

DIGITAL ACCESS TO SCHOLARSHIP AT HARVARD
DASH.HARVARD.EDU



HARVARD LIBRARY
Office for Scholarly Communication

# Self-Medicating With Marijuana for PTSD: Behaviors and Attitudes

**The Harvard community has made this article openly available. Please share how this access benefits you. Your story matters**

| | |
|---|---|
| Citation | Lane, Teresa. 2020. Self-Medicating With Marijuana for PTSD: Behaviors and Attitudes. Master's thesis, Harvard Extension School. |
| Citable link | https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37365042 |
| Terms of Use | This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA |

# Self-medicating with Marijuana for PTSD: Behaviors and Attitudes

Teresa Lane

A Thesis in the Field of Psychology

for the Degree of Master of Liberal Arts in Extension Studies

Harvard University

May 2020

Copyright 2020 Teresa Lane

## Abstract

Marijuana has the potential to be a valuable tool in the treatment of Posttraumatic Stress Disorder (PTSD). In the absence of large-scale efficacy studies, an early survey of self-medication trends can provide a starting point for future clinical research design. This study surveyed individuals who reported symptoms consistent with PTSD (with or without a diagnosis) who self-medicate with marijuana. Survey consisted of a PTSD measure, marijuana usage questions including frequency and patterns of use, a survey-specific marijuana attitudes survey along with measures of sleep quality, and perceived overall improvement attributed to marijuana. This study provides analysis of self-medication patterns that may be of practical use to researchers and clinicians while there remains a lack of clinically based recommendations.


.

# Dedication

This work is dedicated to my loved ones whose lives were shaped by the traumas they experienced, especially the resilient survivors who inspire me and the ones still struggling who give me hope. And most of all, to H.A.C., I still hear your voice.

# Acknowledgments

I wish to express my deepest gratitude to my faculty advisor, Dr. Richard McNally for his support and advice. His timely and practical advice was invaluable when I was in the weeds. Also, I am indebted to my thesis advisor, Dr. Dante Spetter who helped me clarify and define my proposal goals; Professor Spetter also brought calm to the submission process during a uniquely challenging time when world events changed the way we conducted daily business.

I also wish to acknowledge family and friends who provided assistance throughout my study. My parents were always ready to listen despite an incredibly challenging year. Dina and Denise were my constant cheerleaders. Adam listened and provided feedback particularly during the survey design testing phase of my study. John sent work my way and commiserated with me over many lunches; and Roland made numerous dinners for me while I worked through the evening. I also wish to thank the many friends and acquaintances who shared personal experiences, especially Matt whose candid personal perspective was invaluable during the design of my study.

Table of Contents

Dedication ..... iv

Acknowledgments ..... v

Chapter I Introduction ..... 1

Legal Landscape for Cannabis and Related Drugs ..... 4

Neurobiology of PTSD and Cannabinoid Systems ..... 6

Cannabinoids for Treatment of PTSD ..... 7

Cannabis Use Disorder and Self Medicating Behaviors in PTSD ..... 9

Critical Psychological Outcomes in Marijuana Research ..... 10

Social Attitudes Regarding Cannabis Use ..... 12

Chapter II Method ..... 16

Participants ..... 17

Measures ..... 18

Chapter III Results ..... 32

Chapter IV Discussion ..... 40

References ..... 45

# Chapter I

## Introduction

Marijuana has the potential to be a valuable tool in the treatment of Posttraumatic Stress Disorder (PTSD). Large scale efficacy studies are likely to follow the increasing availability and legalization of marijuana in the United States. This early survey of self-medication trends provides a starting point for future research design.

There is a perceived benefit to marijuana use for alleviating symptoms of PTSD that has not been empirically established (Dai & Hao, 2017). Previous studies are small, and findings are inconsistent. Although there is some preliminary evidence showing that marijuana can reduce some symptoms of PTSD such as anxiety and insomnia (Bonn-Miller, Babson, & Vandry, 2014) potential negative effects of marijuana usage may outweigh these benefits. In particular, memory reconsolidation, a primary goal of evidence-based PTSD therapies, may be impaired by marijuana use; and psychoactive effects of marijuana may exacerbate dissociative symptoms (Steenkamp et al., 2017). Additionally, comorbid substance abuse disorders common with PTSD (Tull, McDermott, & Gratz, 2016), may increase as a result of self-medicating.

Widespread availability of marijuana may change trauma survivor's attitudes towards seeking evidence-based treatment. While individuals who could not complete difficult evidence-based therapies such as Prolonged Exposure (PE), may be able to successfully complete therapy with the aid of marijuana (Papini et al., 2017); due to dampened memory reconsolidation, these therapies may be less effective. Some individuals particularly those with treatment-resistant PTSD may turn to marijuana in lieu

of therapy or spend less time in therapy in favor of self-medication (Bedard-Gilligan, Garcia, & Zoellner, 2018). Although self-medicating is a term used in a clinical setting for maladaptive behavior (i.e., masking symptoms with excessive alcohol or through illegal drug use); marijuana use is beginning to be viewed as an acceptable alternative or complimentary therapy. Much like herbal supplements which have been widely available for decades, marijuana is seen by advocates as a healthy, natural choice. However, with no established dosage recommendations, individuals who self-administer marijuana looking to alleviate symptoms are still in a literal sense self-medicating, although not necessarily in a clinical or pejorative sense.

In order to evaluate if individuals who are self-medicating with marijuana perceive reduction in their symptoms among individuals who have PTSD or a self-reported history of trauma with symptoms consistent with PTSD, this study surveyed their marijuana use, attitudes and perceived benefits. The confidential survey employed a screening tool, the PCL-C (PTSD Checklist – Civilian Version) along with questions on use and additional symptom-specific screening measures. Because expected benefits and realized benefits may be different; the survey also included The Short Post-Traumatic Stress Disorder Rating Interview (SPRINT) measure which includes items relating to symptom improvement. Additionally, attitudes and experiences among both medical and recreational marijuana users will likely be shaped by community experience such as veterans' groups, social media, and sellers/marketers of specific cannabis products. Therefore, the survey included questions regarding social influences on individuals' decisions to self-medicate.

The US Drug Enforcement Administration (DEA) lists marijuana as a Schedule 1 drug indicating it has no established medical benefits and high potential for abuse (Drug Enforcement Administration, 2017). However, many US states have adopted regulations allowing for the use of medical marijuana for a variety of medical conditions and increasingly recreational marijuana is also permitted at the state level. This reflects growing support for the use of cannabis products in treating a wide variety of physical, and to a lesser extent, psychological ailments.

With legalization, it is reasonable to expect a significant increase in marijuana use among individuals with PTSD and those with trauma history and symptoms consistent with PTSD. Understanding this trend involves not only exploring the perceived frequency and severity of PTSD symptoms among those who are using marijuana, but also perceived benefits.

Evidence supporting the effectiveness of marijuana for PTSD is limited. Due to the Schedule 1 classification of marijuana, few researchers have been able to access government research supplies adequate to conduct a controlled clinical trial. A handful of largely overlapping literature reviews provide an overview of potential benefits. Steenkamp et al. (2015) found 5 studies that examined marijuana, marijuana products, or Nabilone (a synthetic marijuana compound) for treating specific PTSD symptoms. Similarly, Shishko et al. (2018) found only 5 studies that critically examined the use of cannabis for PTSD, two of which were included in the earlier review by Steenkamp et al. The Marijuana Policy Project (2019), which is a lobbying group advocating legalized marijuana, lists 6 studies to support their legislative efforts, 3 of which appear on

previously mentioned literature reviews. The remaining 3 articles consist of a case study and preclinical mouse studies.

## Legal Landscape for Cannabis and Related Drugs

The incidence of PTSD in the US is estimated at 7–8 % but is significantly higher in combat veterans with around 20% of Iraq and Afghanistan veterans being diagnosed with PTSD or depression (US Department of Veterans Affairs, 2019). Not surprisingly, the Veterans Administration treats a large percentage of the PTSD patient population. Due to the Federal prohibition of marijuana, the Department of Veterans Affairs has been largely restricted from considering marijuana use for PTSD. However, this is changing; veterans who participate in cannabis programs in states where marijuana is legal are no longer subject to loss of VA benefits (US Department of Veterans Affairs, 2017); and although current clinician guidelines do not provide for treatment of PTSD with marijuana, pending legislation would allow clinical care providers at VA hospitals to discuss and recommend marijuana to patients (GovTrack.us., 2019).

The Food and Drug Administration (FDA) has not yet received an approval application for medical marijuana. One barrier to understanding the potential benefits of marijuana among people with PTSD is that the FDA has not approved any specific marijuana products or synthetically derived compounds for use in people with PTSD or other related disorders. However it has approved  Epidiolex which contains cannabidiol (CBD) one of the main chemical compounds found in marijuana, for the treatment of seizures in Lennox-Gestaut syndrome and Dravet syndrome; Marinol and Syndros which contains dronabinol, a synthetic THC for treatment of weight loss from wasting conditions in diseases such as AIDS; as well as the drug Cesamet which contains

Nabilone, a synthetically derived THC analog primarily used as an antiemetic for chemotherapy induced nausea (FDA.gov, 2019). Also, CBD oil and other products containing CBD are increasingly sold throughout the United States for their purported health benefits.

Due to increased interest in cannabis and cannabis-derived products, a public hearing was held on May 31, 2019 to "obtain scientific data and information about the safety, manufacturing, product quality, marketing, labeling, and sale of products containing cannabis or cannabis-derived compounds" (Federal Register, 2019). Table 1 shows the status of current clinical studies seeking to evaluate the efficacy of marijuana for PTSD.

Table 1

Listing of studies relating to marijuana use for PTSD, as of January 2020

| Study Title | Status |
|---|---|
| Evaluating Safety and Efficacy of Cannabis in Participants With Chronic Posttraumatic Stress Disorder | Suspended |
| Nabilone in Cannabis Users With PTSD | Terminated |
| Add on Study on Δ9-THC Treatment for Posttraumatic Stress Disorders (PTSD) | Unknown |
| Cannabidiol as a Treatment for AUD Comorbid With PTSD | Recruiting |
| Outcomes Mandate National Integration With Cannabis as Medicine | Recruiting |
| Pharmacokinetic (PK) and Pharmacodynamics (PD) Study of Ilera Specific Products | Recruiting |
| Effects of Delta9-tetrahydrocannabinol (THC) on Retention of Memory for Fear Extinction Learning in PTSD: R33 Study | Not yet recruiting |

*Note*. All studies found on U.S. National Library of Medicine, ClinicalTrials.gov. website.

## Neurobiology of PTSD and Cannabinoid Systems

Although there is a perceived benefit among advocates for the use of cannabis to alleviate PTSD symptoms; evidence supporting claims of efficacy are largely anecdotal. Preliminary research, including case studies, preclinical studies, and studies on specific symptoms consistent with PTSD diagnosis indicate potential efficacy, but also point to known drawbacks of marijuana use. However, studies examining the neurobiology of PTSD, and the effects of cannabis on areas of the brain associated with PTSD, as well as studies on cannabis abuse and withdrawal, paint a more detailed picture of the reasons why cannabis is thought to be potentially beneficial, and also why the risks of self-medicating with marijuana may outweigh the benefits.

PTSD is associated with several physiological and structural changes in the brain; specifically, in areas of the brain associated with fear response (amygdala), executive function (prefrontal cortex), and hippocampus (processing of emotions) as well as disruption of the HPA axis, the neuroendocrine system responsible for "fight or flight" response (Sherin, 2011). In PTSD, there is increased activity in the amygdala, decreases in volume are seen in the prefrontal cortex and hippocampus, and disruptions of the HPA axis resulting from cortisol and adrenal imbalance. These changes lead to primary symptoms of PTSD such as intrusive thoughts, flashbacks, increased fear response, impulsivity, and hyper-vigilance; dysregulation of neurotransmitters additionally hamper stress responses; serotonin is decreased, and norepinephrine is decreased. These imbalances correspond to symptoms of insomnia, anxiety, and depression seen in PTSD (Sherin, 2011).

Cannabinoid receptor type 1 ($CB_1$) is expressed in the central and peripheral nervous system. Endocannabinoids (i.e., endogenous chemicals of the endocannabinoid system) and THC stimulate the $CB_1$ receptor and assist in regulation of neurotransmitters involved in memory, mood, pain and pleasure. $CB_1$ receptors are absent in the brain stem where autonomic functions such as cardiovascular regulation are controlled; thus, lethal overdose from THC is unlikely (MacCallum & Russo, 2018) Additionally, CBD inhibits THC uptake and thus, may counter-balance some of the effects of THC, particularly at high doses (Boggs et al., 2018).

There are several significant ways in which the endocannabinoid system can play a role in PTSD. Endocannabinoids play a role in the extinction of aversive memories. Activation of $CB_1$ receptors in the amygdala can block reconsolidation of aversive memories. THC can reduce reactivity to threat signals in the amygdala; and at low levels can reduce anxiety, but high levels of THC may be anxiogenic (Passie et al., 2012). Cannabinoid signaling is a primary regulator of HPA axis activity and increased activation of $CB_1$ receptors in the prefrontal cortex has been shown to have antidepressant effects and reduce suicidality (Krumm, 2016).

## Cannabinoids for Treatment of PTSD

Canadian studies on the use of Nabilone showed decreases in nightmare severity in an uncontrolled pilot study of civilian population (Fraser et al., 2009), a reduction in nightmare scores on the Clinician Administered PTSD Scale (CAPS) in randomized placebo-controlled study of military personnel (Jetly, 2015), and a significant reduction in overall score on the PTSD Checklist (PCL) among incarcerated adults using a chart review study (Cameron et al., 2014).

Roitman et al. (2014) completed an uncontrolled pilot study using sublingual THC (5 mg daily dose) in a small group of Israeli adults ($n$ = 10) with chronic, treatment-resistant PTSD. Although there was no significant reduction in PTSD symptom severity as measured by CAPS scores ($M$ = 16.0, $t$ = 1.81, $p$ > 0.1), several measures relating to sleep were significant. They found a significant reduction in nightmares as measured by Nightmare Frequency Questionnaire (NFQ) and Nightmare Effects Survey (NES) as well as improved sleep quality using the Pittsburgh Sleep Quality Index (PSQI). Sleep improvement was attributed to THC effects on sleep architecture which reduces REM sleep (the sleep phase where dreams and thus, nightmares, occur) and improves restorative non-REM phase 4 sleep. Although the results are promising, the lack of a placebo and the small sample size give the study reduced external validity.

In the US, studies on the use of marijuana to alleviate PTSD symptoms began with state-level legalization of cannabis. In 2009, New Mexico became the first state to legalize medical marijuana for the treatment of PTSD. Greer reported receiving unsolicited calls to his private practice from individuals interested in receiving an evaluation for use in applying to the medical marijuana program (Greer, Grob, & Halberstadt, 2014). He and his colleagues studied 80 of these self-selected subjects and their results showed significant decreases in within-subjects CAPS scores between no cannabis use and during cannabis use periods. However, the study was limited to individuals actively seeking to enroll in the medical marijuana program and there was no control group. Additionally, the retrospective chart review method, scoring criteria limitations, and lack of screening tests for cannabis use are further design limitations. These study limitations make it difficult to determine the extent of patient self-report

bias. Individuals may have been more likely to overestimate the severity of pre-cannabis symptoms and the frequency of pre-study cannabis use would likely be underreported. The authors also noted that some of the criteria symptoms they evaluated — namely nightmares, insomnia, and anger — are also reported symptoms of cannabis withdrawal. Although the study only included patients who reported a benefit from marijuana in reducing PTSD symptoms, the effects were consistent with previous literature.

Bonn-Miller and Riggs are currently evaluating safety and efficacy of different potencies of marijuana in veterans with chronic, treatment resistant PTSD in an Investigational New Drug Application study (IND #110513, Amendment 4, Version 1, 2015) sponsored by Multidisciplinary Association for Psychedelic Studies (MAPS). The Phase II triple-blind cross-over placebo-controlled study will assign participants into high THC (12%), high CBD (12%), moderate 1:1 ratio of THC and CBD (8% each), and placebo. Participants will self-administer marijuana at home for three weeks following an initial "familiarization" stage. Then, following a two-week abstinence phase, participants will be randomly assigned to a different dosage level. Potential problems with dosage based on sample quality have been noted. The study began in January 2017 at Scottsdale Research Institute in Phoenix, Arizona, and treatment phase ended January 2019 (MAPS, 2019) with results pending.

## Cannabis Use Disorder and Self Medicating Behaviors in PTSD

Recognizing a robust association between PTSD and cannabis use, Bonn-Miller, Boden, Vujanovic, and Drescher (2013) examined cannabis use disorder (CUD) among veterans in residential treatment for PTSD. They found evidence of a relationship between problematic cannabis use and PTSD severity. Veterans who had a CUD

diagnosis upon entering the residential treatment program (during which cannabis use was discontinued) had lower improvement in PTSD measures compared to participants who did not have a CUD diagnosis. Their findings were significant after controlling for age, trauma severity, and other diagnosed Substance Use Disorders (SUD). Additionally, they found cannabis use could significantly predict PTSD symptom severity suggesting that individuals with PTSD may be more likely to self-medicate with cannabis for short-term reduction in specific symptoms such as insomnia, but long-term use may inhibit recovery from PTSD. Building on previous research, Bonn-Miller, Babson, and Vandry (2014) examined medical cannabis use in a San Francisco dispensary. Study participants self-reported conditions for which they sought treatment with the top conditions being anxiety, chronic pain, stress, insomnia and depression. Using the Comprehensive Marijuana Motives Questionnaire (CMMQ), the PTSD Checklist -Civilian Version (PCL-C) among other measures, they found increased motivation to use cannabis for sleep and coping among participants with probable PTSD and greater frequency of use among participants with high PCL-C scores.

## Critical Psychological Outcomes in Marijuana Research

Beyond the limited research specific to PTSD and cannabis, there is a significant amount of research, case histories and medical reviews regarding the risks of marijuana use on psychological well-being.

The DSM-5 provides criteria for a diagnosis of Substance/Medication-Induced Psychotic Disorder; although the frequency of cannabis-induced psychosis is unknown, it

is generally accepted to be rare; as with other substance induced psychosis, once the causative drug is removed or metabolized, the psychosis resolves.

There is a strong correlation between marijuana use and schizophrenia which has been widely studied. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the risks of marijuana use such as CUD, impaired executive functioning and psychosis increase significantly as age at onset of use decreases (American Psychiatric Association, 2013).

Marijuana use, especially in adolescence, has been associated with increased susceptibility to schizophrenia. It is believed that a genetic predisposition and marijuana use in adolescence (when teens might be on the cusp of a prodromal phase of disease development) can lead to schizophrenia. The presence of the COMT Val158Met and BDNF Val66Met genetic polymorphisms has been shown to be the genetic factor most prevalent in individuals diagnosed with schizophrenia associated with marijuana use especially among young marijuana users (Mané et al., 2017). Guidelines developed to lower risks associated with marijuana use recommend individuals with a genetic predisposition (i.e., a known family history of psychosis) avoid all marijuana usage (Fischer et al., 2017). However, the correlation of increased use of marijuana among individuals with schizophrenia may represent a shared vulnerability (Meffert et al., 2019), thus it can be difficult to establish a directional relationship.

Similarly, studies have shown an increased usage of marijuana in individuals with anxiety and mood disorders. A study by Shalit et al. (2016) showed an increase in suicidality associated with marijuana use. However, it is possible that individuals with

more severe anxiety or depression will tend to self-medicate more than individuals whose symptoms are less severe.

Marijuana use is associated with poorer cognitive functioning. Because $CB_1$ receptors in the prefrontal cortex are disrupted by THC, broad spread impairments in executive functions can be seen. Although IQ is generally stable throughout adulthood, a longitudinal study by Merier et al. (2012) showed a significant decrease in IQ among adult marijuana smokers. Similarly, Thames et al. (2014) showed deficits in attention and working memory. Results of studies examining marijuana use in adolescence are more striking perhaps because the prefrontal cortex is not yet fully developed in teen years. However, the impact of studies in adolescents can be difficult to ascertain because pre-existing behavioral issues such as decreased motivation may skew results (Compton, 2015).

## Social Attitudes Regarding Cannabis Use

According to Substance Abuse and Mental Health Services Administration (SAMHSA), cannabis is the most widely used illicit substance in the United States (Hughes, 2015). Although public perceptions on the dangerousness of cannabis varies across and within states and geographic regions, a growing trend in legalization at the state level reflects increased public perception of the potential benefits of cannabis.

States that pass legislation legalizing cannabis often do so following public referendum. Examining attitudes on the use of marijuana Dai and Hao (2017) found states that legalized medical marijuana had higher rates of public acceptance of marijuana usage. Perhaps not surprisingly, these states also had higher rates of actual marijuana use

and abuse. Dai and Hao (2017) examined Twitter feeds to evaluate attitudes on marijuana use for PTSD. They found that tweets supporting marijuana use for treatment of PTSD outnumbered tweets that were against or neutral for usage 8.6 to 1. Not surprisingly, pro-usage tweets were higher in states that had marijuana available for recreational and medical purposes ($\beta = 1.3 \pm 0.06$) and states allowing medical marijuana ($\beta = 0.5 \pm 0.3$) compared to states without legal use of marijuana ($\beta = 0.2 \pm 0.1$, $p < 0.0001$); also, states with a lower percentage of children had a higher prevalence of pro-usage tweets ($r = -0.35$, $p = 0.01$).

There can be many factors that contribute to attitudes about marijuana. For example, from 2006-2011 before marijuana was legalized in Colorado, SAFER (Safer Alternative for Enjoyable Recreation), a marijuana advocacy group, spent $240,000 on public programs to educate the public on dangers of alcohol and promote marijuana use as a safer alternative although at the time it was still illegal (Schuermeyer et al., 2014). It should be noted that there is significantly more data on alcohol-related deaths, and the relative availability of alcohol plays a role. For example, although statistics on automobile accidents involving alcohol are widely available, data on marijuana related automobile accidents is not widely or consistently reported. In a review on the adverse effects of non-medical cannabis use, Hall and Degenhardt (2009) note that reductions in response time seen in preclinical studies are reflected in increased frequency and culpability for automobile accidents in studies of French and Australian automobile drivers. Although on some measures, such as substance-induced acute and chronic disease states, marijuana does appear to be safer than alcohol, there is insufficient data to determine the degree or scope of health risks.

In states where recreational marijuana is legal, advertising from marijuana advocates and service purveyors is becoming more common. For example, in Massachusetts, dispensaries are not allowed to advertise prices except through a catalog available upon request; storefront displays are not permitted, and products cannot be visible from the street or entrance. Despite regulations limiting advertising by dispensaries, there is a wide array of advertising that falls outside the regulations; through third-party sites, consumers can browse a wide variety of cannabis products and learn about how to use products. In addition to commercial and news media, a variety of social media sites feature stories advocating marijuana use including for treatment for opioid addiction and PTSD. Decisions regarding self-medication among individuals with PTSD or those with a trauma history and symptoms consistent with PTSD will likely also be influenced by dosage recommendations put forth by peers and recommendations from purveyors.

Individuals who previously may have been hesitant to smoke marijuana may be more willing to try marijuana purchased from a dispensary, not only because it is legal, but because dispensaries offer greater quality control (potency/strain is consistent) or increased ease of use (e.g., “pre-rolls”, edibles, vape cartridges, tinctures).

In terms of marijuana flower bud, Cannabis Indica and Cannabis Sativa are types of the cannabis plant horticulturally distinguished by phenotype, although after years of cultivation, whether they remain as distinct species is debated with all modern cannabis considered to be a hybrid plant. The distinction between Indica and Sativa is primarily used to differentiate aspects of the psychoactive properties of the plant. Individuals can choose between a wide variety of strains of marijuana bud or alternative marijuana

products with THC levels and THC to CBD ratios provided. THCA, or tetrahydrocannabinolic acid, is a cannabis compound in the raw, live cannabis plant. THCA converts to THC through decarboxylation as the flowering bud is heated. THCA levels are increasingly included on product labeling.

Additionally, individuals who do not wish to smoke either because of health concerns or because they do not like the smell or taste of marijuana can choose from a wide variety of alternatives to smoking such tinctures and edibles.

Although there is conflicting evidence on the efficacy of marijuana for relieving PTSD symptoms, the overall picture suggests there is a dose-dependent response rate where too little is ineffective and too much can worsen symptoms. Legal access and increased social acceptance of marijuana will likely play a role in how individuals self-medicate with marijuana.

However, despite emerging evidence on the therapeutic uses of cannabis, self-medicating with marijuana may lead to CUD. Because the endocannabinoid system regulates the same neurochemical pathways underlying PTSD and there is an established risk of comorbid substance abuse in PTSD, the distinction between self-medicating and abuse may be difficult for an individual with PTSD to ascertain. Because high levels of THC have been shown to exacerbate symptoms of PTSD, this is particularly troubling.

Examination of self-medicating behaviors in people with PTSD and people with a trauma history and symptoms consistent with a PTSD diagnosis may provide an early look at this evolving issue.

# Chapter II

## Method

The study was conducted via online Qualtrics survey using de-identified data. Recruiting was conducted via the online platform Reddit. The sample collection was limited to a two-month active collection period. Each survey response represents one individual respondent. A screening measure was used at the beginning of the survey and a symptom severity measure was included at the end of the survey. Recruitment was through social media following general usage guidelines established by the platform (i.e., Reddit) and site-specific guidelines (i.e., subreddit policies and permissions.) Due to the confidential nature of these platforms, participants are generally willing to discuss potentially sensitive issues such as PTSD symptoms and marijuana usage.

Exclusion criteria were 1) individuals under the age of 21 years old; or 2) who received treatment for a drug or alcohol dependency; or 3) individuals who have been hospitalized within the past month; or 4) patients taking medical marijuana for a medical condition such as HIV related anorexia, chemotherapy relating wasting condition or seizure disorders including epilepsy.

Although self-medicating behavior is common in PTSD, exclusion of subjects who have known SUD (Substance Use Disorder) is addressed by excluding participants who received treatment for substance abuse. Individuals who have been hospitalized in the last month may have a confounding medical issue. Additionally, recent hospital patients may be on pain medication; or they may be seeking cannabis as an alternative to opioid pain medications. The efficacy of cannabis for pain management or as an alternative to opioid dependence is outside the scope of this study.

To ensure exclusion conditions did not exist, participants first answered yes to a list of qualifying inclusion criteria. Then, in order to take the survey, participants satisfied enrollment eligibility by providing month and year of birth to verify age as well as completing standard PTSD screening measure.

The survey consisted of 5 main sections: inclusion criteria and demographic information, marijuana usage and attitudes, insomnia and sleep disturbance, and PTSD symptom assessment and improvement.

## Participants

Inclusion criteria were residents in states where recreational dispensaries operate, who are at least 21 years old and who have PTSD or a self-reported history of trauma with symptoms consistent with PTSD and who use cannabis products. Although medical marijuana is available in additional states, all states that have recreational dispensaries also allow medical marijuana. Respondents ($N$ = 55) ranged in age from 30-57, $M$ = 38.13, $SD$ = 5.57 based upon reported year of birth. 49.1% were female ($n$ = 27), 34.5% were male ($n$ = 19), and 14.5% were non-binary ($n$ = 8) and one respondent preferred to not identify gender. 36.4% of respondents ($n$ = 20) resided in Colorado, 27.3% in California ($n$ = 15), 18.2% in Massachusetts ($n$ = 10), 5.5% in the state of Washington ($n$ = 3), 3.6% in Oregon ($n$ = 2) and 9.1% ($n$ = 5) were from "other" states reporting under the write-in option for states where legal recreational access became available between the time of survey design approval and the close of the survey period. Additionally, 9 respondents (16.4%) were veterans, and 46 (83.6%) did not claim veteran status; of these 9 respondents, all were male.

## Measures

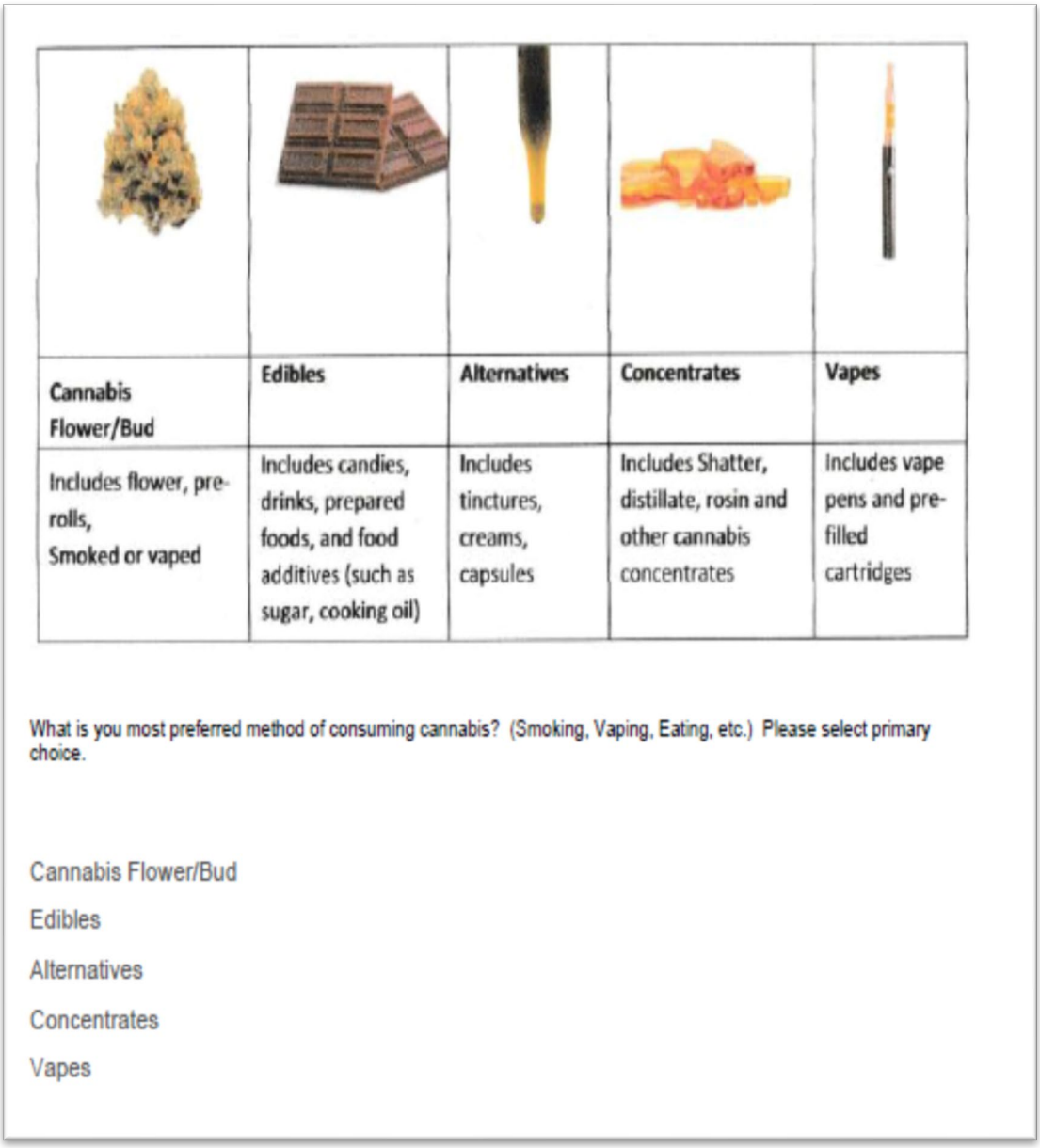
An initial PTSD Checklist – Civilian Version (PCL-C) inventory was given at the start of the survey. The PCL-C is a 17 item self-report measure utilizing a 5-point Likert scale. Thus, a total score of 17-85 is possible (Weathers, Litz, Huska, and Keane, 1994). The National Center for PTSD in the U.S. Department of Veterans Affairs (2012) recommends a diagnostic cut-off score of 35 based upon population setting characteristics, specifically "specialized medical facility," but suggests provisional diagnosis for scores ranging from 31-33. They further suggest due to potential differences in general population, lower scores may be appropriate. The cut-off for this study was 25.

A study-specific survey section included questions regarding usage in the last two weeks, and questions regarding attitudes such as willingness to participate in evidence-based therapy. These questions were intended to reflect general usage patterns including dosage, type of product used, and frequency. Questions regarding usage are quantitative measures and social factors and attitudes were rated on a 5-point Likert scale from 1 (not at all) to 5 (very important/very likely).

Participants were instructed to have product information (label, dispensary receipt, etc.) on hand to answer questions regarding product name, potency, and serving amount. Pictures of example products for different product categories were displayed, and participants were asked to identify type and potency of dispensary product used. Figure 1 provides a screenshot of the categories provided.

Figure 1

Screenshot of Survey Image



| Cannabis Flower/Bud | Edibles | Alternatives | Concentrates | Vapes |
|---|---|---|---|---|
| Includes flower, pre-rolls, Smoked or vaped | Includes candies, drinks, prepared foods, and food additives (such as sugar, cooking oil) | Includes tinctures, creams, capsules | Includes Shatter, distillate, rosin and other cannabis concentrates | Includes vape pens and pre-filled cartridges |



*Note: Screenshot of representational images explaining cannabis product category choices.*

Participants were asked to identify their frequency of marijuana use based upon current (last two weeks) level of usage. A sliding scale was provided with both numerical and frequency guides resulting in a score range of 1–70. Figure 2 provides an image of the frequency selection tool.

Figure 2

Screen shot of survey question regarding frequency of use



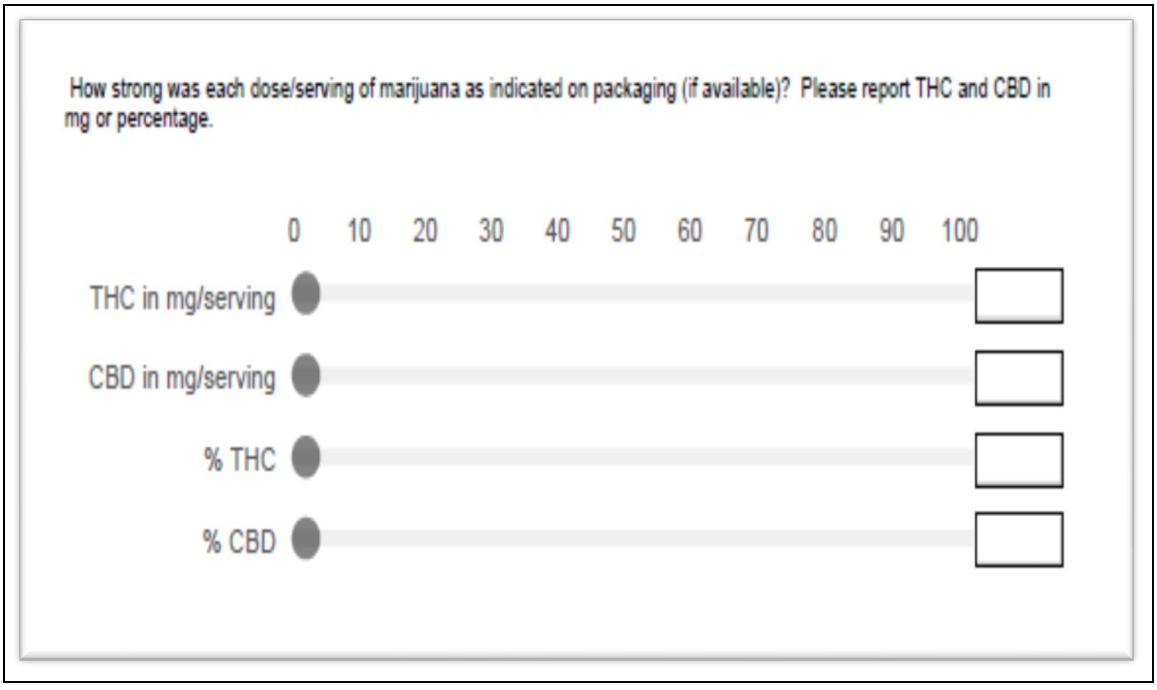

*Note:* Screenshot of slide bar used to report frequency of marijuana use. Specified number chosen appears in the box at the end of the slide bar as selected.

Because the manner in which serving usage, portion, and potency varies, participants were asked additional questions regarding amount, frequency and strength of marijuana consumed using open text fields, sliding scale, and radio buttons to allow respondents to provide an overall report of individual usage consistent with the type of product consumed. Participants were asked to provide the strength of the primary product they consumed in the past two weeks. Because participants may be using additional

marijuana not purchased themselves at a dispensary, they were asked to estimate total usage including usage that falls outside dispensary purchases (such as marijuana they grow themselves.) Recruitment materials specifically asked for marijuana users who purchase from dispensaries; emphasis is on dispensary products because it allows for computation of dosage and potency. However, participants who did not identify specific strains, potency, or products could still complete the study. The sliding scale tool provided to report THC and CBD levels in primary product consumed is shown in Figure 3.

Figure 3

Screenshot of survey question regarding strength and potency of primary product consumed.



Additionally, participants were asked to identify when they consumed marijuana. They could select time preferences for morning, evening, before bedtime, before a stressful event, at a social event, or any combination of time preferences. Respondents reported a preference for evening marijuana consumption (75.9%), and a bedtime preference of 70.4%, followed by 61.1% reporting they consumed marijuana before a stressful event, 55.6% reported in the morning, and 40.7% at social occasions.

Following questions on marijuana usage, participants were also asked to answer questions regarding asks regarding attitudes about marijuana use and its effects. These following questions were rated on a 5-point Likert Scale with 1=very much disagree to 5=very much agree.

1. Legalization of recreational marijuana is a significant factor in my decision to use marijuana.
2. Someone I know uses marijuana to alleviate physical or emotional discomfort.
3. I believe I can alleviate symptoms with marijuana better than with traditional therapies.
4. Using marijuana is safe because it is regulated, and quality is assured.
5. I believe using marijuana is a healthy, empowering choice.
6. I am more likely to seek help from a mental health professional now that I feel I have more control of my symptoms.

A summary descriptive statistics table for the social attitude questions is shown in Table 2. The distribution bar charts for each of the attitude survey questions are shown in Figures 4–9 (for each of the social attitude questions 1–6 respectively).

Table 2

Descriptive statistics for total responses to each of the 6 attitude survey questions.

| | | Question 1 | Question 2 | Question 3 | Question 4 | Question 5 | Question 6 |
|---|---|---|---|---|---|---|---|
| N | Valid | 48 | 48 | 48 | 48 | 47 | 48 |
| | Missing | 7 | 7 | 7 | 7 | 8 | 7 |
| Mean | | 3.06 | 4.35 | 4.06 | 3.77 | 4.21 | 3.94 |
| Std. Deviation | | 1.38 | 0.91 | 0.98 | 0.97 | 0.91 | 1.10 |
| Range | | 4 | 3 | 3 | 3 | 3 | 4 |
| Sum | | 147 | 209 | 195 | 181 | 198 | 189 |

Figure 4

Responses to Attitudes Survey Question 1: Legalization of recreational marijuana

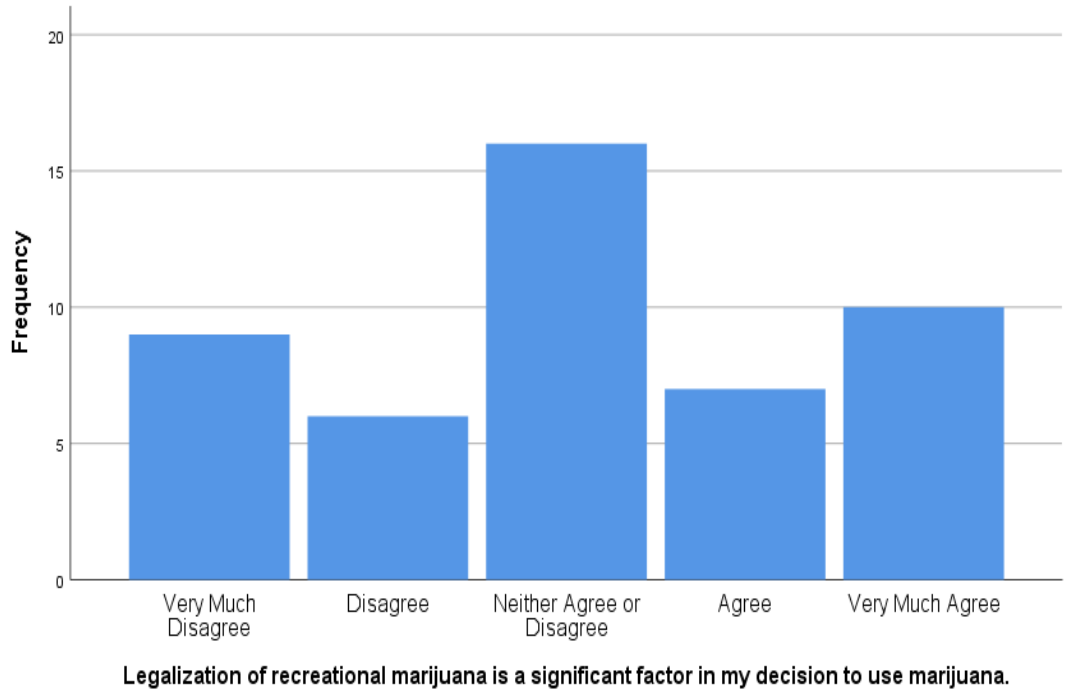


Figure 5

Responses to Attitudes Survey Question 2: Peer usage

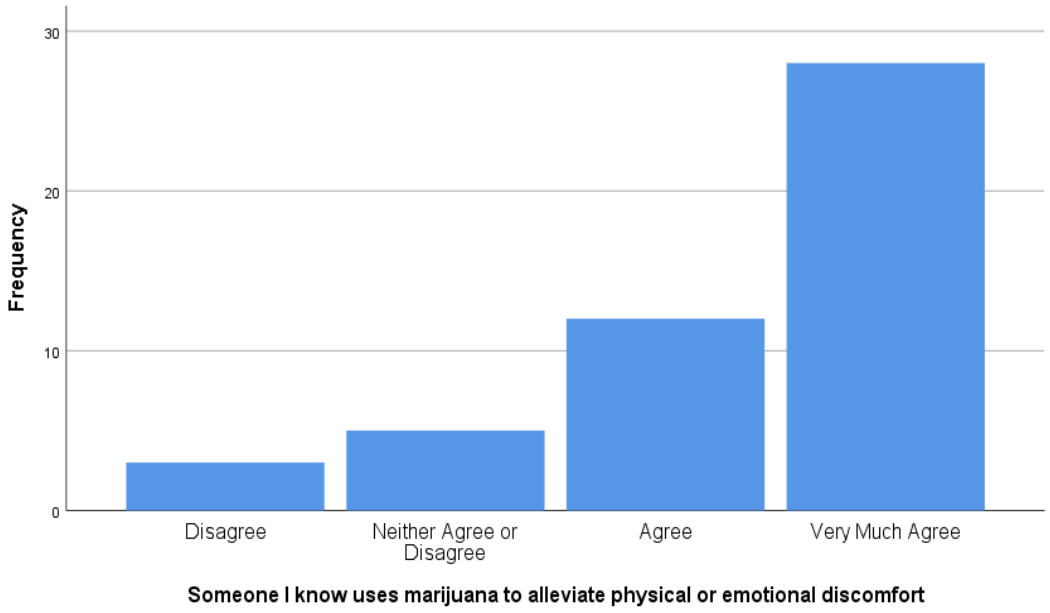



Figure 6

Responses to Attitudes Survey Question 3: Alternative therapy

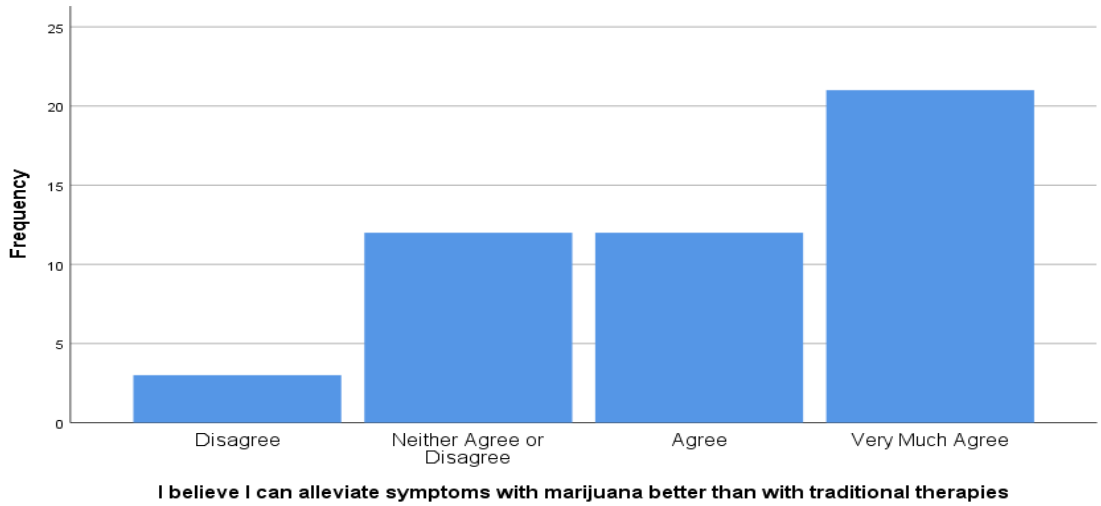


Figure 7

Responses to Attitudes Survey Question 4:  Safety and quality

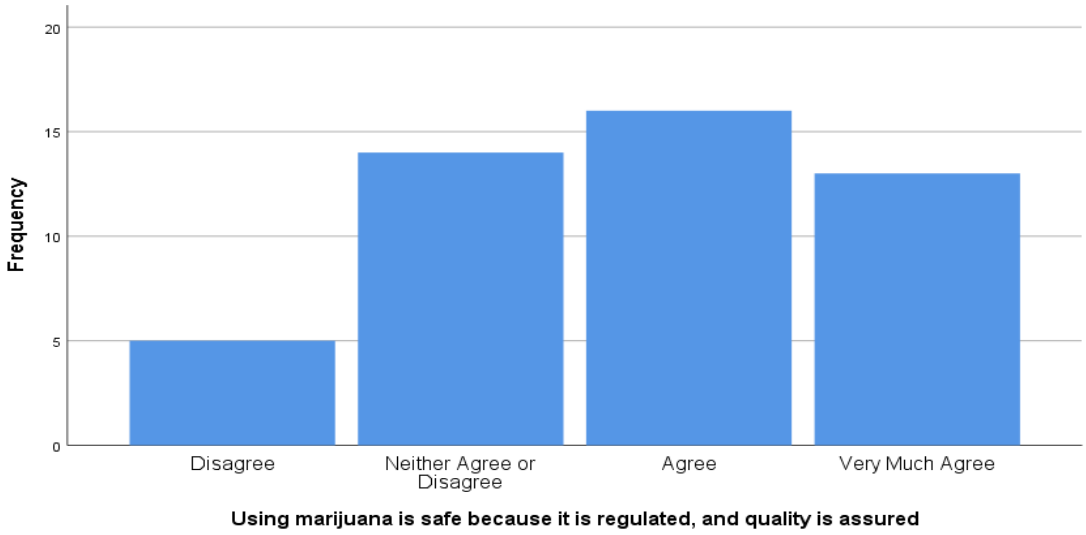



Figure 8

Responses to Attitudes Survey Question 5:  Positive choice

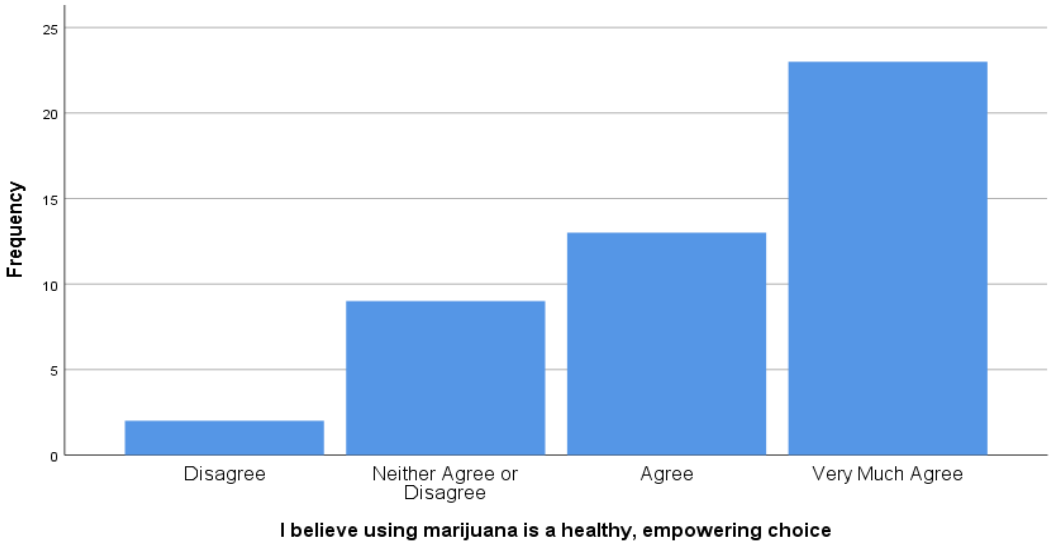
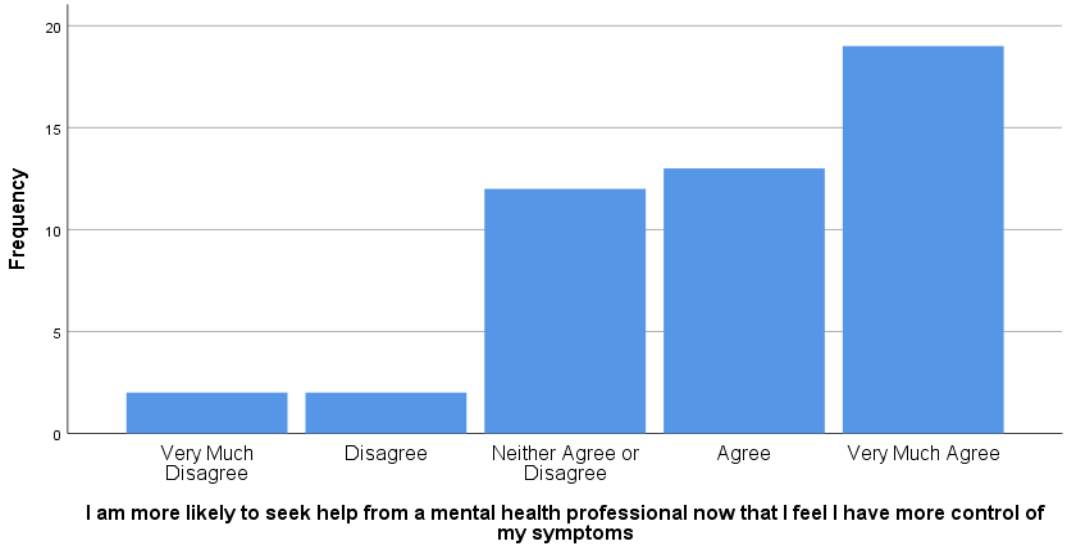


Figure 9

Responses to Attitudes Survey Question 6:  Willingness to see mental health professional




A total score was calculated for social attitudes sections yielding a total possible score of 30. Composite scores on the attitude survey questions were normally distributed ($n$ = 48, $M$ = 23.31, $SD$ = 3.42) with skew = .014, skew $z$ = 0.05, and kurtosis = -.86, kurtosis $z$ = -1.27.

Since THC is known to alter sleep architecture, the ISI (Insomnia Severity Index) was included in the survey to investigate sleep-specific symptom severity. The Insomnia Severity Index (ISI) is a 7 item self-report instrument measuring the individual's assessment of nocturnal and diurnal symptoms of insomnia (Morin, Belleville, Bélanger, and Ivers, 2011). Questions assess the severity of difficulties initiating sleep, staying asleep, as well as satisfaction with current sleep pattern, and how much sleep issues interfere with daily activity. All questions are provided on a 5-point Likert scale. The

measure was used in its entirety and without alteration, although not all questions were used in analysis.

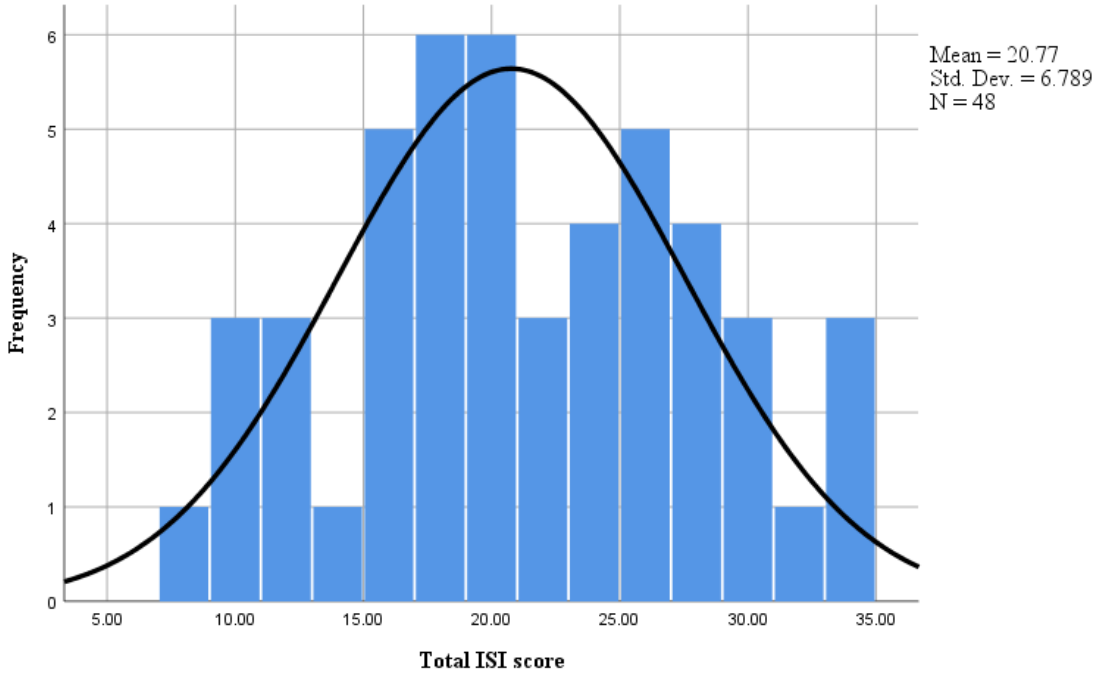
The variable Total ISI Symptoms was created from questions 1–3 on the ISI survey because they related to actual specific sleep symptoms: difficulty falling asleep, difficulty staying asleep, and waking too early. Questions 1–3 are rated from none (0) to very severe (4). The remaining questions 4–7 on the ISI survey ask to what extent sleep problems are noticed by the individual and others. Histograms indicating frequency of scores for the total ISI measure and for the Total ISI Symptoms measure are shown in Figure 10.

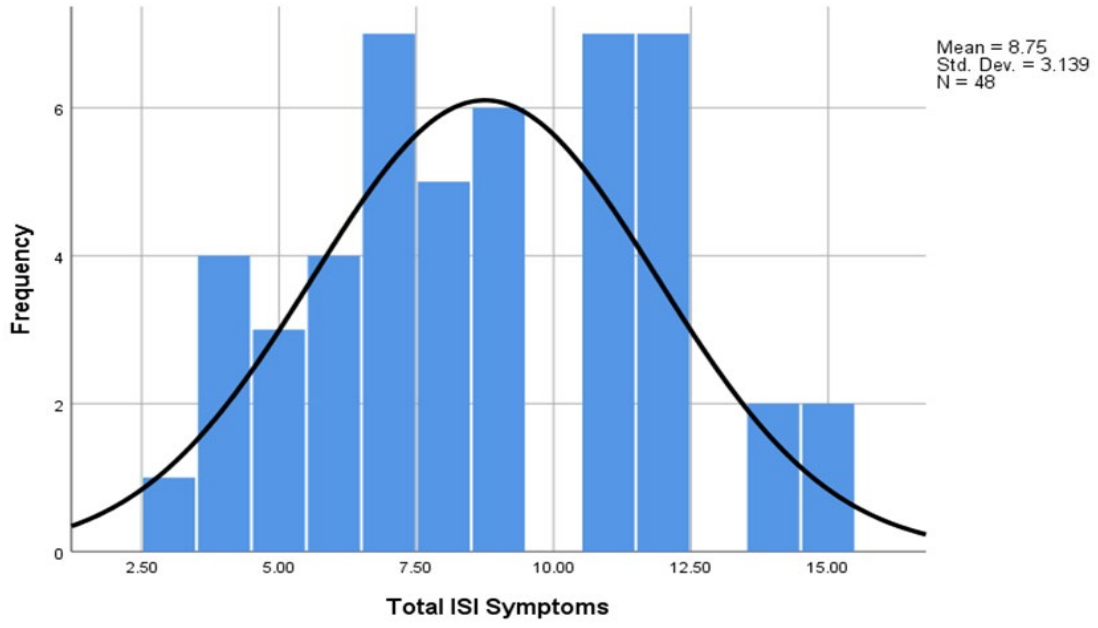
The SPRINT measure (The Short Post-Traumatic Stress Disorder Rating Interview) was used to obtain a score of symptom improvement. The SPRINT is an ideal measure because it is a short 8 question Likert scale self-reported symptom severity and it is also is sensitive to treatment effects (Conner & Davidson, 2001). Questions 9 and 10 ask about symptom improvement since "beginning treatment." In the introduction to this section, "treatment" was defined as using cannabis products for symptom relief. Otherwise the measure was used without alteration.

Question 9 on the SPRINT measure: "How much better do you feel since beginning treatment? (as percentage)" provides a sliding scale of percentage improvement (0-100%) which was used for analysis purposes in this study as the overall improvement measure.

Figure 10

Histograms for Total ISI score and Total ISI Symptoms score



Of a total of 64 responses received, 55 met the inclusion criteria of this study. Using SPSS Version 25, Total PCL-C scores were calculated as well as total scores for each section corresponding to criteria B, C, and D. Responses with a PCL-C total score that was less than 25 were excluded. In all cases, exclusions were a result of missing PCL-C scores and submissions were removed as incomplete responses. Descriptive statistics are provided in Table 3.

Frequency of use was defined within the survey as number of times marijuana products were consumed in the past two weeks with a range permitted on a sliding scale of 1–70. For analysis purposes, scores of 70 were omitted to create a continuous variable range of 1–69 with a bimodal distribution. (Skew $z$ = -0.55, Kurtosis $z$ = -1.96, Shapiro-Wilk test was significant $p$ = .001.) Histogram of frequency distribution is in Figure 11.

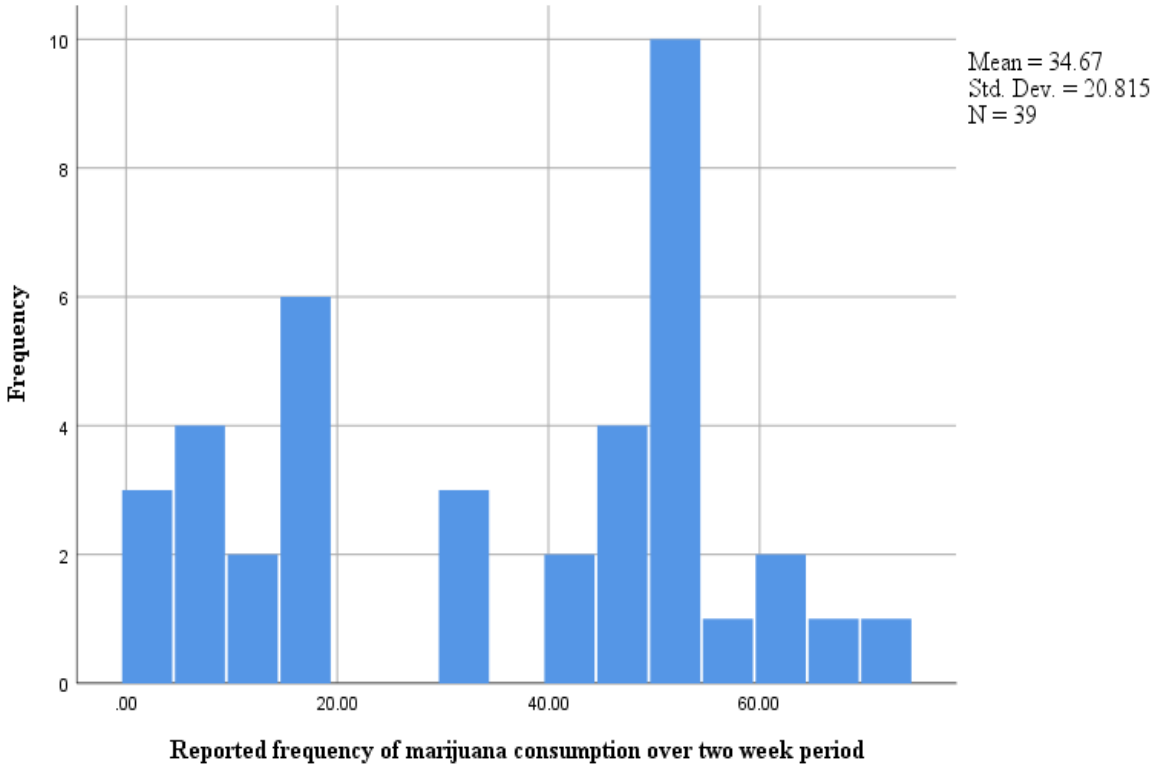
Table 3

Scores for Total PLC and sub-scores corresponding to Criteria B, C, D

| | | Total_PCL_ | PCL B Criteria | PCL C Criteria | PCL D Criteria |
|---|---|---|---|---|---|
| N | | 55 | 55 | 55 | 55 |
| Mean | | 60.64 | 17.55 | 25.29 | 17.80 |
| Median | | 62.00 | 19.00 | 26.00 | 19.00 |
| Std. Deviation | | 14.77 | 4.582 | 6.40 | 5.46 |
| Skewness | | -0.40 | -0.27 | -0.57 | -0.20 |
| Std. Error of Skewness | | 0.32 | 0.32 | 0.32 | 0.32 |
| Skew z score | | -1.25 | -0.85 | -1.77 | -0.63 |
| Kurtosis | | -0.61 | -1.04 | -0.24 | -1.20 |
| Std. Error of Kurtosis | | 0.63 | 0.63 | 0.63 | 0.63 |
| Skew z score | | 0.96 | -1.64 | -0.371 | -1.90 |
| Percentiles | 25 | 48.00 | 13.00 | 21.00 | 14.00 |
| | 50 | 62.00 | 19.00 | 26.00 | 19.00 |
| | 75 | 72.00 | 21.00 | 31.00 | 23.00 |

Figure 11

Histogram of Frequency of Use

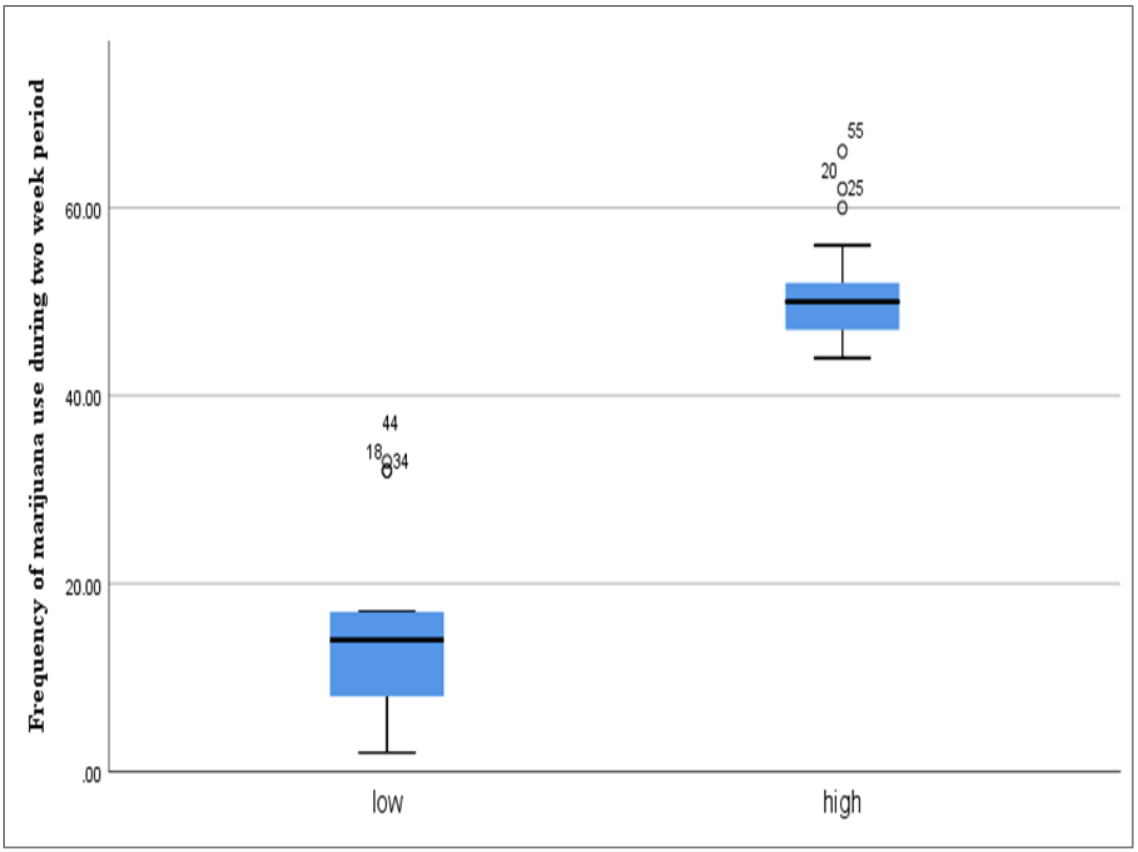



The low group included frequency of use scores below 35, meaning respondents used a marijuana product less than 35 times in a two-week period, while the high use group reported using marijuana 35–69 times in a two-week period. However, the new groups were not normally distributed. A boxplot chart of the low and high frequency of use group is provided in Figure 12. The Low Usage group ($n$ = 18, $M$ = 14.28, $SD$ = 9.71) remained positively skewed at .87, $z$ = 1.62 with kurtosis of -.03, $z$ = -0.04. The High Usage group ($n$ = 20, $M$ = 51.25, $SD$ = 5.76) had a high degree of positive skew at 1.25, $z$ = 2.44, and was also leptokurtic with kurtosis value of 1.35, $z$ = 1.35.) These new

variables were not used as outcome measures due to the low sample population and the continued skew and kurtosis within the new variables.

Figure 12

Distribution boxplots for low frequency of use and high frequency of use groups




Calculations of potency and dose were not performed as a result of the difficulty in obtaining accurate usage information, particularly in the High Use group which typically used multiple types of products in different combinations. Survey design was inadequate to collect more than two products at a time, furthermore, participants who regularly used multiple combinations of cannabis products did not consistently track the amount of individual product or combined amount marijuana consumed at a time.

# Chapter III

## Results

A frequency analysis examining when respondents reported consuming marijuana found 75.9% ($n$ = 41) of respondents reported consuming marijuana in the evening, and 70.4% ($n$ = 38) reported consumption at bedtime. 61.1% ($n$ = 33) reported using marijuana before a stressful event or activity, while 55.6% ($n$ = 30) consumed marijuana in the morning, and 40.7% ($n$ = 22) consumed marijuana while at social activities.

Among the 50 respondents that indicated a primary choice for method of consumption, smoking was the most frequently preferred method with 29 respondents (58%). Frequencies for the remaining primary methods of consumption were 14% ($n$ = 7) preferred vapes, while 12% ($n$ = 6) preferred edibles, another 12% preferred concentrates ($n$ = 6) and 4% ($n$ = 2) preferred alternatives. However, many respondents particularly in the high frequency of usage group reported regularly using multiple methods of consumption.

A two-tailed independent t test was performed to compare total PCL-C scores among veterans and non-veterans. The results were not significant between veterans ($M$ = 62.22, $SD$ = 11.69) and non-veterans ($M$ = 60.33, $SD$ = 15.39), $t_{53} = 0.35$, $p = 0.73$. Additionally, a two-tailed independent t test was performed to compare overall improvement scores among veterans and non-veterans. The results were not significant between veterans ($M$ = 55.38, $SD$ = 25.05) and non-veterans ($M$ = 52.94, $SD$ = 22.74), $t_{42} = 0.27$, $p = 0.79$.

There were no significant differences for gender in the total PCL-C scores and overall improvement scores as measured by an independent t test. For total PCL-C scores, men ($M$ = 57.93, $SD$ = 16.12) had a skew $z$= -0.43, and kurtosis $z$ = -0.70; women ($M$ = 60.36, $SD$ = 15.59) had a skew $z$ = -0.43 and kurtosis $z$ = -0.83; and non-binary ($M$ = 66.50, $SD$ = 8.98) had a skew $z$= 1.37 and kurtosis $z$= 0.47.

Similarly, there were no significant differences in overall improvement scores due to gender measured by z scores for skew and kurtosis or in the Shapiro-Wilk test. For overall improvement, men ($M$ = 53.73, $SD$ = 23.76) had a skew $z$ = -0.80, and kurtosis $z$ = 0.87; women ($M$ = 49.95, $SD$ = 24.755) had a skew $z$ = -1.45 and kurtosis $z$ = -0.50; and non-binary ($M$ = 61.50, $SD$ = 11.33) had a skew $z$ = 0.10 and kurtosis $z$ = -1.67.

Table 4

Shapiro-Wilk test for Gender in Total PCL-C score, Overall Improvement Measure

| | W | df | p. |
|---|---|---|---|
| Male | 0.97 | 15 | 0.81 |
| Female | 0.96 | 22 | 0.59 |
| non-binary | 0.86 | 6 | 0.21 |
| | | | |
| Male | 0.97 | 15 | 0.80 |
| Female | 0.92 | 22 | 0.07 |
| non-binary | 0.82 | 6 | 0.08 |

In order to test the hypothesis that there is a relationship between severity of PTSD symptoms and marijuana usage, a two-tailed independent samples t-test was performed comparing the low frequency usage group with the high frequency group compared to low frequency group using total PCL-C score as an indicator of symptom

severity. Similairly, low and high freuqency marijuana use was tested against each of the subscores on the PLC-C measure correspnding to each PTSD criteria symptom. First, to test the assumption of normality, a Shapiro-Wilk test was conducted for each group. For each group, p values were greater than .05, thus indicating normal distribution. Results are provided in the following table 5.

Table 5

Shapiro-Wilk Test for Normality

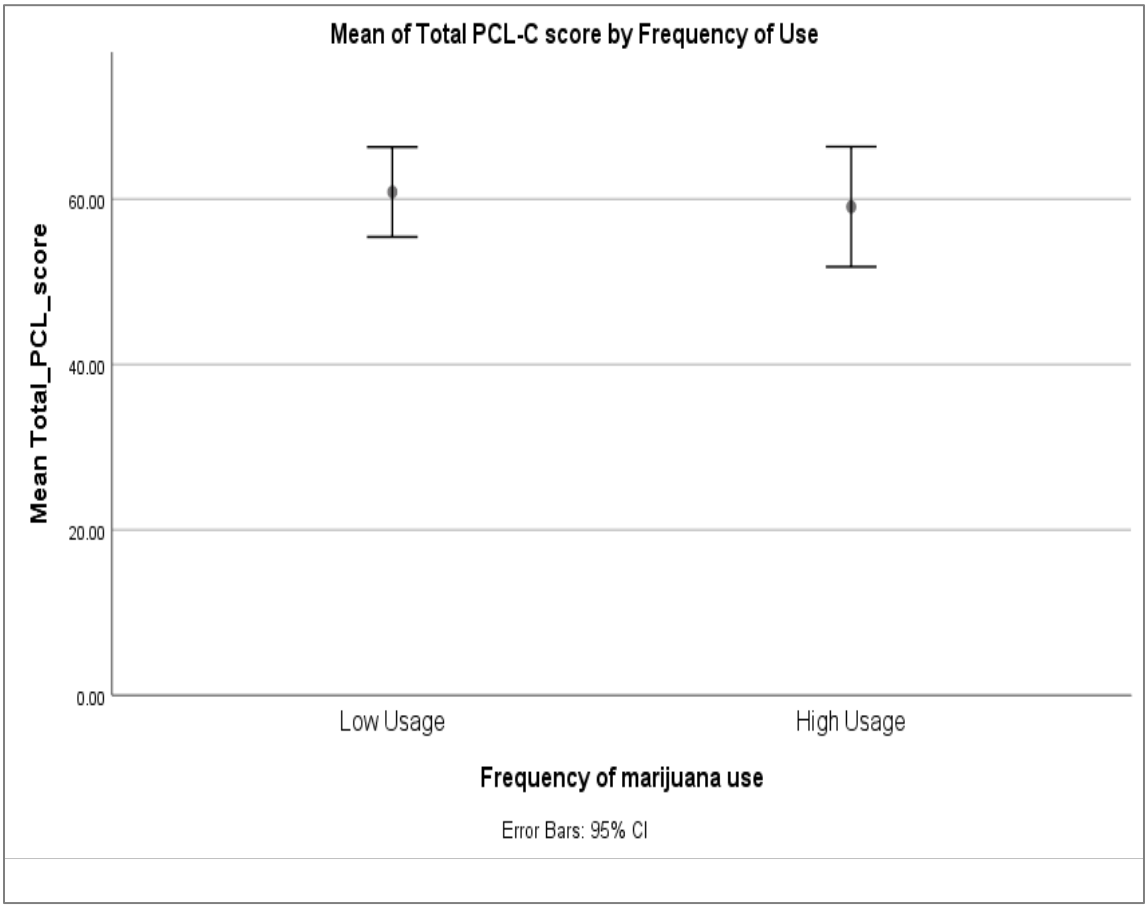
| | | Shapiro-Wilk | | |
|---|---|---|---|---|
| Composite score | Usage Frequency | *W* | *df* | *p* |
| Total_PCL_score | Low | .95 | 18 | .41 |
| | High | .95 | 20 | .33 |
| PCL B intrusive score | Low | .92 | 18 | .13 |
| | High | .94 | 20 | .20 |
| PCL C avoidance score | Low | .96 | 18 | .61 |
| | High | .92 | 20 | .12 |
| PCL D negative affect score | Low | .96 | 18 | .66 |
| | High | .93 | 20 | .16 |

The low frequency usage group ($n$ =18) had a mean of 54.33 with a standard deviation of 14.86 and the high frequency of use group ($n$ = 21) had a mean of 60.19 and a standard deviation of 11.96. There was no significant difference in reported PLC-C score between low usage group and high usage group, $t_{37} = 1.36$, $p = .18$.

Furthermore, visual check of the boxplots of the mean PCL-C scores for the low and high usage groups confirm the t test. Boxplot for mean PCL scores is provided in Figure 13.

Figure 13

Box plot of mean Total PLC-C scores for marijuana usage




Next, each section score of the PCL-C corresponding to PTSD criteria category symptoms was examined using the same two-tailed test. The results are summarized in Table 6. For Criteria B symptoms of intrusive thoughts and memories and Criteria D alterations in mood, there was no significant difference between low frequency and high frequency marijuana use. However, the difference scores in for Criteria C symptoms of avoidance was significant. Respondents with who reported consuming marijuana more than 35 times in a two-week period had significantly higher scores on the Criteria C symptoms score than the low consumption group, $t_{37} = 2.06$, $p = .047$, $d = 0.66$.

Table 6

Two-tailed independent t test for Criteria B, C, and D symptoms

| | Frequency of marijuana use | *n* | *M* | *SD* | *F* | Sig | $t_{37}$ | p |
|---|---|---|---|---|---|---|---|---|
| PCL B intrusive score | High | 21 | 16.76 | 3.94 | .23 | .63 | .20 | .843 |
| | Low | 18 | 16.50 | 4.25 | | | | |
| PCL C avoidance score | High | 21 | 26.24 | 5.23 | 2.72 | .11 | 2.06 | .047 |
| | Low | 18 | 22.22 | 6.94 | | | | |
| PCL D negative alterations score | High | 21 | 17.19 | 5.66 | 1.90 | .18 | .18 | .355 |
| | Low | 18 | 15.61 | 4.73 | | | | |

Next, symptom improvement as measured by SPRINT overall improvement score was used to predict change in PTSD symptoms. A multiple regression analysis was performed to test the hypothesis that PTSD symptom severity, sleep quality, and attitudes about marijuana predicted symptom improvement in individuals self-medicating with marijuana. The overall model predicted 25.2% of variance in the model ($R^2 = .25$, $F_{3,40} = 4.48$, $p = .008$).

The histogram of standardized residuals (Figure 9) and normal p-p plot of standardized residuals (Figure 10) indicated residuals were normally distributed. The scatterplot for standardized predicted values indicates homoscedasticity and linearity assumptions were met (Figure 11).

The first model examined the correlation between Total PCL-C score and SPRINT overall improvement measure. The second model examined sleep quality (using ISI composite symptom score) given the anticipated improvement in sleep symptoms due to the influence of THC on sleep architecture. The third model examined the aggregate

social attitude score (Total Attitude Score) because perceived benefits of marijuana were expected to be different from actual symptom change.

An analysis of standardized residuals showed the data did not contain outliers (Std. Residual Minimum = -2.00, Std. Residual Maximum = 2.61). The collinearity statistics indicated a lack of multicollinearity. Total PLC score had a tolerance = .62, VIF = 1.62; ISI Symptoms had a tolerance = .62, VIF = 1.61; and Total Attitude showed a tolerance = .98, VIF = 1.02. Additionally, data met the assumption of independent errors (Durbin-Watson = 2.02). Data met the assumption of non-zero variance.

The analysis showed that severity of symptoms was not a significant predictor of overall improvement. Total PCL-C score was found to be not be a significant indicator of overall improvement ($\beta = 0.08$, $t_{43} = 0.45$, $p = .65$). Also, sleep quality was also not a significant predictor of overall PTSD symptom improvement. ($\beta = .06$, $t_{43} = 0.35$, $p = .73$).

Attitude towards marijuana usage (measured by Total Social Attitude score) was found to significantly predict overall improvement ($\beta = 0.50$, $t_{43} = 3.63$, $p = .001$). Participants who believed that marijuana would be helpful were more likely to report symptom improvement as indicated by the overall improvement score on the SPRINT measure. Confidence intervals for coefficients are provided in Table 7.

To determine the strength of this model, power was calculated using post-hoc analysis in GPower 3.1. Effect size was calculated from the model using sample parameters ($N = 44$, $p = .008$, 3 predictors). Power (1-β err prob) = .88.

Table 7

Summary Table of Coefficients, Beta values and Confidence Intervals

| | B | 95% CI for B | SE | β |
|---|---|---|---|---|
| Constant | -36.51 | -90.03, 17.05 | 26.50 | .079 |
| Total PLC-C | 0.12 | -0.41, .64 | .26 | .079 |
| Total Attitude | 3.37 | 1.50, 5.25 | .93 | .50 |
| ISI Symptoms | 0.44 | -2.13, 3.01 | 1.27 | .060 |

Figure 14

Histogram of Standardized Residuals for Regression Model

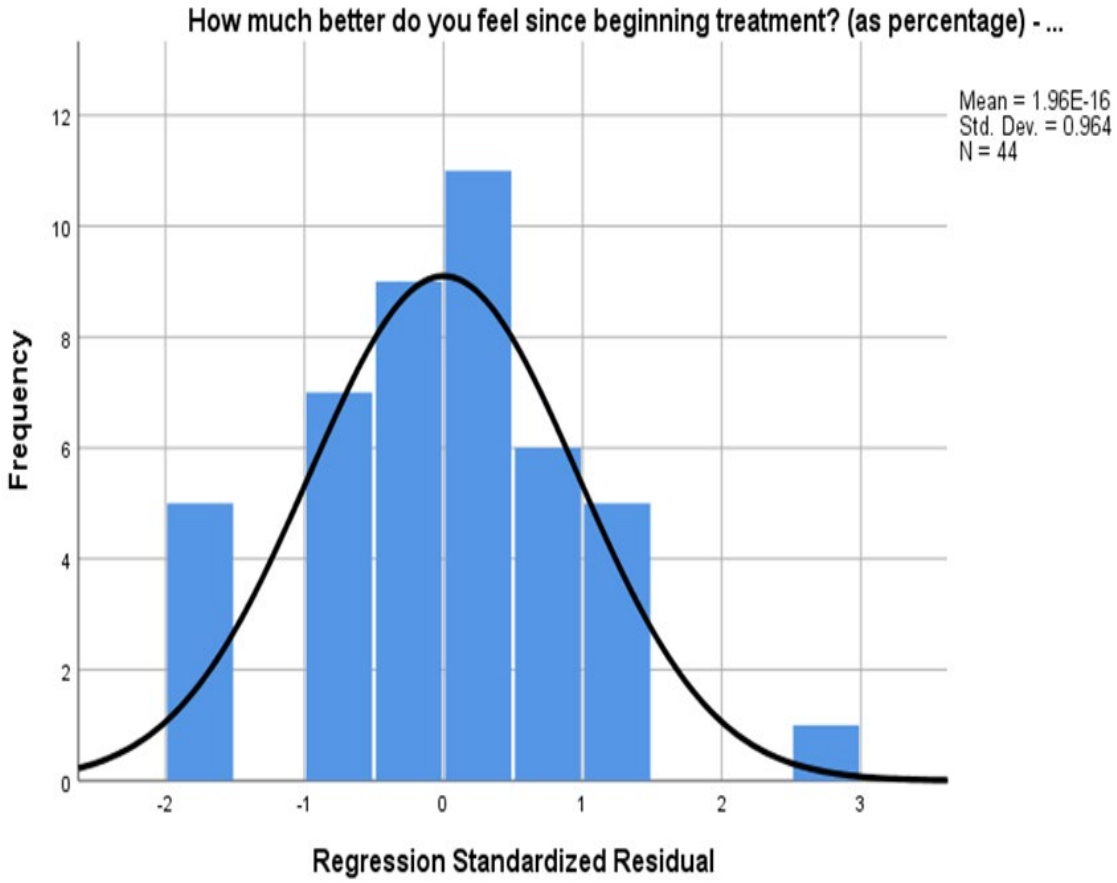


Figure 15

Normal P-P Plot of Standardized Residuals for Regression Model

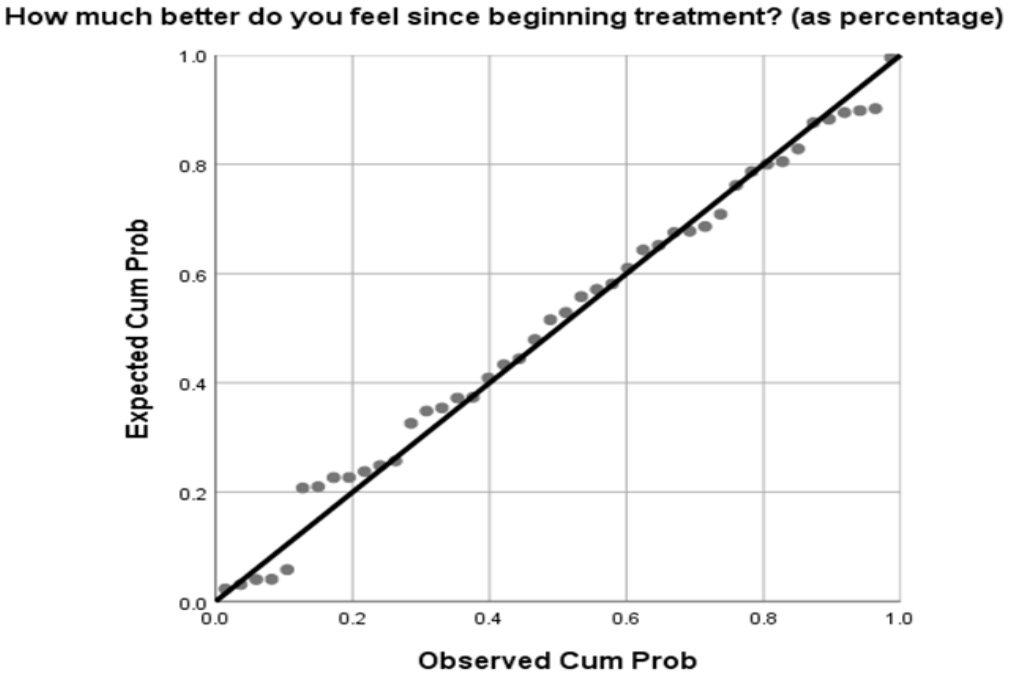
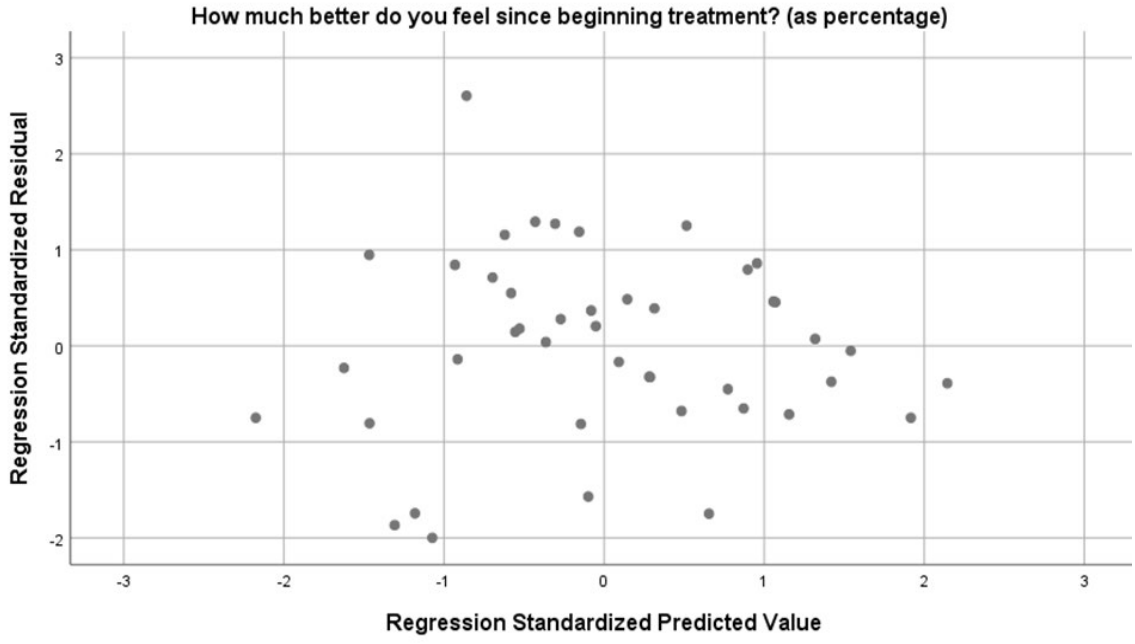



Figure 16

Scatterplot for standardized predicted values



# Chapter IV

## Discussion

While there is a perceived benefit to marijuana for treatment of PTSD symptoms, the need for an experimental evaluation of the effectiveness of marijuana has become increasingly relevant as recreational marijuana is rapidly becoming available in a growing number of states. Significant obstacles to empirical evaluation continue to exist due to legal and regulatory challenges. Without established indications or efficacy for PTSD, people will continue to self-medicate with marijuana. Without randomized controlled trials, observational study of the behaviors and attitudes in individuals self-medicating with marijuana may provide insight into potential efficacy.

Due to the high rate of comorbid SUD with PTSD, the use of marijuana for treatment of PTSD seems to present a contradictory argument in that self-medicating behaviors may reflect a higher comorbid condition. This study found frequency of marijuana use to be inconsistent with severity of overall PTSD symptoms. While high frequency of marijuana use was reported, the difference between those who used marijuana less frequently and those who used marijuana throughout the day was not significant in terms of symptom severity. While it is reasonable to expect that symptoms like anxiety and insomnia might decrease with marijuana use, participants did not report improvement in mood (as measured by PLC-C sub-scales) or sleep quality (as measured by ISI sleep symptom scores.) The only significant differences between low versus high frequency of use occurred in the Criteria C Avoidance symptoms. This may reflect the use of marijuana as an avoidant behavior (i.e., actively avoiding thoughts and activities by getting intoxicated). Although exact dosages of THC were not calculated, in practical

terms, high frequency usage such as consuming cannabis 4 or 5 times a day would likely take significant time from normal daily activities and individuals would likely spend a large portion of their day intoxicated.

Since THC inhibits executive memory and memory reconsolidation, reduced occurrence of triggers is not likely. Thus, although the effects of marijuana may be palliative, direct therapeutic effects do not seem likely given the relatively consistent PLC-C total and criteria subtotal scores.

The only examined variable that was a significant predictor for overall improvement was attitude as measured by the survey-specific Total Attitude score. This further supports the idea that the benefit of marijuana for alleviating PTSD symptoms is more perceived than actualized.

In practical terms, clinicians should enquire if their patients self-medicate with marijuana. With the increased availability of recreational marijuana, it is likely a greater number of patients will be using marijuana. Beyond an increased need to evaluate potential cases of SUD, there are additional practical aspects for clinicians to consider. Survey respondents reported being more willing to seek therapy as a result of their marijuana usage. Thus, it appears from the results of this survey, patients who avoided evidence-based therapies such as Prolonged Exposure (PE) therapy may be more willing to pursue or continue therapy with the aid of marijuana. However, decreases in emotional processing and memory reconsolidation may be an issue.

It may be useful for a clinician to know how their patient uses marijuana since frequent use may be a form of avoidance and numbing. A discussion of the nature of a patient's self-medicating behavior could prove insightful in terms of managing the

therapeutic relationship. Survey respondents reported viewing their self-medicating as healthy and empowering. Thus, it is likely patients will want to discuss their marijuana usage with their clinician as part of their overall plan to manage PTSD symptoms.

This survey only measured current usage. Respondents were already using marijuana; there was no symptom history prior to marijuana use. Future work should include a measurement for symptom severity prior to starting marijuana use. No prior treatment history was included, thus, no differences in usage between individuals with treatment resistant PTSD and emerging PTSD was measured. Similarly, the age range for respondents in this study did not include young or geriatric adults for whom neurophysiological issues (brain maturation or cognitive decline) are more likely to be confounding factors. Additionally, this study looked at sleep disturbance as a primary symptom for which marijuana may be recommended. Future studies could examine other symptoms of PTSD or concurrent symptoms in more detail such as the treatment of pain or other SUD.

Also, future work should consider a wider recruiting population. This survey evaluated participants recruited through one online social media platform (i.e., Reddit). Survey results may not be generalized to the larger population of individuals self-medicating PTSD symptoms with marijuana.

Survey respondents reported often using a combination of products. Future work should more closely examine usage dose, strength and potency particularly in terms of combined products. Survey respondents were inconsistent in reporting these measures and while some respondents were able to provide detailed, accurate usage detail, others were unable to answer with verifiable accuracy. This survey did not anticipate the

complexity in reporting multiple products in combination or the frequency with which the average respondent reported combining products. In order to capture this detail, future marijuana usage surveys need to be more complex or otherwise control for unreliable self-reporting.

There is a vast array of products being sold throughout the US with a much wider range of potency than ever before. Although commercial laboratory measures of manufacturing and testing for products means dosing is more reliable, it has also led to the availability of much higher potency marijuana products. Future studies should measure dosage potency and combined product potency for a more complete picture of self-medicating behavior.

It should be noted that with increases in refined cannabis products, potency has dramatically increased. Although consistent small dosing is more attainable; increasingly higher THC consumption levels are also now possible. Different consumption methods result in different bioavailability and absorption rates thus altering duration for peak effects which may have an impact on timing and frequency. Also, although marijuana is generally considered to be nontoxic, highly refined products may allow individuals to consume significantly more THC than was previously feasible leading to increasing rates of acute intoxication.

In conclusion, despite the lack of demonstrated therapeutic efficacy, marijuana has the potential to be a valuable tool in the treatment of PTSD because it empowers individuals to self-manage symptoms and may make them more likely to seek therapy. While it is not surprising that survey respondents would report feeling marijuana was helpful and a positive decision, the fact that higher levels of THC can exacerbate or

perpetuate symptoms is an important consideration for clinicians monitoring marijuana use in PTSD patients. When regulatory hindrances are resolved, large scale efficacy studies are likely to follow with the possibility of specific usage recommendations. Until then, clinicians should encourage active discussion of marijuana usage with patients who are self-medicating for PTSD.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders : DSM-5* (5th ed.). Arlington, VA: American Psychiatric Association.

Boggs, D. L., Nguyen, J. D., Morgenson, D., Taffe, M. A., & Ranganathan, M. (2018). Clinical and Pre-Clinical Evidence for Functional Interactions of Cannabidiol and Δ9-Tetrahydrocannabinol. *Neuropsychopharmacology*, *43*(1), 142–154. https://doi.org/10.1038/npp.2017.209

Bonn-Miller, M. O., Boden, M. T., Vujanovic, A. A., & Drescher, K. D. (2013). Prospective investigation of the impact of cannabis use disorders on posttraumatic stress disorder symptoms among veterans in residential treatment. *Psychological Trauma: Theory, Research, Practice, and Policy*, *5*(2), 193–200. https://doi.org/10.1037/a0026621

Bonn-Miller, M. O., Babson, K. A., & Vandrey, R. (2014). Using cannabis to help you sleep: Heightened frequency of medical cannabis use among those with PTSD. *Drug and Alcohol Dependence*, *136*(1), 162–165. https://doi.org/10.1016/j.drugalcdep.2013.12.008

Bonn-Miller, M. O., & Riggs, P. (2015). Placebo-controlled, triple-blind, randomized Crossover pilot study of the safety and efficacy of four different potencies of smoked marijuana in 76 veterans with chronic, treatment-resistant posttraumatic stress disorder (PTSD). *Protocol MJP-1 IND #110513*.

Cameron, C., Watson, D., & Robinson, J. (2014). Use of synthetic cannabinoid in a correctional population for posttraumatic stress disorder-related insomnia and nightmares, chronic pain, harm reduction, and other indications: A retrospective evaluation. *Journal of Clinical Psychopharmacology*, *34*, 559–564.

Cannabis Control Commission. (2019) About the Commission. Commonwealth of Massachusetts. Accessed online. https://mass-cannabis-control.com/about-us-2/. Accessed April 17, 2019.

Cannabis Control Commission. (2019) Adult use sales and product distribution. Commonwealth of Massachusetts. Accessed online. https://opendata.mass-cannabis-control.com/stories/s/Sales-and-Product-Distribution/. Accessed May 13, 2019.

ClinicalTrials.gov., National Library of Medicine, Natnal Institute of Health. https://clinicaltrials.gov/

Compton, M. T. (2016). *Marijuana and Mental Health*. *Marijuana and Mental Health*. American Psychiatric Association Publishing. https://doi.org/10.1176/appi.books.9781615370658

Connor, K. M., & Davidson, J. R. (2001). SPRINT: A brief global assessment of post-traumatic stress disorder. *International Clinical Psychopharmacology, 16*(5), 279-284.

Dai, H., & Hao, J. (2017). Mining social media data on marijuana use for Post Traumatic Stress Disorder. *Computers in Human Behavior*, *70*, 282–290. https://doi.org/10.1016/j.chb.2016.12.064

Drug Enforcement Administration. (2017). Drugs of abuse: a DEA resource guide. *Drug Enforcement Administration, US Department of Justice*.

Federal Register. Scientific data and information about products containing cannabis or cannabis-derived compounds; Public hearing; Request for comments. FDA-2019-N-1482-0001. Vol. 84, No. 64, April 3, 2019. https://www.federalregister.gov/d/2019-06436

Fischer, B., Russell, C., Sabioni, P., Van Den Brink, W., Le Foll, B., Hall, W., . . . Room, R. (2017). Lower-Risk Cannabis Use Guidelines: A Comprehensive Update of Evidence and Recommendations. *American Journal of Public Health, 107*(8), E1-E12.

Fraser, G. A. (2009). The use of a synthetic cannabinoid in the management of treatment-resistant nightmares in posttraumatic stress disorder (PTSD). *CNS Neuroscience and Therapeutics*, *15*(1), 84–88. https://doi.org/10.1111/j.1755-5949.2008.00071.x

Greer, G. R., Grob, C. S., & Halberstadt, A. L. (2014). PTSD Symptom Reports of Patients Evaluated for the New Mexico Medical Cannabis Program. *Journal of Psychoactive Drugs*, *46*(1), 73–77. https://doi.org/10.1080/02791072.2013.873843

Hall, W., & Degenhardt, L. (2009). Adverse health effects of non-medical cannabis use. *The Lancet*, *374*(9698), 1383–1391. https://doi.org/10.1016/S0140-6736(09)61037-0

Hughes, A., Lipari, R.N., & Williams, M. (2015) State estimates of adolescent marijuana use and perceptions of risk of harm from marijuana use: 2013 and 2014. Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. *The CBHSQ Report*, December 17, 2015.

Jetly, R., Heber, A., Fraser, G., & Boisvert, D. (2015). The efficacy of nabilone, a synthetic cannabinoid, in the treatment of PTSD-associated nightmares: A preliminary randomized, double-blind, placebo-controlled cross-over design study. *Psychoneuroendocrinology*, *51*, 585–588.

Krumm, B. A. (2016). Cannabis for posttraumatic stress disorder: A neurobiological approach to treatment. *The Nurse Practitioner*, *41*(1), 50–54. https://doi.org/10.1097/01.NPR.0000434091.34348.3c

MacCallum, C. A., & Russo, E. B. (2018). Practical considerations in medical cannabis administration and dosing. *European Journal of Internal Medicine*, *49*(January), 12–19. https://doi.org/10.1016/j.ejim.2018.01.004

Mané, A., Group, Pep., Parellada, M., Cabrera, B., Lobo, A., Corripio, I., … Bernardo, M. (2017). Cannabis use, COMT, BDNF and age at first-episode psychosis. *Psychiatry Research*, *250*(November 2016), 38–43. https://doi.org/10.1016/j.psychres.2017.01.045

Marijuana Policy Project. (2019). Medical Marijuana Research. *Model Medical Marijuana Bill.* Accessed online https://www.mpp.org/issues/medical-marijuana/medical-marijuana-research/

Meffert, B. N., Morabito, D. M., Mosich, M. K., Loflin, M. J., Scottile, J., & Heinz, A. (2019). Navigating Blind in the Green Rush: Clinical Considerations and Harm Reduction Practices for Cannabis. *Curr Drug Res Rev*, *11*(1), 3–11. https://doi.org/10.1007/s10067-014-2707-y

Meier, Madeline H., Caspi, Avshalom, Ambler, Antony, Harrington, HonaLee, Houts, Renate, Keefe, Richard S. E., . . . Moffitt, Terrie E. (2012). Persistent cannabis users show neuropsychological decline from childhood to midlife. *Proceedings of the National Academy of Sciences of the United States of America, 109*(40), E2657-E2664.

Morin, C., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: Psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep, 34*(5), 601-8.

Passie, T., Emrich, H., Karst, M., Brandt, S., & Halpern, J. (2012). Mitigation of post-traumatic stress symptoms by Cannabis resin: A review of the clinical and neurobiological evidence. *Drug Testing and Analysis, 4*(7-8), 649-659.

Powell, D., Pacula, R. L., & Jacobson, M. (2018). Do medical marijuana laws reduce addictions and deaths related to pain killers? *Journal of Health Economics*, *58*, 29–42. https://doi.org/10.1016/j.jhealeco.2017.12.007

Roitman, P., Mechoulam, R., Cooper-Kazaz, R., & Shalev, A. (2014). Preliminary, open-label, pilot study of add-on oral Δ9- tetrahydrocannabinol in chronic post-traumatic stress disorder. *Clinical Drug Investigation*, *34*(8), 587–591. https://doi.org/10.1007/s40261-014-0212-3

Schuermeyer, J., Salomonsen-Sautel, S., Price, R. K., Balan, S., Thurstone, C., Min, S. J., & Sakai, J. T. (2014). Temporal trends in marijuana attitudes, availability and use in Colorado compared to non-medical marijuana states: 2003-11. *Drug and Alcohol Dependence*, *140*, 145–155. https://doi.org/10.1016/j.drugalcdep.2014.04.016

Shalit, N., Shoval, G., Shlosberg, D., Feingold, D., & Lev-Ran, S. (2016). The association between cannabis use and suicidality among men and women: A population-based longitudinal study. *Journal of Affective Disorders*, *205*, 216–224. https://doi.org/10.1016/j.jad.2016.07.010

Sherin, J., & Nemeroff, C. (2011). Post-traumatic stress disorder: The neurobiological impact of psychological trauma. *Dialogues in Clinical Neuroscience, 13*(3), 263-278.

Shishko, I., Oliveira, R., Moore, T. A., & Almeida, K. (2018). A review of medical marijuana for the treatment of posttraumatic stress disorder: Real symptom re-leaf or just high hopes? *Mental Health Clinician*, *8*(2), 86–94. https://doi.org/10.9740/mhc.2018.03.086

Steenkamp, M. M., Blessing, E. M., Galatzer-Levy, I. R., Hollahan, L. C., & Anderson, W. T. (2017). Marijuana and other cannabinoids as a treatment for posttraumatic stress disorder: A literature review. *Depression and Anxiety*, *34*(3), 207–216. https://doi.org/10.1002/da.22596

Thames, A., Arbid, N., & Sayegh, P. (2014). Cannabis use and neurocognitive functioning in a non-clinical sample of users. *Addictive Behaviors, 39*(5), 994-999.

Tull, M. T., McDermott, M. J., & Gratz, K. L. (2016). Marijuana dependence moderates the effect of posttraumatic stress disorder on trauma cue reactivity in substance dependent patients. *Drug and Alcohol Dependence*, *159*, 219–226.

US Department of Veterans Affairs. (2017). Access to VHA Clinical Programs for Veterans Participating in State-approved Marijuana Programs. *VHA DIRECTIVE 1315*. Retrieved from www.va.gov/vhapublications/ViewPublication.asp?

US Department of Veterans Affairs & Department of Defense. (2010). VA/DoD Clinical Practice Guidelines for Management of Post-traumatic Stress: Guideline Summary. Downloaded from: http://www.healthquality.va.gov/guidelines/MH/ptsd/

U.S. Department of Veterans Affairs. (2019). How Common Is PTSD? *PTSD: National center for PTSD*. https://www.ptsd.va.gov/understand/common/index.asp

Weathers F. W., Litz B. T., Huska J. A., & Keane T. M. (1994). PCL-C for DSM-IV. Boston: National Center for PTSD—Behavioral Science Division