure 9: Variables of Interest for Panel Data Regression

Dependent Variables	Source
Major Depressive Events	NSDUH Annual Survey
Serious Mental Illness	NSDUH Annual Survey
Suicidal Thoughts	NSDUH Annual Survey
Independent Variable	**Source**
Marijuana Use in Past Month	NSDUH Annual Survey
Control Variables	**Source**
Percentage Male (Estimated by Age Group)	US Census ACS 1-Year Survey
Percentage Married	US Census ACS 1-Year Survey
Percentage Attained Bachelor Degree	US Census ACS 1-Year Survey
Percentage Veteran Status	US Census ACS 1-Year Survey
Percentage Unemployed	US Census ACS 1-Year Survey
Percentage White	US Census ACS 1-Year Survey
Percentage Hispanic	US Census ACS 1-Year Survey

If the goal of the study is to determine if there is a positive relationship between cannabis use by adolescents (ages 12-17) and young adults (ages 18-25) to corresponding mental health disorders, depression, and suicidal thoughts in the United States, the null hypotheses are no correlation between the independent variable of cannabis use in the past month and each of the dependent variables for major depressive events, serious mental illnesses, or suicidal thoughts. Therefore, statistically significant correlation between the independent variable of interest (cannabis use in the past month) and the specific dependent variables (major depressive events, severe mental illnesses, or suicidal thoughts) would cause a rejection of a null hypothesis and a positive result would indicate that cannabis use influences the prevalence of these mental health issues within the specified population (either adolescents, young adults, or mature adults).

Each dataset was considered for panel data analysis by pooled OLS, fixed effects, or random effects panel regression. Fixed effects regression was chosen for all but one regression, due to test results for common group intercepts, named regressors, inconsistent GLS estimation (Hausman test), correlation between the regressors and their unique errors (Breusch-Pagan test), and cross-sectional dependence (Pesaran CD test). To correct for heteroskedasticity and autocorrelation, HAC robust standard errors were deployed.

Analysis and Findings

The results of the exploratory panel data analysis clearly show correlation between cannabis use and major depressive events, severe mental illness, and suicidal thoughts, especially prevalent among younger age groups. The independent variable of interest (cannabis use in the past month) displayed statistical significance in three fixed effects panel regressions with the dependent variable major depressive events, although the R-squared measurement for the adults aged 26 and older dipped from the strong measures for both adolescents and young adults, suggesting that other unexplained measures impact depression in mature adults. Similarly, the independent variable of interest (cannabis use in the past month) also showed strong correlation and R-squared results for young adults against the dependent variables severe mental illnesses and suicidal thoughts, with less strong results for mature adults (full results are displayed in Figures 10 and 11). R-squared measures are a statistical display of model fitness and indicate the amount of variation of a dependent variable that is explained by the independent variables.

Major Depressive Events (MDE)

Cannabis use displayed a strong correlation with major depressive events, while controlling for gender, marital status, educational attainment, veteran status, unemployment status, race, and ethnicity. Statistical significance was shown among all three age groups, with stronger impacts displayed among younger populations. These population prevalence results are consistent with previous epidemiological research on cannabis-induced psychosis (Marconi et al., 2016; Moran et al., 2022) and especially the epidemiological research on cannabis use and brain development in adolescents (Malone, Hill & Rubino, 2010; Penzel et al., 2021). While positive, statistically significant correlation was displayed among all three age groups, the impact of cannabis use was stronger among the adolescent age group (a 0.45 percent increase in major depressive events per one percent increase

in cannabis use) and was reduced by half (0.21 percent increase) in young adults, and by half again (0.12 increase) among mature adults.

Additionally, while R-squared results were strong among adolescents and young adults,[3] the R-squared results dropped precipitously among mature adults, indicating a greater number of unexplained, missing control variables for this age group. These results potentially provide validation of the previously cited epidemiological results with population prevalence data.

Figure 10: Panel Data Regression Results (MDE)

Panel Data Regression Results
Dependent Variable: **Major Depressive Events** (MDE)

Age Category	Age 12-17	Age 18-25	Age 26+
Dependent Variable	MDE	MDE	MDE
Constant	20.09	-22.27	5.92
	(1.110)	(-1.341)	(0.622)
Cannabis Use	**0.45*** **	**0.21*** **	**0.12*** **
	(4.666)	(7.577)	(3.662)
Gender	-0.03	0.04	0.01
	(4.334)	(0.271)	(0.064)
Marital Status	-0.22	-0.01	0.07
	(1.309)	(-0.028)	(1.257)
Educational Attainment	**0.52*** **	**1.04*** **	0.01
	(3.984)	(8.457)	(0.120)
Veteran Status	**-1.05*** **	-0.39	0.16
	(-5.022)	(-1.819)	(1.666)
Unemployment Status	**-0.53*** **	**0.28** **	^
	(-3.686)	(2.122)	^
Race	-0.14	-0.14	-0.05
	(-0.848)	(-0.951)	(-0.853)
Ethnicity	0.55	**0.72*** **	-0.17
	(1.586)	(2.600)	(-1.609)
Observations	408	408	408
Panel Type	Fixed Effects	Fixed Effects	Fixed Effects
LSDV R-squared	0.8636	0.8547	0.6613
Within R-squared	0.8278	0.8241	0.0939
HAC Standard Errors	Yes	Yes	Yes

^ Omitted due to impact on cross-sectional dependence

[3] LSDV R-squared was 0.8636 and 0.8547 and Within R-squared was 0.8278 and 0.8241, respectively, indicating that approximately 86 percent of the explanation for MDEs in adolescents and 83 percent of the explanation for MDEs in young adults can be described through these variables.

The three fixed effects panel regression models also displayed statistical significance with control variables such as educational attainment and employment status within both the adolescent and young adult models, as well as the control variable for veteran status for adolescents only, and the control variable for ethnicity for young adults only. For example, a rise in education attainment also positively correlated with major depressive events in both the adolescent and young adult regressions, indicating that depression is prevalent in more highly educated states. Gender variables were excluded from the younger age group models due to autocorrelation issues and employment was excluded from the mature adult model due to its impact on cross-sectional dependence tests.

Severe Mental Illnesses (SMI) and Suicidal Thoughts (SuT)

Fixed effects panel regression models displayed similar results for correlation between cannabis use and self-reported severe mental illnesses and suicidal thoughts among young adults (between 18-25 in age), although lack of data for adolescents (between 12-17 in age) and poor R-squared results for mature adults (aged 26 and older) provided less clarity outside of the young adult age group. Statistically significant, positive correlation between cannabis use and severe mental illnesses showed an impact of 0.12 percent growth of severe mental illnesses for every one percent growth in cannabis use among young adults. This result validates the growth in mental illnesses displayed in highly permissive states that was displayed in the differences-in-means results in Figure 8. These two statistical test results (differences-in-means and fixed effects panel regression), along with previous research on the growth in THC levels in highly permissive US states (Moran et al., 2022), suggests that the greater the regulatory permissiveness with cannabis, followed by a greater percentage use of cannabis by young adults, followed by a greater prevalence in self-reported severe mental illnesses, could be causal in nature. And, while the differences-in-means tests showed an 81 percent increase in cannabis use by young adults (ages 18-25) in the most permissive states versus the least permissive

states, the test results also showed a 47 percent increase in cannabis use by adolescents (ages 12-17) between the same comparative states. While cannabis might still be illegal to adolescents in all US states, the data suggests that highly permissive state regulatory structures are incapable of keeping cannabis out of the hands of adolescents. Even more alarming, the correlation between cannabis use and self-reported severe mental illnesses is unknown due to the lack of reportable data.

Finally, positive, statistically significant correlation was also found between cannabis use and self-reported suicidal thoughts in young adults (ages 18-25). The impact of cannabis use displayed a

Figure 11: Panel Data Regression Results (SMI & SuT)

Panel Data Regression Results

Dependent Variable: **Severe Mental Illnesses (SMI) & Suicidal Thoughts (SuT)**

Age Category	Age 18-25	Age 26+	Age 18-25	Age 26+
Dependent Variable	SMI	SMI	SuT	SuT
Constant	-18.41	6.18	-13.21	1.793
	(-1.397)	(.963)	(-0.842)	(0.909)
Cannabis Use	**0.12*** **	**0.08*** **	**0.11*** **	**0.07*** **
	(4.717)	(3.359)	(3.329)	(4.560)
Gender	-0.01	-0.11	0.05	0.03
	(-0.019)	(-0.810)	(0.313)	(0.633)
Marital Status	0.06	**0.09*** **	0.16	0.07
	(0.5052)	(2.508)	(1.182)	(0.350)
Educational Attainment	**0.70*** **	0.02	**0.73*** **	**-0.02*** **
	(7.414)	(0.554)	(6.255)	(-3.045)
Veteran Status	**-0.51*** **	-0.04	**-0.59*** **	-0.03
	(-3.683)	(-0.865)	(-3.405)	(-1.282)
Unemployment Status	0.17	0.07	0.20	-0.04
	(1.785)	(1.439)	(1.602)	(-0.218)
Race	-0.05	-0.02	-0.19	0.04
	(-0.473)	(-0.335)	(-1.400)	(1.679)
Ethnicity	**0.48** **	-0.03	**0.51** **	**-0.01*** **
	(2.536)	(1.439)	(2.107)	(-3.727)
Observations	408	408	408	408
Panel Type	Fixed Effects	Fixed Effects	Fixed Effects	Random (GLS)
LSDV R-squared	0.8579	0.7682	0.8076	
Within R-squared	0.8370	0.1676	0.7797	
HAC Standard Errors	Yes	Yes	Yes	Yes

^ All fixed effect models showed significant results for tests for joint named regressors, differing group intercepts, and cross-sectional dependence

0.11 increase in the percentage of self-reported suicidal thoughts in young adults for every one percent increase in cannabis use. The fixed effects panel regression model showed similarly strong R-squared results, while panel regression tests for mature adults required use of a random effects model due to consistency in GLS estimates. As with the fixed effects panel regression models for major depressive events, statistical significance was displayed for educational attainment, veteran status, and ethnicity for young adults (ages 18-25).

The goal of this study was to answer the research question of whether **a positive relationship exists between cannabis use by adolescents (ages 12-17) and young adults (ages 18-25) and corresponding mental health disorders, depression, and suicide in the United States. The panel regression models clearly show a correlation between cannabis use and self-reported major depressive events, severe mental illnesses, and suicidal thoughts, while controlling for age, gender, marital status, race, ethnicity, education achievement, veteran status, and employment status**. While there is no population measure for cannabis-induced psychosis (CIP) in the US, potential causation exists between cannabis use and three self-reported mental health disorders regularly measured and reported by a federal health agency.

Contributions, Limitations, and Future Research Opportunities

The results of this study bring greater attention to the potential link between high potency cannabis and mental health disorders. Data clearly shows that cannabis use by adolescents and young adults clearly grows as individual US states create more permissive regulatory environments. Previous research plainly details the growth of THC levels in legalized cannabis, especially in states with recreational programs (Cash et al., 2022). The research also shows a clear connection between this increase in THC potency and cannabis-induced disorders (Arterberry et al., 2019), negative impacts on adolescent brain development, and the onset of psychosis (Penzel et al., 2022). This study of US

population prevalence data demonstrates a statistically significant correlation between monthly cannabis use and self-reported mental health disorders, including major depressive events, severe mental illness, and suicidal thoughts.

While cannabis use continues to be recreationally illegal for all US adolescents, including those in more highly permissive US states, the differences-in-means tests brings clarity to the growth in adolescent cannabis use in US states with more permissive cannabis regulations. Coupled with rapid growth in THC levels in these same states, greater attention should be given to the potential mental health risks posed to adolescents and young adults. As epidemiological research continues to unlock the physiological connections between cannabis use, brain development, and cannabis-induced psychosis (CIP), greater research consideration should be given to exploration of the prevalence of cannabis-induced psychosis in highly permissive US states. Additionally, further consideration should be given to data collection of average THC levels in cannabis products marketed and sold in highly permissive US states.

Several limitations exist within this study that provided several obstacles in adding additional control variables and in the estimation of demographic data. First, the choice of control variables in the panel regression data was guided by literature. DiForti et al. (2009) utilized age, gender, ethnicity, education achievement, and employment status in their groundbreaking epidemiological study. In this study, multicollinearity issues preempted the use of certain other control variables, such as alcohol use and other drug use, in the consideration of major depressive events. Multicollinearity is a statistical problem that exists when two or more independent variables are highly correlated with one another in a regression model and are identified using correlation matrix tests. If statistically significant collinearity between independent variables is determined, conflicting variables are removed from the regression. While age groups were separated into three groups, the gender variable was estimated for the specific age group within each model using relevant census data. While education, employment, and ethnicity

showed significance across several of the panel models, race and marital status were not statistically significant control variables.

An additional limitation includes the influence of dissimilar age groupings in the estimation of age group populations using NSDUH data and the US Census American Community Survey data. The NSDUH data is annually reported within three age ranges (ages 12-17, 18-25, and 26+) and those ranges were employed as three groups within this research. The US Census Bureau American Community Survey 1-Year reports provide state population estimates as populations of ages 15 and older, ages 18 and older, ages 18-24, and ages 25 and older. These totals were utilized to annually estimate total state populations within the NSDUH ranges, but estimations of ages 12-14 and 25 were necessary due to the lack of specific US Census data within those ranges. The lack of congruent data could decrease the accuracy of statistical prevalence estimates.

Finally, a link between high potency cannabis and cannabis-induced psychosis could be more clearly presented if data measures existed to quantify the levels and prevalence of these variables within the US states. For this research, proxies were utilized to demonstrate the connection between these phenomena. Previous literature clearly demonstrates a link between the growth of more highly permissive state cannabis laws and THC levels. The differences-of-means results clearly shows greater use of cannabis among adolescents and young adults in states with greater access to cannabis, along with greater prevalence of mental health disorders. However, due to the lack of nationwide high potency cannabis and cannabis-induced psychosis (CIP) data, cannabis use and the three mental health disorders are utilized as proxies for analysis. While a logical conclusion can be drawn between the two phenomena using these proxies, this research indicates a clear need for the development of more exact measures for the actual variables of interest. As logic dictates, the uncertainty of the proxies is, therefore, a study limitation.

This research does contribute greatly to the growing field of study of cannabis-induced mental health disorders. Utilizing federally reported prevalence data, a clear link is established between frequent cannabis use and self-reported depression among adolescents and young adults, as well as severe mental illnesses and suicidal thoughts among young adults. As opposed to smaller patient samples, this research provides a nationwide look at geographic variations between the US states and the District of Columbia to model correlations between cannabis use and three major mental health disorders. The results provide validation between the potential causal links between cannabis use and mental health disorders that are described in both population prevalence and epidemiological research.

Future policy research could be directed to the potential benefits of THC caps in limiting mental health risks in states adopting such policies. For example, the State of Vermont recently placed limits on THC at 30 percent for products that are smoked or vaped and 60 percent on cannabis concentrates – a policy supported by the Vermont Medical Society, the American Academy of Pediatrics Vermont Chapter, and the Vermont Psychiatric Association (Picard, 2022). Additionally, a recent bipartisan report from the United States Senate Caucus on International Narcotics Control (2021) authored by US Senators Diane Feinstein (D-CA) and John Cornyn (R-TX) suggested the following recommendations:

> Given the increasing number of individuals using high potency cannabis in the United States and the potential adverse public health effects associated with its use, the Caucus believes that the NIH should intensify its research on the short- and long-term impacts associated with high potency cannabis. The Caucus further believes that NIH and the FDA should make a public recommendation as to whether states should cap the potency of products that may be sold in order to mitigate the public health consequences associated with high potency cannabis. (p. 24).

The results of this study support these recommendations as the data clearly demonstrates a correlation between cannabis use and the risk of mental health disorders. Combining these results with previous

research on THC levels and various state cannabis laws, a strong recommendation for future consideration of THC caps policies at the federal and/or state level is supported.

Conclusion

While nationwide data for the potency of THC and the prevalence of cannabis-induced psychosis (CIP) is unavailable, data for cannabis use and mental health disorders for individual US states clearly shows an increase in both cannabis use and mental health disorders in states with more highly permissive regulatory structures. Unfortunately, previous research studies on cannabis potency indicate that more permissive state cannabis laws generate cannabis products with higher THC levels. This study proposed a research question that suggested a positive correlation between increased cannabis use and increased prevalence of mental health disorders, such as depression, severe mental illness, and suicidal thoughts.

Fixed effects panel regression models showed statistically significant correlation between increased cannabis use and increased prevalence of self-reported major depressive events among both adolescents and young adults, as well as increased prevalence of severe mental illnesses and suicidal thoughts among young adults, with strong model fitness results. While statistically significant results existed for mature adults, poor R-squared results indicate additionally unexplained control variables exist within the older age grouping. The results support a potential causal link between frequent cannabis use, the use of high potency cannabis products, and the growth of mental health disorders.

While nationwide data on cannabis-induced psychosis (CIP) does not currently exist, the correlative link between cannabis use and mental health disorders displayed in this research, coupled with recent groundbreaking research on the impact of cannabis on brain development in young adults, suggests that the epidemiological existence of cannabis-induced psychosis (CIP) could be explained in the connection to increased self-reported mental health disorders.

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