THE ROLE OF CANNABIS USE IN ANXIETY AND RELATED DISORDERS

THE ROLE OF CANNABIS USE IN ANXIETY AND RELATED DISORDERS: MOTIVES
FOR USE, PATTERNS OF USE, AND IMPACT ON TREATMENT OUTCOMES

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TITLE: The Role of Cannabis Use in Anxiety and Related Disorders: Motives for Use, Patterns of Use, and Impact of Treatment Outcomes

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LAY ABSTRACT

Individuals with anxiety and related disorders have been shown to use cannabis at an elevated rate and are at higher risk of problematic cannabis use than those with low anxiety. Unfortunately, little is known about the association between cannabis use, and anxiety and related disorders. This body of work begins to address four important questions about cannabis use in those with anxiety and related disorders: 1. How is cannabis used?, 2. Why is cannabis used?, 3. Is marijuana use temporally associated with anxiety symptoms?, 4. Does cannabis use impact anxiety and related disorder psychological treatment outcomes? Understanding the answers to these questions may inform mental health care workers about how to best care for individuals struggling with anxiety and related disorders, who also use cannabis.

ABSTRACT

Objectives: The objective of this body of work was to begin addressing four questions about the association between cannabis use and anxiety and related disorders: 1. How is cannabis used?, 2. What are the motives for cannabis use?, 3. Is marijuana use temporally associated with anxiety symptoms?, 4. Does cannabis use impact anxiety and related disorder cognitive behavioural therapy (CBT) outcomes?

Methods: Using self-report questionnaires, study 1 focused on understanding patterns of cannabis use in those seeking anxiety and related disorders services, while study 2 extended the findings from study 1 by examining motives for cannabis use in this population. Further, an experience sampling method was implemented for study 3 to explore whether clinical anxiety symptoms and marijuana use (i.e., dried cannabis material) were temporally associated. Using smartphone technology, marijuana use and anxiety data were captured over a 2-week period. Finally, study 4 investigated whether pre-treatment cannabis use impacted the change in anxiety and related disorder symptoms throughout CBT.

Results: Individuals seeking anxiety and related disorder services often used cannabis, primarily via smoking joints. They used cannabis for various reasons but most commonly for coping and enhancement. Coping and expansion motives were significantly more common in frequent users compared to infrequent users. Further, earlier worry, but not anxiety or negative affect, was associated with increased likelihood of later marijuana use, however no long-term reduction in worry following marijuana use, suggesting that it is not an effective worry management strategy. Finally, frequent cannabis use was associated with dampened CBT outcomes compared to non-users, however their anxiety symptoms improved significantly from pre- to post-CBT.

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Conclusions: Collectively, results suggest that cannabis use plays an important role in anxiety and related disorders. The findings contribute to the understanding of the association between cannabis use and anxiety and related disorders, highlighting important clinical implications upon replication.

Keywords: Cannabis, Marijuana, Anxiety and Related Disorders, Worry, Motives, Cognitive behavioural therapy

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
ANCOVA	Analysis of covariance
APA	American Psychological Association
ATRC	Anxiety Treatment and Research Clinic
AUDIT	Alcohol Use Disorder Inventory Test
CBT	Cognitive behavioural therapy
CBD	Cannabidiol
COVID-19	Coronavirus disease of 2019
CTADS	Canadian Tobacco, Alcohol, and Drugs Survey
CUD	Cannabis Use Disorder
CUDIT-R	Cannabis Use Disorder Identification Test-Revised
DART	Diagnostic Assessment Research Tool
DASS-21	Depression Anxiety Stress Scales 21
DSM-5	Diagnostic and Statistical Manual, Fifth Edition
ESM	Experience Sampling Method
GAD	Generalized Anxiety Disorder
HLM	Hierarchical linear modelling
HSD	Honestly Significant Difference
ICART	Integrated cannabis and anxiety reduction treatment
IIRS	Illness Intrusiveness Rating Scale
MDD	Major Depressive Disorder

MET-CBT	Motivational enhancement therapy combined with CBT
MHQ	Marijuana History Questionnaire
MMQ or MMM	Marijuana Motives Questionnaire or Marijuana Motives Measure
NA	Negative affect
OCD	Obsessive-Compulsive Disorder
OCI-R	Obsessive-Compulsive Inventory-Revised
PA	Positive affect
PANAS	Positive and Negative Affect Schedule
PCL-5	PTSD Checklist for DSM-5
PD	Panic Disorder
PDA	Panic Disorder and Agoraphobia
PDD	Persistent Depressive Disorder
PDSS	Panic Disorder Severity Scale
ps	p values (plural)
PSWQ	Penn State Worry Questionnaire
PSWQ-PW	Penn State Worry Questionnaire-Past Week
PTSD	Posttraumatic Stress Disorder
REDCap	Research Electronic Data Capture
REML	Restricted maximum likelihood
SAD	Social Anxiety Disorder
SES	Socio-economic status
SPIN	Social Phobia Inventory
SPSS	The Statistical Package for the Social Sciences

SUDs   Substance Use Disorders

t   Time

THC   delta-9-tetrahydrocannabinol

DECLARATION OF ACADEMIC ACHIEVMENT

This dissertation contains 6 chapters. Chapter 1 is a general introduction of the dissertation topic and includes relevant background information. Chapters 2, 3, 4, and 5 are empirical articles. Chapter 6 summarizes the conclusions, limitations, and future directions.

The article presented in Chapter 2 was conceived by M. Ouellette, Dr. Rowa, and Dr. McCabe. M. Ouellette carried out data analyses and wrote the majority of the manuscript, while C. Puccinelli wrote the introduction. A. Elcock facilitated data curation. Further, Drs. McCabe and Rowa provided key revisions.

The article presented in Chapter 3 was conceived by M. Ouellette and Drs. Rowa, McCabe, and Cameron. M. Ouellette carried out data analyses and wrote the manuscript. A. Elcock facilitated data curation. Dr. Cameron provided guidance related to data analyses, and Drs. Rowa, McCabe, Pawluk, and Soreni provided key revisions.

The article in Chapter 4 was conceived by the Marijuana Working Group at St. Joseph's Healthcare Hamilton: M. Ouellette, and Drs. Rowa, McCabe, MacKillop, Pawluk, and Soreni. The study received funding from the Michael G. DeGroote Centre for Medicinal Cannabis Research. A. Elcock facilitated data curation. M. Ouellette, Dr. Pawluk, and Dr. Cameron carried out data analyses. M. Ouellette wrote the manuscript, with key revisions made by Drs. Pawluk, Rowa, McCabe, MacKillop, and Cameron.

The article presented in Chapter 5 was conceived by M. Ouellette, and Drs. Rowa, McCabe, and Cameron. A. Elcock facilitated data curation. M. Ouellette and Dr. Cameron carried out data analyses. M. Ouellette wrote the majority of the manuscript, with Dr. Cameron writing part of the results and data analyses sections. Drs. Rowa, McCabe, Pawluk, and Soreni provided key revisions.

CHAPTER 1: GENERAL INTRODUCTION

Cannabis is a psychoactive substance derived from the plant *cannabis sativa* (Goodman et al., 2020; Health Canada, 2019; Steigerwald et al., 2018). The use of recreational cannabis was legalized in Canada in 2018 (Health Canada, 2018). Although cannabis use had been on the rise prior to legalization, it is expected to continue rising with legalization (Hasin et al., 2015; Hasin et al., 2019; Health Canada, 2019). Individuals with anxiety and related disorders have been shown to use cannabis at an elevated rate and are at higher risk of problematic cannabis use than those with low anxiety (Kedzior & Laeber, 2014; Spalletta et al., 2007). Notably, the global prevalence of anxiety disorders ranges from 5.3% to 10.4%, with Euro/Anglo cultures such as North America, reporting rates on the higher end of this range (Baxter, Scott, et al., 2013). Given the growing use of recreational cannabis with its legalization, and the lack of knowledge about the association between cannabis use and some of the most prevalent mental health concerns— anxiety and related disorders—it is important that further research be conducted to understand the nuanced relationship between cannabis and anxiety to address these concerns effectively in healthcare settings (Baxter, Patton, et al., 2013; Baxter, Scott, et al., 2013; Hasin et al., 2015; Health Canada, 2019; Rotermann, 2020; Steel et al., 2014). Specifically, how do individuals with anxiety and related disorders use cannabis? Why are they using? Are marijuana use patterns in this population temporally associated with anxiety symptoms? Does cannabis use impact anxiety and related disorder psychological treatment outcomes? The aim of this body of work is to begin addressing these questions and add to the growing literature on the association between cannabis use and anxiety and related disorders, as well as highlight related clinical implications to be able to provide evidence-based care and information about cannabis use to members of this

population when they present for services. The following sections will provide relevant

background information and highlight gaps in the literature. This chapter will review anxiety and

related disorders as well as define cannabis and Cannabis Use Disorder (CUD). It will

summarize the known relationship between cannabis use and anxiety, theoretical models of

substance use and their application to cannabis use, as well as known motives for cannabis use.

Further, the current status of the impact of cannabis use on cognition, behaviour, and cognitive

behavioural therapy (CBT) outcomes will be highlighted.

1.0. Relevant Anxiety and Related Disorders

Some of the most common anxiety and related disorders presenting to anxiety services,

described in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorder, include:

Social Anxiety Disorder (SAD), Generalized Anxiety Disorder (GAD), Panic Disorder (PD),

Agoraphobia, Posttraumatic Stress Disorder, and Obsessive-Compulsive Disorder (DSM-5;

American Psychiatric Association [APA], 2013; Kessler et al., 2009; Lenze & Wetherell, 2011).

Of these, SAD is the most common anxiety disorder, with approximately 5%–13% of the

population experiencing it in their lifetime, depending on the study (Grant et al., 2005; Kessler et

al., 2012). SAD is characterized by consistent fear of negative evaluation in social situations

including social interactions, performing, and being observed (APA, 2013; Crome et al., 2015).

Symptoms include fear of negative evaluation of physical symptoms of anxiety and/or fear of

acting in a way that will be negatively evaluated by others, which often leads to avoidance of

feared social situations. GAD is another common anxiety disorder, with a lifetime prevalence of

approximately 4%–6% (Grant et al., 2006; Kessler et al., 2012). GAD is generally characterized

by excessive anxiety across several different functional domains (e.g., work, school, daily

activities; APA, 2013; Hobbs et al., 2014). GAD worries are difficult to control and are associated with physical symptoms (e.g., restlessness, fatigue, muscle tension). As per the DSM-5, PD is described as recurrent unexpected panic attacks accompanied by worry about additional panic attacks, their consequences, or maladaptive behaviour changes in response to panic attacks (APA, 2013; Asmundson et al., 2014). The lifetime prevalence of PD alone is approximately 4%–5% and 1% for those with PD and Agoraphobia (Grant et al., 2006; Kessler et al., 2012). Agoraphobia tends to be accompanied by PD, with a lifetime prevalence independent from PD of only approximately 1.5% (Roest et al., 2019). Agoraphobia is generally characterized by fear or anxiety about various situations (e.g., enclosed or open spaces, crowds, transportation) due to concerns of not being able to escape the situation or access help if they experience panic, incapacitating, or embarrassing symptoms.

Additionally, the DSM-5 classifies OCD within the Obsessive-Compulsive and Related Disorders category and PTSD within the Trauma- and Stressor-related Disorders category. The lifetime prevalence of OCD is approximately 2–3% (Grant et al., 2006; Kessler et al., 2012). OCD symptoms include recurrent obsessions and/or compulsions (Abramowitz & Jacoby, 2014; APA, 2013). Obsessions can occur in the form of thoughts, urges, or images, while compulsions can present as repetitive behaviours or mental acts in response to obsessions or due to rigid rules to manage distress. PTSD impacts approximately 8% of adults across their lifetime (Kessler et al., 2012; Kilpatrick et al., 2013). According to the DSM-5, PTSD is a set of symptoms that initiate or worsen following direct or indirect exposure to one or multiple traumatic events including natural disasters, sexual assaults, physical abuse, sexual abuse, combat, or car accidents (APA, 2013; Friedman et al., 2011). Additionally, symptoms are categorized within 4 clusters: 1) intrusions (e.g., nightmares, intrusive memories of the trauma), 2) negative changes

in mood and cognition (e.g., self-blame, persistent negative emotions), 3) avoidance (e.g., of

trauma-reminders), and 4) alterations in arousal and reactivity (e.g., hypervigilance, aggression;

APA, 2013; Friedman et al., 2011).

1.2. Cannabis

According to the *Canadian Tobacco, Alcohol and Drugs Survey (CTADS): Summary of*

results for 2017, cannabis was the most prevalent illicit drug used among Canadian individuals

ages 15 and older in 2017 (Health Canada, 2017). Since the legalization of recreational cannabis

use in Canada in 2018, it has been found to be most prevalent among individuals between the

ages of 20 and 24 in the general population, with 51% of individuals having endorsed using

cannabis in the past 12 months (Health Canada, 2019). The rate of cannabis use has been on the

rise and is expected to continue rising with the legalization of recreational cannabis (Hasin et al.,

2015; Health Canada, 2019).

Cannabis comes in many forms; the term **"cannabis"** is a broad term referring to a

psychoactive substance derived from the plant *cannabis sativa*, its most commonly known form

being "marijuana" (dried plant leaves and flowers; Goodman et al., 2020; Health Canada, 2019;

Steigerwald et al., 2018). Other forms include cannabis oils (taken orally or vaped), edibles

(foods and drinks), concentrates (e.g., hash, shatter), and ointments (Goodman et al., 2020;

Health Canada, 2019; Health Canada, 2018; Steigerwald et al., 2018). Cannabis can be

consumed via various methods of administration, including smoking (e.g., joints, water bongs),

vaporizing, and orally (e.g., edibles), as well as less popular forms of administration such as

topically (e.g., lotions), vaginally, or rectally (Borodovsky et al., 2016; Knapp et al., 2019; see

review by Spindle et al., 2019; Steigerwald et al., 2018). Smoking is the most commonly used method of cannabis administration (Borodovsky et al., 2016; Knapp et al., 2019).

Among its various forms and methods of administration, cannabis also comes in a range of delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) concentrations, which impact the experienced psychological effects (Freeman & Winstock, 2015). Although there are hundreds of cannabinoids found in cannabis, THC and CBD have been the most studied (see Mechoulam et al., 2014). CBD is a non-psychoactive compound that has been primarily studied in the context of its potential therapeutic utility. CBD has shown therapeutic promise for symptom management in various conditions, including seizure disorders, Multiple Sclerosis, and Parkinson's disease (Chagas et al., 2014; Russo et al., 2015; Szaflarski et al., 2019). THC is a psychoactive cannabinoid associated with the euphoric effects of cannabis (see Pertwee, 1988). The concentration of THC has been increasing in recent decades (Chandra et al., 2019; ElSohly et al., 2016; Mehmedic et al., 2010). Current marijuana THC concentration can reach approximately 18% and over 70% for concentrates (Caulkins et al., 2018; Chandra et al., 2019). THC is also an addictive property, where the risk of developing cannabis dependence increases positively with THC concentration (Freeman & Winstock, 2015).

The studies included in this dissertation vary in terms of what cannabis forms and methods of ingestion were included. Studies 1, 2 and 4 examine cannabis use generally to capture a broad representation of cannabis use in individuals with anxiety and related disorders, whereas study 3, which examines the temporal relationship between anxiety and cannabis use specifically, is limited to individuals who reported using marijuana via inhalation regularly, although use of other forms and methods of consumption were not exclusionary criteria. Marijuana consumed via inhalation (i.e., via smoking or vaping) was chosen as the focus for

study 3 because it is the most common form and method of consumption, which therefore warrants closer examination of its role as it pertains to anxiety in those with anxiety and related disorders (Borodovsky et al., 2016; Health Canada, 2019; Knapp et al., 2019).

1.2.1. Cannabis Use Disorder

In the DSM-5, CUD has replaced the DSM-IV diagnoses of *Cannabis Abuse* and *Cannabis Dependence*, with the latter requiring more symptoms (3 or more) to meet criteria than the former (1 or more; APA, 2000; Compton et al., 2013). Although cannabis is often perceived as low risk among users, the lifetime prevalence of Cannabis Use Disorder (CUD) is 6.3% (Hasin et al., 2016; Kerridge et al., 2017; Mader et al., 2019; Pacek et al., 2015). CUD is characterized by problematic patterns of cannabis use, leading to significant distress or impairment (APA, 2013; Agrawal et al., 2014; Compton et al., 2009). Individuals with CUD may spend a substantial amount of time engaging with cannabis and related activities (e.g., buying cannabis), experience unsuccessful attempts to reduce cannabis use, and often use cannabis in large amounts or over longer periods than intended. Additionally, they may continue cannabis use despite health problems as well as cannabis use in hazardous situations (e.g., driving intoxicated). Cannabis use may interfere with daily life activities (e.g., social, occupational, or recreational activities) and be used despite related interpersonal problems. Other symptoms of CUD include increased cannabis tolerance, cannabis craving, and withdrawal. CUD severity ranges from mild to severe based on the number of symptoms endorsed.

CUD is more prevalent in males than in females, as well as among adolescents and young adults between the ages of 18 to 29 compared to older adults (Hasin et al., 2016; Kerridge et al., 2018). The prevalence of CUD also varies by ethinicity (Hasin et al., 2016; Kerridge et al., 2018;

Wu et al., 2016). Specifically, CUD tends to be more prevalent in Black and Indigenous individuals than in White, Hispanic, and Asian indviduals (Hasin et al., 2016), although there is some variation across studies (Wu et al., 2016). Further, those with lower socio-economic status (SES) are more likely to be diagnosed with CUD than those of higher SES (Hasin et al., 2016; Kerridge et al., 2018; Lee et al., 2018). Additionally, CUD is strongly associated with comorbid mental health conditions (Hasin et al., 2016). Specifically, CUD is commonly comorbid with other substance use, anxiety, mood, and personality disorders (Hasin et al., 2016; Hasin & Walsh, 2021). It remains unclear why these differences among various groups are observed, however researchers have speculated that one factor may be that certain groups experience more distress than others (e.g., related to low SES, mental health concerns) and attempt to manage their distress with cannabis (Hasin et al., 2016; Paulus et al., 2018). Reporting rates of CUD in the anxiety and related disorder samples examined across the studies included in this dissertation is important in characterizing cannabis use severity in this population.

1.3. The Relationship Between Cannabis Use and Anxiety

Research has examined the relationship between cannabis use and anxiety *symptoms*, and has started to address the relationship between cannabis use and anxiety and related *disorders*. This distinction between anxiety *symptoms* and anxiety and related *disorders* is important because the latter implies a higher level of symptom severity compared to the former, leading to clinically significant distress or impairment in daily functioning warranting a clinical diagnosis. Currently, there is a lack of research examining this association in those with anxiety and related *disorders*, which the current dissertation will focus on.

The co-occurrence and positive association between cannabis use and anxiety in general is fairly well established. Individuals with anxiety and related disorders use cannabis at an elevated rate and are at higher risk of cannabis use disorders compared to those with low anxiety (Kedzior & Laeber, 2014; Spalletta et al., 2007). Frequent cannabis use, especially daily use, has been associated with anxiety disorders as well as cannabis dependence (Cheung et al., 2010; Degenhardt et al., 2013; Hayatbakhsh et al., 2007). Individuals who use cannabis daily or more, as well as individuals who use less frequently (less than monthly but at least annually) have been significantly more likely to experience an anxiety disorder than non-users (Cheung et al., 2010). Specifically, daily cannabis users have been found to be twice as likely than non-users to have anxiety or mood disorders, with infrequent users being 1.43 times as likely (Cheung et al., 2010).

Researchers have started to examine the co-occurrence and positive association between cannabis use in individuals with specific anxiety disorder symptoms and clinical anxiety disorders. SAD most commonly co-occurs with cannabis dependence compared to other types of anxiety disorders and has been one of the most researched in the context of cannabis use (Agosti et al., 2002). Research has shown that increased state social anxiety has been associated with increased cannabis craving (Buckner, Ecker, et al., 2013). Interactions between social anxiety and craving have been identified, with an increase in these factors increasing the likelihood of cannabis use (Buckner, Crosby, et al., 2012). Further, the age of onset for SAD often precedes that of CUD (Buckner, Heimberg, et al., 2012). Taken together, it may be that that individuals with social anxiety use cannabis as a means to cope with their anxiety symptoms as well as craving (Buckner, Crosby, et al., 2012; Buckner, Heimberg, et al., 2012). Additional research is needed to examine how social anxiety is specifically related to patterns of and motives for

cannabis use in individuals who meet DSM-5 SAD criteria, based on a clinician's diagnostic assessment.

PTSD is the second most highly comorbid anxiety and related disorder with cannabis dependence (Agosti et al., 2002). Lifetime PTSD has been significantly associated with daily cannabis use and increased risk of CUD (Cougle et al., 2011; Kevorkian et al., 2015). Cannabis use severity also seems to be differentially associated with trauma exposure and PTSD, where PTSD is associated with CUD, while simple trauma exposure is associated with less severe cannabis use (Kevorkian et al., 2015). Often PTSD has also been said to precede the onset of cannabis use (Cougle et al., 2011). Individuals with PTSD have been significantly more likely to report increased cannabis withdrawal severity and using cannabis to cope than individuals without PTSD (Boden et al., 2013). Among those with PTSD, cannabis withdrawal severity and craving related to emotionality have been significantly positively associated with PTSD symptom severity (Boden et al., 2013). Similarly to those with SAD, researchers have suggested that cannabis may be used to manage PTSD symptoms (e.g., hyperarousal, alleviate low mood, help with sleep) as well as negative affect and situational anxiety (Bonn-Miller et al., 2014; Cougle et al., 2011; Metrik et al., 2016).

Cannabis use patterns and co-occurrence in other anxiety and related disorders has been less well studied. When it comes to PD, cannabis seems to play a unique role; not only has cannabis use been associated with lifetime and current panic attacks, but also may induce panic attacks (Dannon et al., 2004; Zvolensky et al., 2010). Additional research is needed to understand the motives for cannabis use in individuals with PD; it is possible that there are unique subgroups of cannabis users with PD (e.g., where some individuals experience increased panic attacks with cannabis use and therefore do not use for coping motives, while others may

perceive cannabis to be helpful in managing their anxiety; Feingold et al., 2016). Further, recently some researchers have begun to examine cannabis use in individuals with OCD symptoms. Although OCD symptoms have been unrelated to frequency and amount of cannabis used, OCD symptom severity has been positively related to cannabis misuse and risky cannabis use (Bakhshaie et al., 2020; Spradlin et al., 2017). Additionally, coping motives (i.e., use to alleviate distress) have been found to mediate the relationship between cannabis misuse and OCD symptom severity, suggesting that increased OCD symptom severity may lead to use of cannabis to cope, potentially contributing to cannabis dependence (Spradlin et al., 2017). Additional research is needed to directly examine motives for cannabis use in individuals who meet DSM-5 criteria for OCD. Furthermore, when it comes to GAD, unfortunately there remains little to no research on patterns of cannabis use despite cannabis dependence being fairly common among individuals with GAD, with an odds ratio of 2.7 according to Agosti et al., (2002).

Although there is evidence suggesting an adverse relationship between anxiety symptoms and disorders and cannabis use, there is also evidence to the contrary. Some studies have not found anxiety to be associated with increased rates of CUD and vice versa (Feingold et al., 2016) or an association between cannabis use frequency and anxiety disorders, longitudinally (Degenhardt et al., 2001). Interestingly, Cheung et al., (2010) did not find an association between moderate cannabis users (used once per month and up to once per week) and anxiety disorders as they did for individuals who use cannabis daily or more, as well as individuals who use less frequently (used less than once per month but at least once in the past year). Additionally, other research has found that cannabis may decrease anxiety (Colvin, 2013). The cannabinoid CBD specifically, a non-psychoactive compound derived from the cannabis plant, may have acute

anxiolytic effects which have been shown in humans and animal models (Crippa et al., 2011; Gomes et al., 2011; Mandolini et al., 2018; Zuardi et al., 1993). Some studies suggest that CBD may counteract anxiogenic effects of THC (Fusar-Poli et al., 2009; Zuardi et al., 1982). A review by Blessing et al., (2015) suggests that CBD's relationship with anxiety is bell-shaped, where anxiolytic effects occur at moderate but not high CBD doses. Although evidence for the anxiolytic effects of CBD in humans with anixety disorders is limited, there are animal studies that suggest that CBD has potential to be used as a treatment for anxiety disorders (Blessing et al., 2015). Recently, there has been evidence demonstrating that CBD can reduce anxiety symptoms in individuals with SAD acutely and over longer periods of time (i.e., 4 weeks), although further research is needed to support these findings (Bergamaschi et al., 2011; Masataka, 2019). Neuroimaging studies have also supported the anxiolytic effects of CBD, indicating changes in brain activity along with reduced anxiety in individuals with and without clinical anxiety (Crippa et al., 2004; Crippa et al., 2011; Fusar-Poli et al., 2009). Despite these findings, there is not enough evidence to support using cannabis as a treatment for anxiety disorders at this time (Van Ameringen et al., 2020).

Taken together, research on cannabis and anxiety is still in its infancy. Studies tend to use non-clinical samples and research is mixed on whether cannabis is uniformly problematic for individuals with anxiety. The relationship between anxiety and cannabis use is nuanced and worthy of further investigation, especially in clinical samples. For example, research is needed to examine motives for cannabis use in those with anxiety and related disorders to better understand why individuals use. Additional research is also needed to improve our understanding of the temporal relationship between cannabis use and anxiogenic or anxiolytic effects in those with anxiety and related disorders. Understanding self-reported motives for cannabis use in tandem

with the temporal relationship of cannabis use relative to changes in anxiety will provide a better understanding of motivating factors driving patterns of cannabis use in those with anxiety and related disorders.

1.3.1. Theoretical Models of Substance Use

Theoretical models of substance use consistently highlight the relationship between substance use and emotions, suggesting that emotions play an important role in motivating patterns of substance use. Although few models have been described for cannabis use specifically, models of motivation for substance use in general and alcohol use have recently been applied to cannabis use. The tension-reduction model, motivational model of alcohol use, and the mutual maintenance model are summarized below.

The tension-reduction model is based on the idea that substances are used to reduce tension (Conger, 1956). Tension is derived from an unsatisfied need. Importantly, it can present as fear or anxiety. Continued use of the substance occurs as it is associated with reduction in tension, which is experienced as rewarding (Conger, 1956; Greeley & Oei, 1999). In an anxiety and related disorder population, the tension-reduction model would predict that cannabis is used to reduce distress in the short term, especially anxiety symptoms, and that cannabis continues to be used because the relief associated with acute alleviation of anxiety symptoms is rewarding. Research has begun to apply this model to anxious cannabis users and has been supported, where cannabis has been shown to be used as a means to cope with anxiety (e.g., Buckner et al., 2006; de Dios et al., 2010; Foster et al., 2015; Walukevich-Dienst et al., 2019). Generally, this model seems to be most commonly referred to when examining the association between anxiety and cannabis use.

The motivational model of alcohol use, conceptualizes alcohol use for the purpose of regulating positive and negative emotions (Cooper et al., 1995; Cox & Klinger, 1988). Accordingly, alcohol users may drink for the purpose of enhancing positive emotions. Negative emotions may motivate alcohol use for coping purposes, providing a sense of avoidance, escape, or regulation of their negative emotions, similarly to the tension-reduction model. This model has also been applied to cannabis use (see review by Cooper et al., 2015; Feinstein & Newcomb, 2016). Similar motives for substance use related to managing positive and negative affect have been identified in alcohol and cannabis users (Simons et al., 1998; Skalisky et al., 2019). In an anxiety and related disorder population, this model would predict that cannabis is used to manage negative affect, similarly to the tension-reduction model, as well as enhance positive emotions such as using cannabis because they enjoy the feeling.

The mutual maintenance model has also been suggested to illustrate the relationship between comorbid substance use and anxiety (Stewart & Conrod, 2008). This model explains that regardless of whether the anxiety or substance use disorder developed first, once both are present, they may maintain and exacerbate each other. Specifically, the anxiety disorder may lead to self-medication with substances and the substance use disorder can exacerbate anxiety symptoms, leading to the maintenance of each disorder. There has been some support for this model to explain the relationship between anxiety and cannabis use, where anxiety seems to increase cannabis craving and vis versa (Buckner, Crosby, et al., 2012). Relatedly, coping motives for cannabis use have been linked to problematic cannabis use, suggesting that using cannabis to manage other concerns that cause distress can lead to problematic cannabis use (Buckner et al., 2007; Fox et al., 2011). Further, this model predicts that individuals with comorbid anxiety and substance use are likely to relapse if either of the two disorders is treated

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rather than if both are treated (Stewart & Conrod, 2008). Studies have started demonstrating the efficacy of treating CUD and anxiety disorders concurrently to address this concern (Buckner et al., 2016, 2019). In summary, this model could predict that in an anxiety and related disorder population, individuals use cannabis to cope with their negative affect and as their cannabis tolerance increases, more cannabis is used to achieve the same psychological effect which could lead to CUD and distressing withdrawal symptoms (which include anxiety). At this point, cannabis may be used to avoid withdrawal symptoms in the short term but perpetuate anxiety in the long-term.

Although these models each have unique features, a common theme seen across models is the idea that substances such as cannabis are used to manage distressing emotions. Although the source of distress differs across models to varying degrees, it is clear that negative affect is highlighted as an important factor in motivating substance use. Additionally, it is important to consider that these models may not be mutually exclusive, where several models may fit a particular presentation of cannabis use or the best fitting model may change as cannabis use patterns evolve. For example, the tension-reduction may best explain cannabis use in someone who uses small amounts of cannabis to manage their anxiety, however as their tolerance to cannabis increases, more cannabis is used, which could lead to distressing withdrawal symptoms. At this point, the mutual maintenance model may best describe the motivation for cannabis use. A better understanding of motives for cannabis use in an anxiety and related disorders population may provide evidence for which of these models fits best most often. This understanding is important to guide interventions.

Further research is needed to support these models in the context of cannabis use as they have been traditionally studied in the context of other substances such as alcohol and tobacco

(see review by Cooper et al., 2015). As mentioned, some researchers have examined the relationship between cannabis and anxiety (e.g., co-occurrence of cannabis use and anxiety, association between cannabis use frequency and anxiety symptoms), however additional research is needed to examine this relationship in clinical anxiety disorders to understand nuances within this relationship. Little research has been done to examine the relationship between cannabis use frequency and anxiety as well as cannabis use co-occurrence in diverse clinical anxiety and related disorder. Further, there is a need for research exploring specific self-reported motives for cannabis use to provide a more detailed understanding of why individuals with anxiety disorders use cannabis and how these motives fit within the three broad models of substance use.

1.3.2. Motives for Cannabis Use

According to all models of cannabis use presented above, it would be predicted that cannabis is used to cope with negative affect. Additionally, the motivational model would also predict that cannabis is used for the purpose of enhancing positive emotions. In general, the literature on motives for cannabis use coincides with the models of cannabis use, with a 5 factor model of motives for cannabis use being supported by research, namely: coping, enhancement, expansion, social, and conformity motives (Benschop et al., 2015; Simons et al., 1998; Zvolensky et al., 2007). Coping motives are related to cannabis use for the purpose of managing distress (e.g., to forget worries, to help with low mood; Simons et al., 1998). Enhancement motives focus on cannabis use for fun or for the feeling whereas expansion motives are generally related to use for the purpose of changing one's thinking (e.g., increase creativity, awareness, knowledge of self; Simons et al., 1998). Social motives are relevant to social situations

specifically such as partying, confidence, enjoyment of social gatherings, whereas conformity motives are specifically related to peer pressure (Simons et al., 1998).

Research has found different associations between various motives for cannabis use and constructs associated with anxiety. Some motives have been associated with mental health symptoms, for example, expansion and conformity motives have been found to moderate the relationship between stress and anxiety (Glodosky & Cuttler, 2020). As such, the authors suggest that individuals experiencing stress should avoid using cannabis use for expansion and conformity motives as it may increase their anxiety (Glodosky & Cuttler, 2020). Other motives have not been associated with mental health symptoms, for example, social motives for cannabis use have not been associated with distress (Brodbeck et al., 2007). Similarly, enhancement and social motives have also been found to be unrelated to perceived stress, depression symptoms, cannabis problem severity, and CUD (Moitra et al., 2015). Further, various motives have been differentially associated with amount of cannabis use. For example, expansion and enhancement motives have been associated with heavier cannabis use than using for experimentation purposes (Lee et al., 2007). Additionally, Skalisky et al., (2019) found that low conformity motives were associated with greater cannabis use, however they noted that this may be specific to their study sample, private college undergraduate students (i.e., it may be normative to abstain from cannabis use due to rules and religious beliefs). Nevertheless, there seems to be differential associations between motives for cannabis use and amount of cannabis used.

Coping motives for cannabis use have been of particular interest in recent years and have been linked to several factors including patterns of cannabis use and various forms of distress (e.g., withdrawal, psychological distress). First, coping motives have been linked to problematic cannabis use. Specifically, a review by Hyman and Sinha (2009) suggested that coping motives

for cannabis use are more common among chronic users than experimental or occasional users. Coping motives have also been positively associated with frequency of cannabis use (Sofis et al., 2020). Cannabis used for coping motives has also been significantly positively associated with cannabis problems, dependence, and CUD (Benschop et al., 2015; Bujarski et al., 2012; Hyman & Sinha, 2009; Moitra et al., 2015).

Relatedly, distressing symptoms such as cannabis craving and withdrawal have played a role in motivating cannabis use. Craving positively predicts greater marijuana use and has been positively related to later feelings of anxiety and subsequent craving, fitting with the mutual maintenance model (Buckner, Crosby, et al., 2013; Phillips et al., 2015). Additionally, coping motives have been found to mediate the positive association between perceived distress intolerance and cannabis dependence symptoms, problems, and craving (Bujarski et al., 2012; Farris et al., 2016). Withdrawal symptoms include difficulty sleeping, depressed mood, restlessness, anxiety or nervousness, decreased appetite or weight loss, irritability, anger, or aggression, as well as physical symptoms such as abdominal pain, shakiness or tremors, sweating, fever, chills, and headache (APA, 2013; Cornelius et al., 2008). Among heavy cannabis users, 50%-95% experience withdrawal symptoms (Hasin et al., 2013). Withdrawal symptoms have been associated with cannabis relapse (Cornelius et al., 2008). Consistent with the tension-reduction model, it may be that withdrawal symptoms in general, including anxiety, motivate cannabis use to avoid such distress. Anxiety has been positively related to cannabis withdrawal severity as well as lower self-efficacy to avoid cannabis use when distressed (Buckner et al., 2017).

Coping motives have also been associated with psychological distress (Moitra et al., 2015). For example, coping motives have been positively associated with psychosocial distress

(e.g., job), perceived stress, distressing life events, emotional dysregulation, lower mental health, and psychopathology (Brodbeck et al., 2007; Buckner et al., 2017; Moitra et al., 2015). As previously described, coping motives have been associated with anxiety and related disorder symptoms such as social anxiety, PTSD, and OCD, in line with the tension-reduction model (Boden et al., 2013; Buckner, Crosby, et al., 2012; Buckner, Heimberg, et al., 2012; Conger et al., 1956; Spradlin et al., 2017). Coping motives have also been associated with specific constructs related to anxiety. For example, avoidance is a construct well understood to be linked to anxiety (Borkovec et al., 2004; Maner & Schmidt, 2006). Research has shown that avoidance in individuals with social anxiety symptoms has been associated with coping motives for cannabis use and behavioural avoidance mediated the relationship between social anxiety and coping motives (Buckner et al., 2014). It may be that cannabis is used to avoid distressing situations and emotions. Additionally, cannabis use to cope has been specifically associated with symptoms like sleep disturbances (Bonn-Miller et al., 2014; Metrik et al., 2016). Individuals with PTSD symptoms have been found to use cannabis specifically to improve sleep (Bonn-Miller et al., 2014). Motives for coping with sleep disturbances have also been identified as the main factor mediating the relationship between PTSD with cannabis use frequency, more so than situational anxiety or negative affect (Metrik et al., 2016). It is possible that the role of sleep as a coping motives for cannabis use is applicable to other anxiety disorders as well given that sleep difficulties are associated with anxiety and related disorders (Marcks et al., 2010).

In sum, there seems to be a link between coping motives for cannabis use and anxiety. However, there is a lack of research examining motives for use in anxiety disorder samples specifically, rather than individuals from the general population with symptoms of anxiety disorders.

1.4. The Impact of Cannabis on Cognition and Behaviour

It is important to consider the impact of cannabis use on cognition and behaviour given that the studies presented in this dissertation examine the impact of cannabis use from a cognitive-behavioural lens, where cognitions, emotions, and behaviours are thought to interplay (Beck, 1979; Williams & Garland, 2002). As such, hypotheses will draw on the relationship between cognitions, emotions, and behaviours relevant to cannabis use and results will also be contextualized within this framework.

It is understood that cannabis use impairs cognition and behaviour, although there remain gaps in our understanding of these impairments (Broyd et al., 2016; Meier & White, 2018). Cognitive impacts of cannabis use are observed with acute and chronic use, most consistently in verbal learning, memory, and attention (see reviews by Broyd et al., 2016; Ranganathan & D'Souza, 2006). There have been mixed findings about the impact of cannabis use on other cognitive domains, although according to a review by Broyd et al., (2016), this is likely due to various methodologies (e.g., cognitive tests) and samples (e.g., cannabis use history, methods of administration) employed. A recent meta-analysis by Lovell et al., (2020) explored the impact of long-term recreational regular cannabis (having used an average of 2 or more years, 4 or more days per week) use on 6 cognitive domains in adults. Compared to control groups, cannabis users experienced small deficits in executive function, learning, memory, and global cognitive, as well as moderate deficits in decision making. Notably, there were no significant differences between cannabis users and non-users in information processing, working memory, and attention. Some of these findings are conflicting with other studies, for example other authors have suggested that cannabis likely impairs processing speed and attention (Petker et al., 2019; Solowij et al., 2002;

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Umut et al., 2016). Additionally, it is interesting that Lovell et al., (2020) found that the difference between groups on executive function became non-significant when cannabis users were abstinent for 25 days or more, which supports that some of these observed cognitive changes may not be enduring with abstinence. Similar findings have been observed for other cognitive domains, for example, reaction time and motor function have been found to improve after one month of abstinence (Umut et al., 2016). In summary, the relationship between various cognitive domains and cannabis use is complex and remains unclear, however there is evidence suggesting some cognitive impairments associated with cannabis use.

In addition to the cognitive effects of cannabis, there are behavioural impacts of cannabis use. Notably, sensitivity to drug and non-drug related rewards impact drug use seeking. Generally in addiction disorders, it has been observed that individuals addicted to a substance are sensitive to drug cues and expect rewarding drug effects while being less sensitive to non-drug rewards (Ferland & Hurd, 2020; Filbey et al., 2016; Volkow et al., 2019). These factors may play a role in the disinterest in non-drug related activities seen in individuals who are addicted to substances (Volkow et al., 2019). As seen with other substance use, research has shown that cannabis users specifically are more sensitive to cannabis cues than to natural rewards, unlike in non-users (Filbey et al., 2016). Sensitivity to the rewarding effect of cannabis has also been associated with increased likelihood of cannabis use (Emery & Simons, 2017; Ferland & Hurd, 2020; Scalco & Colder, 2017). Taken together, it may be that the heightened sensitivity to drug rewards and decreased sensitivity to non-drug rewards may not only lead to further cannabis use but also reduce interest in changing cannabis-use behaviours.

Additionally, although few studies have examined the association between cannabis and amotivation until recently, research has shown that cannabis use seems to be linked to

amotivation (Lane et al., 2005; Meier & White, 2018; Petrucci et al., 2020). For example, informants have reported significantly higher levels of amotivation in young adults who use cannabis compared to those who had used less than 52 days in the past year, even when controlling for other drug use and depression symptoms (Meier & White, 2018). Cannabis has also been shown to lead to acute amotivation, likely due to THC (Lawn et al., 2016). Additionally, cannabis use has been specifically associated with less persistence and initiative, unlike tobacco and alcohol (Lac & Luk, 2018). Although there seems to be an understanding that cannabis use is associated with amotivation, there have also been mixed results as it pertains to this association; varying findings may be due to the different operationalizations of motivation and lack of controlling confounding variables across studies (Pacheco-Colón et al., 2018; Petrucci et al., 2020).

1.5. The Impact of Cannabis Use on Cognitive Behavioural Therapy Outcomes

Cognitive behavioural therapy (CBT) is a psychological treatment that addresses dysfunctional thoughts and behaviours, which has been specifically applied to many conditions including various anxiety and related disorders (Beck, 1993). CBT is typically 8-12 sessions in length, each lasting 1-2 hours, and includes weekly homework to practice symptom management skills taught during each session (Erickson, 2003; Kazantzis et al., 2010). Generally, CBT is considered the gold standard treatment for anxiety and related disorders (Otte, 2011), demonstrating significant improvement in anxiety symptoms (Asnaani et al., 2020; Hans & Hiller, 2013).

Notably, few studies have examined the impact of cannabis use on CBT for anxiety and related disorder outcomes, although findings from studies examining similar constructs seem to

have mixed implications. For example, some studies have found that decreases in anxiety during CBT/motivational enhancement therapy for cannabis dependence were associated with less cannabis use, which was a trend seen post-treatment (Buckner & Carroll, 2010). This may be linked to the mutually maintaining relationship between CUD and anxiety, leading some research groups to develop integrated CBT protocols which have shown promise in reducing cannabis use and anxiety symptoms (Buckner et al., 2016, 2019). If individuals use cannabis to cope with their anxiety, providing alternative coping skills for anxiety may be particularly important to prevent relapse of cannabis use (Buckner et al., 2019; Copersino et al., 2006). Recently, a study by Buckner et al., (2021) compared the efficaciousness of motivational enhancement therapy combined with CBT (MET-CBT) and integrated cannabis and anxiety reduction treatment (ICART). The ICART protocol combined transdiagnostic CBT for anxiety disorders and MET-CBT for CUD. Participants were 55 individuals whose symptoms met DSM-5 criteria for CUD and an anxiety disorder. They were randomly assigned to the MET-CBT or ICART condition. Results suggested that ICART was associated with better outcomes than MET-CBT for participants with more severe baseline cannabis use and cannabis-related problems, and vise versa for those with less severe baseline cannabis use and related problems. Taken together it is possible that cannabis use may play a role in psychological treatment outcomes.

In contrast, others have found no effect of cannabis on treatment outcomes (Bricker et al., 2007; Ruglass et al., 2017). For example, Bricker et al., (2007) randomized 203 less than monthly cannabis users and 29 monthly cannabis users to receive care as usual or an intervention. The intervention included 6 CBT sessions for PD as well as anxiety and depression symptoms, with medication. Participants were excluded if they met criteria for cannabis abuse or

dependence or used cannabis more than once per week. Individuals were included if they used cannabis at least once in the past month or less. They did not find an impact of cannabis use on combined CBT-pharmacotherapy outcomes meant to address PD and associated social anxiety and depressive symptoms. Another study by Ruglass et al., (2017) used data from two previous clinical trials which included 104 non-cannabis users and 32 cannabis users. The first trial involved 12 sessions of CBT for Substance Use Disorder (SUD) and PTSD either with sertraline or a placebo. The second trial involved 12 weeks of a prolonged exposure with relapse prevention-based protocol to address PTSD and SUDs, respectfully. Participants were considered cannabis users if they reported using cannabis in the past 7 days. Individuals with CUD as their primary SUD were excluded. The authors did not find an association between baseline cannabis use and PTSD symptom severity post-treatment for comorbid PTSD and SUDs. These may have lacked adequate power and therefore warrant replication (Bricker et al., 2007; Ruglass et al., 2017). Additionally, both studies defined cannabis users differently, excluded individuals with cannabis use disorders, and used different diagnostic samples and treatment protocols, all of which likely impacted observations.

Clearly, additional studies are needed to explore the impact of cannabis specifically on CBT outcomes for anxiety and related disorders to clarify this relationship. An improved understanding this relationship has the potential to inform clinicians about psychoeducation and treatment planning to provide patients with effective and efficient care plans.

1.5. Overview of the Current Studies

Four studies were designed to begin addressing four primary questions. Study 1 focuses on understanding *how* cannabis is used in those seeking anxiety and related disorders services,

including rates and patterns of use. It also explores the association between cannabis use and subjective psychological distress. The premise for study 2 was to extend the findings from study 1, examining *why* cannabis is used in this population. Coping, expansion, enhancement, social, and conformity motives are examined. Given the apparent link between anxiety and cannabis use, and the lack of research examining this relationship in real-time, an experience sampling design was implemented for study 3 which explores whether or not anxiety and marijuana are temporally related in this population. Using smart phone technology and web-based applications, data on marijuana use and emotions was captured over a 2-week period in a sample of individuals with anxiety and related disorders. Further, given the elevated rates of cannabis use in those with anxiety and related disorders, the impact of cannabis use on CBT outcomes is examined in study 4 to provide a broad perspective of how cannabis use may or may not impact treatment outcome.

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CHAPTER 2: CANNABIS USE IN PATIENTS SEEKING THERAPY FOR ANXIETY AND

RELATED DISORDERS: A DESCRIPTIVE STUDY

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Previous research has demonstrated inconsistent findings regarding the relationship between anxiety and cannabis use. Further, there have been few studies that have examined the prevalence and severity of cannabis use in clinical samples of individuals seeking treatment for anxiety and related disorders. This chapter examined the patterns of cannabis use, motives for use, and the relationship between cannabis use and problematic alcohol use in a large sample of individuals seeking treatment for anxiety and related disorders, to better understand cannabis use presentations in this population.

Cannabis Use in Patients Seeking Therapy for Anxiety and Related Disorders:

A Descriptive Study

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Abstract

Objectives: The present study describes patterns of cannabis use, motives for use, and the relationship between cannabis use and problematic alcohol use in a large sample of individuals seeking treatment for anxiety and related disorders at a specialized outpatient clinic in a Canadian hospital.

Methods: Seven hundred ninety-six participants ($n = 308$ cannabis users; $n = 488$ cannabis nonusers) completed questionnaires examining patterns of cannabis use, severity of cannabis and alcohol use, and level of psychological distress before receiving any treatment at a specialty anxiety clinic.

Results: Of the total sample, 39% reported using cannabis in the past 6 months and 43% of cannabis users endorsed using cannabis multiple times per week, primarily via smoking joints. Twenty-two percent of cannabis users exceeded the cutoff score on a validated screening tool for Cannabis Use Disorder. A significant small positive correlation was found between cannabis use severity and level of psychological distress. Commonly reported motives for use included sleep, mental health concerns, and chronic pain, suggesting that cannabis may be used to broadly manage distress. Alcohol and cannabis use severity were not significantly correlated; however, cannabis users were significantly more likely to abuse alcohol than cannabis nonusers.

Conclusions: These findings are congruent with previous research that has demonstrated a positive association between anxiety symptoms and cannabis use. Cannabis use is prevalent in those seeking therapy for anxiety and related disorders and is associated with several indicators of psychological distress. These results are in line with the tension-reduction model of cannabis use.

Keywords: anxiety, cannabis, cognitive behavioural therapy, prevalence

Cannabis Use in Patients Seeking Therapy for Anxiety and Related Disorders:

A Descriptive Study

1.0 Introduction

Anxiety disorders and rates of cannabis use are both highly prevalent. The current global prevalence of anxiety disorders is between 5.3% and 10.4% (Baxter et al., 2013). According to Health Canada (2017), 29% of Canadians ages 16 and older reported using cannabis in the past 12 months. The 12-month prevalence of Cannabis Use Disorder (CUD) is 3.5% for men and 1.7% for women (Kerridge et al., 2018). Research has shown a link between cannabis use and anxiety symptoms such that individuals with high levels of anxiety symptoms use cannabis at an elevated rate compared to those with lower levels of anxiety symptoms (Spalletta et al., 2007).

A systematic review by Crippa et al., (2009) concluded that regular cannabis users are more likely to have an anxiety disorder than nonusers, and those with anxiety disorders are more likely to use cannabis at higher rates than those without an anxiety disorder. Associations between cannabis dependence and anxiety disorders have also been identified (Kedzior & Laeber, 2014). A meta-analysis of 31 studies found that anxiety disorders are positively associated with cannabis use and CUD (Kedzior & Laeber, 2014). Furthermore, the rate of comorbidity of CUD and any anxiety disorder is 23.4% for males and 36.1% for females (Kerridge et al., 2018). These results suggest a positive association between anxiety symptoms and cannabis use.

However, some studies have shown no association between cannabis use and anxiety symptoms. In general population samples, cannabis use has been described as a minor risk factor for increased anxiety or has not been found to be associated with increased risk of anxiety (Hill

2017; Twomey, 2017). Other researchers have claimed that there is a negative association between social anxiety symptoms and cannabis use (Nelemans et al., 2016).

The association between cannabis use and anxiety symptoms may be explained by the tension-reduction model, which suggests that substances are used to reduce unpleasant emotions (i.e., tension; Conger, 1956). The tension-reduction model has been used to describe the motivation for alcohol use and has been supported within the alcohol abuse literature (Levenson et al., 1980). Drinking alcohol can reduce feelings of tension and therefore, alcohol consumption is negatively reinforced (Kushner et al., 1994). Researchers have begun to study cannabis use within the tension-reduction model (Buckner et al., 2006). In support of this model, research has shown that a common motive for using cannabis is to reduce stress or tension (Fox et al., 2011; Lee et al., 2007; Reilly et al., 1998). Cannabis users have reported that there tends to be increased use of cannabis during times of psychological distress (Kaplan et al., 1986) and that a common effect of cannabis is a decrease in feelings of tension (Reilly et al., 1998). More recently, researchers have found support for cannabis reducing negative affect (Buckner et al., 2015). A large proportion of the literature examining associations between cannabis use and anxiety symptoms has been conducted using nonclinical community samples. Therefore, further research is needed to examine these associations in a large clinical sample.

Commonly reported motives for cannabis use include enjoyment, conformity, experimentation, social enhancement, boredom, relaxation, and coping (Lee et al., 2007). Interestingly, individual motives for cannabis use have been associated with the frequency and severity of cannabis use, as well as cannabis use problems (Fox et al., 2011; Lee et al., 2007; Bonar et al., 2017). Specifically, using cannabis to cope with negative affect is significantly

associated with increased frequency of cannabis dependence symptoms (Fox et al., 2011). Hyman and Sinha (2009) found that individuals who use cannabis chronically are more likely to use cannabis to cope with stress compared to those who have only experimented with cannabis. Coping motives for cannabis use are significantly associated with greater amounts of cannabis used (Bonar et al., 2017). However, there is relatively little research looking at rates of cannabis use, the amount and frequency of cannabis use, and rates of CUD in people with clinical anxiety and related disorders. This population by definition has difficulty coping with stress and regulating their emotions (Cisler et al., 2010). Based on the current literature, coping motives may be particularly common in cannabis users who are seeking therapy for anxiety and related disorders and therefore rates of chronic or problematic use may be high.

If individuals with anxiety or related disorders have higher rates of chronic or problematic cannabis use, there are important implications for clinicians working with anxious clients. For example, clinicians might need to be vigilant in screening for problematic cannabis use in this population to determine optimal treatment approaches (e.g., comorbid anxiety/substance use treatment, treat CUD before anxiety). This line of research is especially important given that Canada has recently legalized cannabis use. Legalization may contribute to the normalization of cannabis use as a method to cope with distress, which could further increase rates of use in this population. Due to the inconsistent findings of the relationship between anxiety and cannabis use and the limited amount of studies addressing the prevalence and severity of cannabis use in clinical samples of individuals seeking treatment for anxiety and related disorders treatment, this study intends to address these research gaps.

This study describes patterns of cannabis use in a sample of individuals seeking treatment for anxiety disorders (e.g., panic disorder, agoraphobia, social anxiety disorder, generalized

anxiety disorder) and related disorders [e.g., obsessive-compulsive disorder and post-traumatic stress disorder (PTSD)] at a specialized hospital-based outpatient clinic. Specifically, this study characterizes the proportion of patients who report recently using cannabis, the frequency and amount of cannabis used, the proportion of patients who exceed the cutoff score on a measure of cannabis use symptoms which suggests that CUD criteria is likely met, motives for cannabis use, and whether or not cannabis users are more likely to abuse alcohol than cannabis nonusers. Based on the tension-reduction model, it is hypothesized that individuals presenting to an anxiety clinic will report an elevated rate of cannabis use compared to the general population and that those who endorse more depression and anxiety symptoms will use cannabis more frequently and in larger amounts than those who report fewer symptoms. Consequently, we predict that patients with higher symptoms of psychological distress will be more likely to score higher on a measure of cannabis use symptoms and exceed the threshold associated with CUD. Further, it is hypothesized that the primary motive for cannabis use in this population will center around attempts to regulate mental health symptoms. It is also hypothesized that those who use cannabis at an elevated rate may also use alcohol at an elevated rate to further reduce their distress.

2.0 Method

2.1 Patients

A total of 796 patients ($n = 308$ cannabis users; $n = 488$ non-cannabis users) were recruited from a large, specialized anxiety and related disorders clinic in an academic hospital in Ontario, Canada. For the purpose of the present study, patients who endorsed using cannabis at least once in the past 6 months on a screening question were considered cannabis users. Patients were seeking treatment services for an anxiety or related disorder as per their family physician's

or other healthcare professionals' referral. Sample demographics are summarized in Table 1. Note that cannabis users and nonusers differed by age, education, and ethnicity (Table 1).

2.2 Procedure

As part of the intake procedure at the clinic, all patients completed a battery of self-report measures, including the Depression Anxiety Stress Scales 21 (DASS-21; Lovibond & Lovibond, 1995) and the Alcohol Use Disorder Inventory Test (AUDIT; Saunders et al., 1993). All cannabis users ($N = 308$) completed the Cannabis Use Disorder Identification Test-Revised (CUDIT-R; Adamson et al., 2010) between May 9, 2018 and February 24, 2019, and 53 cannabis users also completed the Marijuana History Questionnaire (MHQ; Metrik et al., 2009) between January 14, 2019 and February 24, 2019, therefore providing a snap shot of cannabis use near October 17, 2018, the date of legalization of cannabis in Canada. All patients provided written consent to participate in this study. The study was approved by the institutional research ethics board.

2.3 Measures

The DASS-21 is a 21-item measure of distress with 3 subscales: depression, anxiety, and stress states (Lovibond & Lovibond, 1995). Items are rated on a 4-point scale, from 0 = Did not apply to me at all to 3 = Applied to me very much or most of the time. Scores are summed and multiplied by 2 for each scale to yield total scale scores. Higher scores indicate increased severity. Cutoff scores have been determined, which indicate normal, mild, moderate, severe, or extremely severe symptoms (Crawford et al., 2003; Lovibond & Lovibond, 1995).

The AUDIT is a 10-item self-report screening tool for symptoms of alcohol use disorder (AUD; Saunders et al., 1993). Each item is scored from 0 to 4 and a total score is achieved by summing the rating on each item. Total scores above 8 suggest problematic alcohol consumption (Saunders et al., 1993).

The CUDIT-R is an 8 item self-report screening tool for symptoms of CUD in the past 6 months (Adamson et al., 2010). Items reflect 4 domains: consumption, cannabis problems, dependence, and psychological features. Each item is rated on a 5-point scale, ranging from 0 = Never or Less than 1 to 4 = 4 or more times per week. The CUDIT-R has high sensitivity (91%) and specificity (90%) with the suggested cutoff score of 13, where those who score above 13 are likely to have CUD (Adamson et al., 2010).

The MHQ is a 32-item, self-report data collection tool. It measures cannabis use history including information about method of consumption, frequency and amount of use, age of first use, and motives for use (Metrik et al., 2009). Multiple responses can be selected for questions related to reasons for use (i.e., medical, psychiatric) and method of consumption (e.g., smoking, vaping, eating). Given that only a subset of questions from the MHQ addressed the objectives of the present study, some MHQ questions were excluded.

2.4 Data Analysis

The proportion of patients seeking therapy for anxiety symptoms who reported cannabis use in the past 6 months was calculated by dividing the proportion of users by the total sample size. To describe patterns of cannabis use, the mean age of first use was calculated, frequency analyses were conducted for various rates of use endorsed, and the mean amount of cannabis

used in grams per session, day, and week, in the past 3 months was calculated. The proportion of patients who smoke, vape, and ingest cannabis was calculated to describe methods of cannabis consumption within this population. Frequency analyses were used to determine the primary methods of smoking (e.g., joints, bong) and vaping (e.g., vaping pens, other portable devices), and the proportion of people who vape concentrates or marijuana plant material. The severity of cannabis use was reflected by the mean total CUDIT-R score and the proportion of patients who likely met criteria for CUD (i.e., score 13 or higher on the CUDIT-R). Rates of total CUDIT-R scores of 13 or over were compared between individuals identifying as male or female as well as frequency of cannabis use. Note that rates of cannabis use in transgender and intersex individuals were not included due to small sample sizes. In addition, to explore the hypothesis that cannabis users may use to reduce distress, Pearson correlations were conducted between the CUDIT-R and DASS-21 total scores as well as DASS-21 subscale scores. To further examine the motives for cannabis use, the proportion of patients who endorsed using cannabis for medical reasons, using with the authority of a medical doctor, and for various medical and psychiatric purposes, were calculated. Pearson correlations were also conducted between the AUDIT and DASS-21 scores to determine if alcohol may be used to reduce distress in cannabis users and nonusers. A Pearson correlation between total AUDIT and CUDIT-R scores was also calculated in cannabis users, to determine if alcohol and cannabis use severity were associated in this population. An independent samples t test was conducted to determine if there was a significant difference in total AUDIT scores between cannabis users and nonusers. Levene's test for equality of variance was violated, therefore the t test correction for unequal variances is reported below.

3.0 Results

3.1 Descriptive Statistics

Cannabis users were significantly younger than nonusers [$t(735.54) = 5.82$, $p < 0.001$]. As indicated in Table 1, education and ethnicity differed significantly between cannabis users and nonusers [$x^2(2) = 9.22$, $p = 0.010$; $x^2(6) = 15.22$, $p = 0.019$, respectively]. Sex and relationship status did not differ significantly between users and nonusers [$x^2(2) = 1.18$, $p = 1.183$; $x^2(1) = 1.18$, $p = 0.030$, respectively].

3.2 Description of Cannabis Use Patterns

Thirty-nine percent ($n = 308$) of patients seeking treatment for anxiety reported using cannabis in the past 6 months. The mean age of first use was 17.42 years [standard deviation (SD) = 3.83], the youngest and oldest ages of first use reported being 11 and 30 years old. In the past 6 months, 43% of cannabis users endorsed using 4 or more times per week, 33% using monthly or less, 12% using 2 to 4 times per month, and 9% using 2 to 3 times per week. Three percent reported never using which may be explained by patients who used cannabis in the past 6 months but do not use on a regular basis (e.g., they may have tried it for the first time in the past 6 months or they may use only on special occasions). Frequency of cannabis use was generally similar between males and females, with the largest proportion of patients using 4 or more times a week (41% of females and 46% of males).

More detailed information about patterns of use was collected for a subset of patients ($n = 53$). In a typical session, patients reported using a mean of 0.31g of cannabis ($SD = 0.42$). On a typical day when using cannabis, they reported consuming an average of 0.53g ($SD = 0.82$). In a typical week when using cannabis, they reported consuming an average of 2.65g ($SD = 4.82$), with a maximum of 21g. A total of 78 responses were made regarding method of consumption by

the 53 patients who completed the MHQ. Note that patients could endorse as many responses about method of consumption as applicable. Twenty-one individuals made a single response for primary mode of use (smoking, vaping, or edibles), 12 individuals made 2 responses, and 11 individuals made 3 responses. Of the 78 responses, 49% endorsed consuming cannabis via smoking, 24% via vaping, and 27% via edibles. Of the 38 patients who endorsed smoking as a primary method of cannabis consumption, 49 responses were made to specify most common smoking methods (e.g., joints, bong). Forty seven percent of responses were made for smoking joints, 38% smoking via pipes, bowl, or one-hitter, 12% reported using a bong, and only 4% using blunts (marijuana in cigars) and spiffs (tobacco and marijuana in a joint). No respondents endorsed frequently using a hookah. Of the 19 patients who endorsed vaping as one of their primary methods of consumption, 20 responses were made to specify most common vaping methods. Forty-five percent endorsed vaping pens, 40% endorsed other portable devices, 10% endorsed dab/oil rings, and 5% endorsed using tabletop vapes. No reports of e-cigarettes as a common form of consumption were made. Sixty percent of these patients fill their vapes with dried marijuana plant material and 40% fill them with concentrates. Of the 308 cannabis users, the mean CUDIT-R score was 8.38 ($SD = 6.97$). Twenty-two percent scored a total of 13 or above on the CUDIT-R, and were therefore likely to meet criteria for CUD. Thirty-two percent of males and 11% of females scored 13 or above on the CUDIT-R.

3.3 Correlates of Cannabis Use and Reasons for Use

There was a positive and significant correlation between the total DASS-21 and CUDIT-R scores ($r = 0.29$, $p < 0.001$) representing a small to medium effect size. Similar correlations were found between the CUDIT-R and each of the DASS-21 subscales (stress: $r = 0.22$, $p <$

0.001; anxiety: $r = 0.23$, $p = 0.010$; depression: $r = 0.30$, $p < 0.001$). Of the 53 patients who completed the MHQ, 45% of users reported using cannabis for medicinal purposes but only 17% of patients reported that their cannabis was prescribed by a medical doctor (23% reported that it was not prescribed and 60% did not provide an answer). Given that patients could endorse multiple responses to best represent their motives for use, 86 responses were made to represent the most common medicinal reasons for cannabis use, suggesting that some patients endorsed multiple reasons. In terms of medical reason or psychiatric reasons for cannabis use, 4 individuals endorsed 1 answer, and 19 individuals gave 2 or more reasons. Twenty-one percent ($n = 18$) of responses suggested that cannabis was used to aid sleep, 21% ($n = 18$) to simulate appetite, manage nausea or vomiting, 20% ($n = 17$) to manage pain, 19% ($n = 16$) to manage psychiatric disorder (anxiety, depression, schizophrenia, etc.), 6% ($n = 5$) for inflammation, 6% ($n = 5$) for fibromyalgia, 5% ($n = 4$) for arthritis, 2% ($n = 2$) for gastrointestinal disorders, and 1% ($n = 1$) for other reasons. Thirty-eight responses provided more specific psychiatric reasons for cannabis use. Three individuals made 1 response and 13 individuals made more than 1 response. Thirty-nine percent ($n = 15$) of responses suggested that use was for anxiety, 34% ($n = 13$) for depression, 21% ($n = 8$) for PTSD, and 5% ($n = 2$) for addiction to a different substance. In our sample, no responses reflected use for psychotic symptoms.

A Pearson correlation between total AUDIT and CUDIT-R scores ($n = 308$) was not significant ($r = 0.08$, $p = 0.150$). A t test comparing total AUDIT scores between cannabis users and nonusers was significant, $t(530.11) = 7.26$, $p < 0.001$, (users: $M = 5.52$, $SD = 5.50$; nonusers: $M = 2.86$, $SD = 4.21$). Cannabis users reported significantly more symptoms of AUD than nonusers, despite differences on demographic factors of age, ethnicity, and education. Hierarchical linear regression analyses showed that these demographic factors did not account

for a significant proportion of the variance in AUDIT scores, strengthening confidence that this group difference is not best explained by demographic differences between users and nonusers. In cannabis users ($n = 308$), correlations between the total AUDIT and DASS-21 stress score ($r = 0.09$, $p = 0.120$) and anxiety score ($r = 0.076$, $p = 0.182$) were not significant. A significant positive correlation was found between the AUDIT and DASS-21 total score ($r = 0.14$, $p = 0.018$) and depression score of the DASS-21 ($r = 0.17$, $p = 0.002$) representing a small effect size. In cannabis nonusers ($n = 487$), correlations between the AUDIT and DASS-21 total score ($r = 0.09$, $p = 0.056$), depression score ($r = 0.07$, $p = 0.139$) and anxiety score ($r = 0.05$, $p = 0.250$) were not significant. There was a small but significant Pearson correlation between the AUDIT and stress subscale scores ($r = 0.11$, $p = 0.016$). These results suggest that generally, alcohol use is not significantly related to symptoms of distress; however, it is differentially related to depressive symptoms in cannabis users and stress symptoms in nonusers.

4.0 Discussion

To our knowledge, this is the first study to describe patterns of cannabis use in a large sample of patients seeking treatment for anxiety and related disorders. Cannabis users and nonusers differed demographically on education level, age, and ethnicity. Nonusers were generally older; this may be because cannabis tends to be used in adolescence and young adulthood rather than later in life (Chen et al., 2012). It appears that cannabis users generally have lower levels of education which may be related to the cognitive and behavioural effects of cannabis (e.g., reduces attention, memory, and behavioural motivation; Reilly et al., 1998; Dougherty et al., 2013), which could impede academic performance. Given that those with lower education levels tend to discount larger later rewards for smaller more immediate rewards, it is

possible that these individuals are more likely to manage their anxiety with cannabis, which provides short term-immediate relief but adverse health consequences, than other means (Hall & Solowij, 199; Reimers et al., 2009).

Consistent with previous research that demonstrates a positive association between cannabis use and anxiety (Spalletta et al., 2007), rates of cannabis use were high in this population, with 39% of patients endorsing having used cannabis in the past 6 months, whereas only 29% of Canadians ages 16 and older have reported using cannabis in the past 12 months (Health Canada, 2017). A large portion of cannabis users in the current sample (43%) reported using 4 or more times per week, most commonly via smoking joints. The majority of patients did not screen positive for CUD on the CUDIT-R and reported using only an average of 0.53g on a day they use cannabis, which is less than recreational users who use 1.6g on average (Duff et al., 2009). Thus, the vast majority of cannabis users in our sample do not report problems with the amount or severity of their use. However, 22% of the current sample scored above the cutoff score on the CUDIT-R, indicating likely CUD. This rate is elevated given that the 12-month prevalence rate of CUD in the general population is approximately 3.5% in men and 1.7% in women (Kerridge et al., 2018). Therefore, while the majority of clients in an anxiety clinic who use cannabis may not report any difficulties associated with their use, 1 in 5 of these individuals likely do as they report scores equal to or greater than 13 on the CUDIT-R.

Based on the tension-reduction model, which suggests that substances are used to reduce distress, we hypothesized that this population may use cannabis to cope with their distress. Our results found indirect support for this hypothesis. Overall symptoms of psychological distress (total DASS-21 scores) were significantly and positively correlated with the severity of CUD

symptoms (total CUDIT-R scores). Further, stress, anxiety, and depression symptoms (represented by DASS-21 subscales), were also significantly and positively correlated with the severity of CUD symptoms. Although we cannot comment on the direction of this relationship, if high distress is prompting cannabis use, this may explain the elevated rates of cannabis use in this population. In addition, of the 53 patients who answered additional cannabis-related questions, 45% of users reported using cannabis for medicinal reasons (i.e., medical or psychiatric), suggesting that a significant proportion of users in this population identify using cannabis to cope with psychiatric and medical forms of distress. Interestingly, most individuals did not provide an answer as to whether or not they have a prescription for cannabis. It is possible that patients consider their cannabis use to be "medicinal" as they believe it provides relief from mental or physical illness, but do not have a prescription. As such, they may feel that there is stigma related to using cannabis without the recommendation of a doctor for their ailments and therefore, feel uncomfortable answering this question. Nineteen percent endorsed using for psychiatric reasons and 21% endorsed using to aid sleep (which may be as a result of psychiatric illness such as anxiety, depression, or PTSD; Spoormaker & van den Bout, 2005). These findings suggest that some patients who use cannabis may specifically use to cope with mental health symptoms. The reasons for initial cannabis use, which occurs on average in adolescence in this population, remain unclear. It may be that cannabis was initially used to cope with mental health symptoms at their onset (which also tend to begin in adolescence and young adulthood; Jones, 2013). It may also be that cannabis was used for social and enhancement motives in adolescence, which may have increased their risk of later mental health concerns or CUD, at which point the motives for use may have changed to coping (Bonar et al., 2017; Degenhardt et al., 2001; Jones et al., 2013). Further research should examine the temporal

relationship between mental health concerns and age of first use. Collectively, these results are in line with the tension-reduction model in the context of cannabis use because distress ratings and CUD symptoms were significantly positively correlated; further research could examine the direction of this relationship.

Contrary to our expectations, not all correlations between total AUD symptoms and severity of distress in cannabis users and cannabis nonusers were significant and positive. There were nonsignificant correlations between AUD symptoms and symptoms of stress and anxiety, however there was a significant correlation between AUD and distress in general, as well as depression symptoms in cannabis users, and between AUD symptoms and stress in cannabis nonusers. It may be that alcohol is not used to reduce anxiety- and stress-related distress in this sample, but that it may be used specifically to cope with depressive symptoms in cannabis users and with stress in cannabis nonusers. However, it could be that alcohol use is related to more distress as a result of the harmful consequences of alcohol use (e.g., alcohol use causing relationship problems which leads to greater distress). The direction of this relationship is not clear in the present study. Further, there was no correlation between severity of CUD and AUD; however, cannabis users were significantly more likely to exceed the cut off score suggestive of AUD. In other words, those who use cannabis at an elevated rate do not necessarily use alcohol at an elevated rate but cannabis-users in general are more likely to abuse alcohol than nonusers. These results suggest that there may be other factors at play in the decision to use cannabis rather than alcohol. It may be that individuals who use any amount of cannabis have personality factors that increase their likelihood of addiction to multiple substances (e.g., impulsivity; Moeller & Dougherty, 2002; Moreno et al., 2012) or that cannabis and alcohol are used together to varying degrees (Subbaraman & Kerr, 2015). Further research should examine other potential factors

involved in the decision to use cannabis specifically rather than other substances to reduce distress.

The current findings have important clinical implications. Given the elevated rate of cannabis use in patients seeking treatment for anxiety and related disorders, clinicians may want to carefully screen for CUD when clients present with anxiety symptoms to provide optimal treatment recommendations. In this screening, idiosyncratic reasons for cannabis use can be determined that may have implications for therapy. For example, if clients are using cannabis to manage anxiety (e.g., cannabis use as a safety behaviour), this can be addressed in a cognitive behaviour therapy (CBT) protocol. Further, given that CBT is both cognitively and behaviourally demanding and cannabis use impedes cognitive functioning (e.g., reduces attention, memory) and behavioural motivation (Reilly et al., 1998; Dougherty et al., 2013), patients using at high amounts and frequencies may not be able to optimize their treatment outcomes for anxiety while using cannabis. Therefore, it may be optimal for patients to complete CUD treatment before CBT for anxiety or also consider reducing cannabis use as they engage in treatment for their anxiety and related symptoms. Moreover, clinicians may consider recommending integrated treatment for anxiety and CUD whereby both problems are treated simultaneously with focus on the functional relationship between symptoms (Milosevic et al., 2017). Future studies should examine the effect of cannabis use on treatment outcomes.

Limitations of this study include that the sample is ethnically homogeneous in that it is predominantly Caucasian. Future research should examine these patterns across cultural and racial groups, as there may be important differences (Degenhardt et al., 2008). Some differences in cannabis use have been identified; for example, some research shows African-Americans' highest rate of cannabis use is later compared to other racial groups (i.e., late 20s; Chen &

Jacobson et al., 2012) and that African-American women are 3 times more likely to use cannabis for the first time before alcohol compared to European-Americans and are at greater risk of cannabis related problems (Sartor et al., 2013). Further research is warranted to identify which groups are at highest risk of cannabis related problems and anxiety symptoms. In addition, there is a lack of full demographic (e.g., income, employment, lifetime history of cannabis use) and diagnostic data in this sample. Although these patients had elevated scores on the anxiety subscale of the DASS-21, indicating the presence of significant anxiety symptoms, detailed diagnostic information would be helpful to fully describe this sample. It may be that patients' patterns of cannabis use vary across type of anxiety disorder or that patients with some disorders are at greater risk of using cannabis at a higher rate than others. Future research could compare patterns of cannabis use and motives for use across specific anxiety and related disorders as there may be unique patterns within specific diagnostic groups. In addition, we did not collect data in a sample of healthy controls, which would provide base rates of cannabis use and characteristics of use in a healthy sample. The present study also relied on self-report data rather than biological data (e.g., urine samples). As a result, patients may have misrepresented their use (e.g., under-reported their use).

In summary, the results suggest that cannabis use is prevalent in those seeking therapy for anxiety and related disorders and is related to several indicators of psychological distress. Severity of cannabis use and alcohol use was not correlated, suggesting that there may be other factors moderating substance use (e.g., impulsivity; Moeller & Dougherty, 2002; Moreno et al., 2012). Considering the recent legalization of cannabis use in Canada, reports of problematic cannabis use in this population may continue to increase; this study provides an important

baseline snapshot of cannabis use around the time of legalization in a large sample of patients seeking specialized treatment for anxiety symptoms. Future research should focus on examining patterns of cannabis use more closely across specific mental health diagnoses to determine whether or not there are populations at particularly high risk of CUD, investigating the causality of the relationship between cannabis use and symptom severity, and systematically studying the impact of cannabis use and CUD on treatment outcomes for anxiety disorders.

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Table 1

Demographics: Means and Proportions by groups (Standard Deviations in parenthesis)

Variable	Group Membership		
	Cannabis users	Cannabis non-users	Group difference (*p*)
N	*n* = 308	*n* = 488	
Sex (% female)	67.53%	69.40%	.554
Age	31.56 (11.80)	36.95 (14.27)	<.001**
N	*n* = 303	*n* = 477	
Relationship Status (%)			.863
In a relationship	60.73%	61.43%	
Single	39.27%	38.57%	
N	*n* = 298	*n* = 473	
Education (%)			
High school	26.17%	20.72%	.010*
College/University	68.79%	68.92%	
Grad school	5.03%	10.34%	
N	*n* = 306	*n* = 466	
Ethnicity			
Indigenous	1.96%	1.50%	.019*
Black	1.96%	1.07%	
Caucasian	87.91%	86.27%	
Hispanic	1.31%	1.50%	
Asian	1.63%	6.01%	
Biracial/multiracial	2.94%	1.77%	
Other	2.29%	1.93%	

*Note. *p* < .05. **p* < .001

CHAPTER 3: WHY USE CANNABIS? EXAMINING MOTIVES FOR CANNABIS USE IN INDIVIDUALS WITH ANXIETY AND RELATED DISORDERS

Chapter link:

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The previous chapter's results suggest that cannabis use is prevalent in those seeking treatment for anxiety and related disorders. However, it remains unclear as to why this population uses cannabis at an elevated rate. This chapter examined specific motives for cannabis use in individuals with anxiety and related disorders, and compared motives between infrequent and frequent users, to better understand motives associated with various patterns of cannabis use in this population.

Why Use Cannabis? Examining Motives for Cannabis Use in Individuals with Anxiety and Related Disorders

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Abstract

Objectives: The current study examined rates of endorsement of motives for cannabis use in a sample of individuals with anxiety and related disorders, and compared endorsement between infrequent and frequent users. It was hypothesized that coping motives would be endorsed at a significantly higher rate than other motives, and that frequent cannabis users would endorse coping motives significantly more than infrequent users.

Methods: Participants were 316 individuals seeking clinical services for anxiety and related disorders, 144 (29.9%) of whom were current cannabis users. Participants completed measures of motives for cannabis use, cannabis use patterns, and Cannabis Use Disorder (CUD) symptoms.

Results: In general, cannabis users endorsed coping (i.e., use for managing distress) and enhancement (i.e., use for fun or the feeling) motives at equal rates ($p = .265$) and endorsed both more than other motives (ps $< .001$). Additionally, frequent users reported using cannabis for coping and expansion motives (i.e., use to change one's thinking) significantly more than infrequent users.

Conclusions: These results indicate that individuals with anxiety and related disorders use cannabis for various reasons, some of which may not be directly related to their mental health symptoms. Future research is needed to compare motives for cannabis use in those with anxiety and related disorders and the general population, as well as examine the association between motives for cannabis use and patterns of use using longitudinal research designs (e.g., experience sampling) to better understand these associations.

Keywords: Cannabis, Marijuana, Coping, Motives, Anxiety and Related Disorders

Why Use Cannabis? Examining Motives for Cannabis Use in Individuals with Anxiety and Related Disorders

1.0 Introduction

Individuals with anxiety and related disorders have been shown to use cannabis at an elevated rate and are at higher risk of Cannabis Use Disorder (CUD) compared to those with low anxiety (Kedzior & Laeber, 2014; Spalletta et al., 2007). Although both frequent and infrequent cannabis users have been shown to be at significantly higher risk of an anxiety disorder than non-users, frequent users, especially those who use daily, are more likely than infrequent users to have a mood or anxiety disorder as well as cannabis dependence (Cheung et al., 2010; Degenhardt et al., 2013; Hayatbakhsh et al., 2007). Early research on the association between anxiety and cannabis use in individuals with subclinical symptoms of specific anxiety disorders as well as those with anxiety and related disorders has demonstrated similar relationships, where cannabis use and anxiety appear to be positively associated. For example, increased social anxiety states have been associated with increased cannabis craving, and interactions between social anxiety symptoms and craving have been shown to increase the likelihood of cannabis use (Buckner et al., 2012; Buckner, Ecker, et al., 2013). Further, lifetime PTSD has been significantly associated with daily cannabis use and increased risk of CUD (Cougle et al., 2011; Kevorkian et al., 2015). Less research has been conducted examining the association between cannabis and other anxiety and related disorders, however some similar positive associations between cannabis use and anxiety and related disorder symptoms have been identified. For

example, obsessive-compulsive symptom severity has been positively related with cannabis misuse and risky cannabis use (Bakhshaie et al., 2020; Spradlin et al., 2017).

Three models of substance use have been used to explain the association between cannabis use and anxiety: the tension-reduction model, the motivational model of alcohol use, and the mutual maintenance model. The tension-reduction model characterizes substance use in general as a means to reduce tension, which is derived from an unsatisfied need (Conger, 1956). The reduction in tension is rewarding and, therefore, perpetuates further substance use (Conger, 1956; Greeley & Oei, 1999). The tension-reduction model has been applied to anxious cannabis users, where cannabis is used to cope with anxiety (i.e., tension; e.g., Buckner et al., 2006; de Dios et al., 2010; Foster et al., 2015; Walukevich-Dienst et al., 2019). The motivational model of alcohol use is similar in that it describes alcohol use as a method of managing distressing emotions (e.g., providing a sense of avoiding or escape); however it also suggests that alcohol is used to enhance positive emotions (Cooper et al., 1995; Cox & Klinger, 1988). Although this model was initially applied to alcohol use, it has also been more recently applied to cannabis use (Cooper, 2015; Feinstein & Newcomb, 2016). The mutual maintenance model suggests that comorbid anxiety and Substance Use Disorders (SUDs) maintain and exacerbate each other, where anxiety may lead to self-medication with substances and SUDs may exacerbate anxiety symptoms (Stewart & Conrod, 2008). There has been some support for this model in the context of cannabis specifically. For example, anxiety seems to increase cannabis craving (and vice versa) and using cannabis to cope with distress has been associated with problematic cannabis use (Buckner et al., 2007; Buckner, Crosby, et al., 2013; Fox et al., 2011).

Although these models provide a broad description of the association between cannabis use and anxiety, identifying specific motives for cannabis use in those with clinical anxiety is

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important to improve our understanding of this relationship in the context of these models. It may be that specific motives are differentially associated with cannabis use patterns, supporting some of these models better than others. For example, if individuals are using cannabis exclusively to manage anxiety, this may be best represented by the tension reduction model. However, if individuals use cannabis to cope with their anxiety as well as to enhance positive emotions, this may be best represented by the motivational model. Treatment planning will depend on the motives for use and the associated patterns of cannabis use. For example, if cannabis is used to manage anxiety leading to mutual maintenance of CUD and anxiety, integrated treatment for both conditions is needed to minimize relapse risk (Buckner et al., 2016, 2019). However, if cannabis is used to manage anxiety (i.e., tension reduction) but has not led to a mutually maintaining relationship between cannabis use and anxiety, then cognitive behavioural therapy (CBT) for anxiety may be sufficient to replace cannabis use with alternative CBT coping strategies (Kadden et al., 1995).

Thus far, five motives for cannabis use have been identified in the literature (Benschop et al., 2015; Simons et al., 1998; Zvolensky et al., 2007). Specifically, coping (i.e., use to manage distress), enhancement (i.e., use for fun or for the feeling), expansion (i.e., use to change one's thinking), social (i.e., use for social gatherings), and conformity (i.e., use due to peer pressure) motives (Benschop et al., 2015; Simons et al., 1998; Zvolensky et al., 2007). Preliminary research has begun to examine specific motives for cannabis use in individuals with anxiety symptoms. Coping motives appear to play a particularly important role in individuals who experience high levels of anxiety, consistent with the idea of using cannabis to manage negative emotions. Coping motives have been associated with symptoms of posttraumatic stress disorder (PTSD) as well as symptoms of social anxiety and obsessive-compulsive symptoms (Boden et

al., 2013; Buckner, Crosby, et al., 2012; Buckner, Heimberg, et al., 2012; Spradlin et al., 2017). In individuals with PTSD, using cannabis to cope with sleep disturbances mediated the relationship between PTSD and cannabis use frequency (Metrik et al., 2016). It has also been suggested that cannabis is used to cope with social anxiety symptoms, as individuals with social anxiety are more likely to use cannabis when those around them are using compared to individuals with lower social anxiety (Buckner, Crosby, et al., 2012). Coping motives also mediate the relationship between cannabis misuse and obsessive-compulsive symptom severity (Spradlin et al., 2017).

Additionally, individuals with high anxiety may not only endorse coping motives related to managing anxiety disorder symptoms, but also to manage anxiety and depressive symptoms associated with withdrawal and craving as per the mutual maintenance model (Buckner, Crosby, et al., 2013; Cornelius et al., 2008; Phillips et al., 2015). Individuals who use for coping motives tend to experience problematic cannabis use (e.g., CUD, frequent and chronic use; Benschop et al., 2015; Bujarski et al., 2012; Hyman & Sinha, 2009; Moitra et al., 2015; Sofis et al., 2020) and 50%-95% of heavy cannabis users experience withdrawal symptoms (Hasin et al., 2013). Additionally, anxiety symptoms associated with craving and withdrawal due to frequent use have been associated with later cannabis use, supporting the mutual maintenance model (Buckner, Crosby, et al., 2013; Cornelius et al., 2008). Taken together, frequent cannabis users may endorse more coping motives related to coping with both anxiety symptoms and CUD-related symptoms (i.e., withdrawal and craving).

In sum, coping motives have been consistently reported as the most common motive for cannabis use in individuals with high anxiety, however there is a lack of research examining overall motives for cannabis use in clinical anxiety and related disorder samples. Given that

some individuals with anxiety disorders misuse cannabis and may experience related consequences such as withdrawal, it is possible that cannabis motives differ between frequent and infrequent users, warranting investigation. As such, the purpose of the current study was to examine the rates of various motives for cannabis use in a clinical anxiety and related disorders sample, as well as compare motives between frequent and infrequent cannabis users. It was hypothesized that coping motives would be endorsed most frequently compared to other motives given that previous studies have demonstrated frequent coping motives in subclinical anxiety samples, in line with the tension-reduction model. Additionally, it was hypothesized that individuals who use cannabis frequently would report more coping motives than individuals who use cannabis infrequently, as individuals who use at higher rates may be using to manage symptoms related to craving and withdrawal (including anxiety and depressive symptoms) in addition to anxiety disorder symptoms, as represented broadly by the mutual maintenance model (Buckner, Crosby, et al., 2013; Cornelius et al., 2008).

2.0 Methods

2.1 Participants

Participants were 316 adults seeking services for anxiety and related disorders. They were recruited from a large, specialized anxiety and related disorders clinic within a Canadian hospital. Inclusion criteria for the current study were that participants had been referred to a symptom-specific anxiety or related disorder cognitive behavioural therapy (CBT) group at the clinic following a diagnostic assessment by a psychiatrist, clinical psychologist, graduate-level clinical psychology student, or specialized registered nurse. Although diagnostic data were only available for 73% ($n = 230$) of participants, all participants referred to symptom-specific CBT

groups at the clinic had clinically significant symptoms consistent with the symptom-specific CBT group they attended (whether it was a principal or additional diagnosis), as per the clinic's policy. To support this assumption, participants completed a symptom-specific questionnaire relevant to the CBT group they had been referred to. To be included in the current study, their total score on the symptom-specific measure had to be equal to or above the cut-off score indicating clinically significant symptoms for that particular diagnosis.

Cannabis use was categorized by three groups: infrequent users ($N = 54$), frequent users ($N = 90$), and non-users ($N = 172$). The infrequent and frequent users were categorized based on how participants answered the first question of the Cannabis Use Disorder Identification Test-Revised (CUDIT-R; "How often do you use cannabis?"). Participants who answered "Monthly or less" or "2-4 times a month" were considered infrequent users and those who answered "2-3 times a week" or "4 or more times a week" were considered frequent users. Frequent and infrequent user categories were chosen to be similar to other studies' categorizations (e.g., Buckner & Schmidt, 2008; Henry et al., 2014). Non-users were defined as individuals who answered "No" to having used in the past 6 months (a screening question preceding the CUDIT-R). Those who answered "No" to the screening question but reported cannabis use on the first question of the CUDIT-R were still considered non-users, as they were likely reporting historical patterns of use. Those who answered "yes" to the screening question but reported "never" on the first question of the CUDIT-R were also considered non-users.

2.2 Procedure

Participants were referred to a specialized anxiety and related disorders clinic in an academic hospital by healthcare professionals (e.g., family physician) for concerns about anxiety

and related disorders. Participants received a diagnostic assessment from a mental health professional. Sixty-seven percent received the Diagnostic Assessment and Research Tool (DART; a semi-structured modular interview based on DSM-5 criteria; see McCabe et al., 2017; Schneider et al., 2021), 22% received a psychiatric consult, and 4% received an assessment with a specialized nurse. Based on their assessment results, participants were referred to symptom-specific CBT groups for social anxiety disorder (SAD), generalized anxiety disorder (GAD), panic disorder (PD) and/or agoraphobia, obsessive-compulsive disorder (OCD), and posttraumatic stress disorder (PTSD). Prior to beginning group CBT, participants completed measures of cannabis use patterns, CUD symptom severity, motives for cannabis use, and measures specific to the group they were referred to (e.g., participants completed a measure of social anxiety symptom severity when referred to the SAD group). The collection and use of this information was approved by the institution's research ethics board, and all participants provided written and informed consent to participate in research.

2.3 Measures

  Marijuana History Questionnaire. The Marijuana History Questionnaire (MHQ) is a data collection tool composed of 32 items, measuring self-reported cannabis use history (Metrik et al., 2009). Questions about forms of cannabis consumption, THC content, patterns of use (frequency and amount), and age of first use are included (Metrik et al., 2009). For the current study, only items 6 ("On a typical **day** you use marijuana, how much do you personally use?) and 7 ("In a typical **week** you use marijuana, how much marijuana do you personally use?") were used to describe cannabis use in grams.

The Cannabis Use Disorder Identification Test-Revised. The Cannabis Use Disorder Identification Test-Revised (CUDIT-R) is an 8 item self-report screening tool for CUD in the past 6 months (Adamson et al., 2010). Items reflect 4 domains: consumption, cannabis problems, dependence, and psychological features, which are rated on a 5-point scale. The CUDIT-R has high sensitivity (91%) and specificity (90%) with the suggested cut off score of 13, where those who score 13 or above are likely to have CUD (Adamson et al., 2010). The Cronbach alpha on the CUDIT-R was .82 for the current sample, demonstrating good internal consistency.

Marijuana Motives Measure. The Marijuana Motives Measure (MMM) is a 25-item self-report measure, which assesses motives for cannabis use based on 5 subscales: coping (e.g., "I use marijuana because it helps me when I feel depressed or nervous"), social (e.g., "I use marijuana to be sociable"), enhancement (e.g., "I use marijuana to get high"), conformity (e.g., "I use marijuana to fit in with the group I like"), and expansion (e.g., "I use marijuana so I can understand things differently"; Simons et al., 1998). Each item is scored using a 5-point scale, where *1 = Almost never/Never* and *5 = Almost always/Always*. Higher scores on each item represents more frequent use for that particular reason and vice versa for lower scores. The MMM has shown good discriminant validity and MMM subscales have shown strong internal consistency with Cronbach alphas of .84 to .94 (Simons et al., 1998). The current study's Cronbach alpha values across the motive subscales were .68 for conformity, .88 for social, .89 for enhancement, .92 for coping, and .94 for expansion.

The Social Phobia Inventory. The Social Phobia Inventory (SPIN) is a 17-item self-rated measure of symptoms of SAD (Connor et al., 2000). Each item is rated from 0 = *Not at all* to 4 = *Extremely* and the sum of all items yields a total score. SAD symptoms are categorized from none, mild, moderate, severe, and very severe based on the total scores. For the purpose of

this study, only those who scored within the moderate range and above were included in the study (total scores of 31 and above; Moscovitch et al., 2011; Moser et al., 2008). The SPIN has demonstrated sound psychometric properties, with good divergent and convergent validity (Antony et al., 2006; Connor et al., 2000). The current study's internal consistency for the SPIN was good, with a Cronbach alpha of .81.

The Penn State Worry Questionnaire. The Penn State Worry Questionnaire (PSWQ) is a 16-item measure of trait worry which screens for symptoms of GAD (Fresco et al., 2003; Meyer et al., 1990). Each item is rated from 1= *Not at all typical of me* to 5 = *very typical of me*. Clinically significant worry is indicated by a total cut off score of 45 and above, with a sensitivity and specificity for a GAD diagnosis of 99% and 98% respectively (Behar et al., 2003). The PSWQ has shown good internal consistency and discriminant validity (Meyer et al., 1990). The current study's Cronbach alpha for the PSWQ was .86, which is considered good.

The Panic Disorder Severity Scale. The Panic Disorder Severity Scale (PDSS) is a 7-item self-report measure of PD (Furukawa et al., 2009; Shear et al., 1997). Items are rated on a scale from 0 to 4 which are summed for a total score. The cut off score for clinically significant PD symptoms is 8 and above, with a sensitivity of 83% and specificity of 64% (Shear et al., 2001). The PDSS has also shown good internal consistency and discriminant validity (Shear et al., 2001). The current study's PSWQ had good internal consistency with a Cronbach alpha of .82.

The Obsessive-Compulsive Inventory-Revised. The Obsessive-Compulsive Inventory - Revised (OCI-R) measures symptoms of OCD (Foa et al., 2002). All 18 items are rated from 0 = *Not at all* to 4 = *Extremely* and a total score is yielded by summing all 18 items. Total scores of 21 and above are considered likely indicative of OCD, with a sensitivity of 65.6% and specificity

of 63.9% (Foa et al., 2002). The OCI-R has also demonstrated good internal consistency and convergent validity in previous studies (Foa et al., 2002). The current study's Cronbach alpha for the OCI-R was .48 which is poor but may be due to the small sample size (N = 16).

The PTSD Checklist for DSM-5. The PTSD Checklist for DSM-5 (PCL-5) is a 20-item measure of PTSD symptom severity (Weathers et al., 2013). Items are rated from 0 = *Not at all* to 4 = *Extremely*. Total scores between 31 and 33 and above are considered likely indicative of PTSD (Bovin et al., 2016). The current study used the conservative cut off score of 33. The PCL-5 has also shown sound psychometric properties with good internal consistency (α = .94), as well as convergent and discriminant validity (Blevins et al., 2015). The current study's Cronbach alpha for the PCL-5 was .88, which is considered to indicate excellent internal consistency.

2.4 Data analysis

Frequencies, means, and chi-square analyses were conducted to summarize demographic and diagnostic information of the three sample subgroups (infrequent, frequent, and non-cannabis users). Descriptive statistics were conducted to characterize the sample's patterns of cannabis use. Given that the normality and equality of variance assumptions for a t-test were violated, the non-parametric Mann-Whitney U test was applied to the raw total scores of the CUDIT-R to compare them between frequent and infrequent users. Additionally, participants' scores were calculated for each MMM subscale (coping, social, enhancement, conformity, and expansion; Simons et al., 1998). Given that the MMM data significantly violated ANOVA assumptions, as well as the highly ordinal nature of the data, subscale medians were used to conduct the non-parametric Kruskall-Wallis test with all pairwise comparisons between MMM subscales to determine whether or not any motives for cannabis use were reported significantly

more frequently than others. The Bonferroni correction was applied to correct for multiple comparisons. Additionally, to investigate differences in motives between infrequent and frequent cannabis users, the Mann-Whitney U test with Bonferroni corrections was applied to the subscale medians to correct for multiple comparisons. Another Mann-Whitney U test with Bonferroni corrections was conducted to compare whether rates of motive endorsement differed between genders. Analyses were conducted using IMB® Statistical Package for the Social Sciences (SPSS).

3.0 Results

3.1 Descriptive Statistics

The means of symptom-specific measure total scores were well above clinical cut-off scores, indicating clinically significant anxiety and related disorder symptoms. The mean SPIN score was 46.44 (SD = 8.48). Mean scores for the PSWQ and PDSS were 67.50 (SD = 8.50) and 15.23 (SD = 4.39) respectively. Mean scores on the OCI-R and PCL-5 were 31.25 (SD = 8.04) and 54.53 (SD = 11.13), respectively.

The mean age of the overall sample was 35.23 (SD = 11.57), ranging from age 17 to 70. Demographic information is summarized for all three sample subgroups (non-users, infrequent, and frequent cannabis users) in Table 1. Additionally, there were no differences on demographic variables across non-users, infrequent users, and frequent user subgroups (summarized in Table 1) except for age, $F(2, 306)$ = 3.67, p = .027, where non-users were significantly older than infrequent users with a post-hoc Tukey HSD p = .019. Most participants had a principal diagnosis of an anxiety or related disorder (see Table 2). No participants had a principal diagnosis of CUD and 2.9% had an additional of CUD (5.6% in infrequent users and 12.2% in frequent users). They also had an average of 2.16 additional diagnoses, ranging from 1 to 6

additional diagnoses, most of which were mood disorders and anxiety and related disorders. There was also no difference in the number of additional diagnoses across these subgroups, $H(2)$ = 2.22, p = .330.

3.2 Patterns of cannabis use in a mixed anxiety and related disorder sample

Those who did not respond to the cannabis use questions were excluded from analyses that compared non-users, frequent, and infrequent users. Of those who were categorized as infrequent users, 80% (N = 43) individuals reported using monthly or less and 20% (N = 11) reported using 2 to 4 times per month. Of the frequent users, 26% (N = 23) reported using 2 to 3 times per week and 74% (N = 67) reported using 4 or more times per week.

In terms of amount of cannabis used in grams (derived from the MHQ), infrequent users used a mean of .23 (SD = .71) grams per day, with a range from 0 to 5 grams. They also reported using a mean of .85 (SD = 4.79) grams per week with a range of 0 to 35 grams. Frequent users reported using a mean of 1.21 (SD = 2.37) grams per day with a range of 0 to 20 grams. They also reported using a mean of 6.80 (SD = 12.27) grams per week, with a range of 0 to 100 grams. Further, the mean CUDIT-R score for infrequent users was 3.82 (SD = 3.12) with a range of 1 to 14. The mean CUDIT-R score for frequent users was 11.61 (SD = 5.69) with a range of 3 to 27. The Mann-Whitney U test statistic of 468.00, p < .001 confirmed that CUDIT-R scores were significantly higher in frequent (mean rank of 94.3) than infrequent (mean rank of 36.17) users. Only 2% of infrequent user scored 13 or above, whereas 37% of frequent users scored 13 or above on the CUDIT-R indicating likely CUD.

3.3 Motives for cannabis use in a mixed anxiety and related disorder sample

Rates of endorsement of each motive for cannabis use was compared within the cannabis users (frequent and infrequent user group) to determine whether or not certain motives were endorsed more frequently than others in the current sample. The omnibus Kruskall-Wallis test comparing MMM subscale medians was statistically significant, $H(4) = 163.46$, $p < .001$. Of the 5 motives for cannabis use, coping and enhancement motives were the most frequently endorsed across cannabis users. Pairwise comparisons of MMM subscales (i.e., motive types) showed several statistically significant differences in rates of motives endorsed ($ps < .005$). Only scores for coping and enhancement as well as expansion and social motives, respectively, were similar ($ps > .005$). All pairwise comparisons are presented in Table 3 and are accompanied by MMM mean subscale ranks in Figure 1.

When comparing motives for cannabis use between infrequent and frequent users, the Mann-Whitney U test showed that there were statistically significant differences between cannabis users on coping and expansion motives, while accounting for the Bonferroni correction of $p = .001$ (see Table 4). Specifically, coping ($p < .001$) and expansion ($p = .001$) were significantly more frequently reported by frequent users than infrequent users (Table 4). There were no statistically significant differences between cannabis user groups on other motives (i.e., social, enhancement, and conformity) as summarized in Table 4. Motives for cannabis use were also compared between individuals who identified their gender as either "man" or "woman" (there were too few transgender or gender diverse participants to include in this analysis). There were no significant differences in rates of motive endorsement between self-identified males and females included in this analysis (see Table 5).

4.0 Discussion

The current study explored motives for cannabis use in a sample of individuals with anxiety and related disorders. As hypothesized, coping motives were frequently endorsed in the sample, especially in frequent users compared to infrequent users. These findings are consistent with the tension-reduction model and previous findings, where cannabis has been used to manage anxiety symptoms when individuals have expectancies that it will help reduce their symptoms (Conger, 1956; de Dios et al., 2010; Foster et al., 2015; Walukevich-Dienst et al., 2019). Individuals with anxiety and related disorders who use cannabis to cope likely do so in part due to feeling unable to cope with their symptoms otherwise. For example, lower perceived distress tolerance has been associated with increased cannabis coping motives for negative affect (Farris et al., 2016; Peraza et al., 2016) and distress intolerance has been associated with anxiety and related disorder symptoms (Keough et al., 2010). Future studies should examine the specific associations (e.g., with longitudinal or mediation analyses) between coping motives, anxiety and related disorders, and patterns of cannabis use in this population to further understand these relationships. Moreover, coping motives were more frequently reported in frequent users than infrequent users, as hypothesized. This is likely a reflection of what previous research has found, where individuals with higher psychological distress use cannabis more frequently than those with lower distress (Ouellette et al., 2019; Weinberger et al., 2019). Their distress may be related to more severe anxiety and related disorder symptoms and CUD symptoms (as heavy cannabis users are more likely to experience CUD); CUD symptoms may exacerbate anxiety further (Buckner et al., 2017; Kedzior & Laeber, 2014; Stewart & Conrod, 2008). For example, high levels of cannabis use may lead to use for coping with anxiety related to cannabis withdrawal (Cornelius et al., 2008). Taken together, the mutual maintenance model may be particularly relevant in this population when cannabis is used frequently, however further research is needed

to examine this explicitly. Additionally, future research should examine the interaction between coping motives and cannabidiol (CBD) alone, rather than cannabis or marijuana, to explore whether or not there are any therapeutic benefits of CBD use in this population and if it is associated with less cannabis related problems than in those who use other forms of cannabis. There is some evidence of anxiolytic effects of CBD which may reduce anxiety symptoms with and without clinical anxiety (Crippa et al., 2004; Crippa et al., 2011; Fusar-Poli et al., 2009; Bergamaschi et al., 2011; Masataka, 2019). A more nuanced understanding of cannabis and its effects on anxiety symptoms is important to critically evaluate and weigh any pros and cons of the impact this substance has on patients presenting to treatment settings.

Additionally, enhancement motives were also frequently endorsed among cannabis users. Previous studies have shown elevated rates of enhancement motives compared to other motives in cannabis user samples, and have been positively associated with cannabis use (Bonar et al., 2017; Buckner et al., 2019; Buckner et al., 2015). For example, Buckner et al., (2019) found that enhancement motives were linked to more frequent cannabis use and related problems in a sample of undergraduate current cannabis users (i.e., used in the past 3 months). Additionally, Buckner et al., (2015) found that enhancement and coping motives were the most frequently reported motives in adult cannabis users, most of whom met criteria for CUD and a mental health disorder. Together, these findings suggest that enhancement motives may be common among both clinical and non-clinical samples and therefore, reasons for use are not necessarily always related to symptoms of anxiety and related disorders. As such, this indirectly supports the motivational model, demonstrating that individuals with anxiety and related disorders not only use for coping motives, but also to enhance positive emotions. The current study is one of the first to find elevated enhancement motives in a sample of individuals with anxiety and related

disorders specifically. Future research should compare clinical and general population samples of cannabis users on various motives to determine whether the rates of motives reported differ between these populations or if the reported rates are similar. Additionally, some research has shown that enhancement motives have been unrelated to perceived stress, depression symptoms, cannabis problem severity, and CUD, suggesting that enhancement may not only be unrelated to distress but also to cannabis related problems (Moitra et al., 2015). Future research is needed to explore the impact of motives on associated cannabis use problems to determine if enhancement motives are associated with problematic cannabis use.

Additionally, expansion motives were reported at a higher rate in frequent users than in infrequent users. This is in line with other research findings which show a positive association between cannabis use frequency and expansion motives (Bresin & Mekawi, 2019). Further, there are some recent studies that have found an association between expansion motives and anxiety. For example, Glodosky and Cuttler (2020) found that expansion motives interacted with stress to predict anxiety in a sample of undergraduate students, most of which had used cannabis in the past year (88.9%), month (67.7%), but only some daily (16.3%). Notably, this study did not examine the association between rates of cannabis use and motives for use and therefore, this study is not completely comparable to the current study's results. Additionally, Chowdhury et al. (2016), found that neuroticism was positively associated with expansion motives (as well as coping motives) in a sample of young adults, most of whom reported experiencing mental health disorders and subclinical panic attacks. These studies suggest that expansion motives may not only be associated with heightened cannabis use (independent of anxiety), but may also be indirectly associated with anxiety symptoms. Given that expansion motive items on the MMM include using cannabis to expand awareness, to increase openness to experiences, for creativity,

to understand things differently, and to better know oneself, it may be that individuals with anxiety use cannabis as a means to think differently about stressors, problem solve, or gain more self-understanding (Bravo et al., 2020). Expansion motives may fit best with the motivational model of substance use, where cannabis may be used to enhance positive emotions or manage negative emotions. Further research is needed to replicate these findings and examine more specifically why individuals with anxiety and related disorders use cannabis for expansion motives as well as how this may be associated to the elevated rate of cannabis use.

Additionally, the current study assessed cannabis use patterns and CUD symptoms in those with anxiety and related disorders. Rates of cannabis use are consistent with previous studies which demonstrate an elevated rate of cannabis use in those with high anxiety compared to those with low anxiety and the general population (e.g., Kedzior & Laeber, 2014; Ouellette et al., 2019). Frequent cannabis users also used larger quantities of cannabis per day than infrequent users, and reported significantly more symptoms of CUD. Twenty-four percent of cannabis users (infrequent and frequent users) scored above the cutoff for possible CUD on the CUDIT-R, and 5.6% of infrequent users and 12.25% of frequent users had a confirmed additional diagnosis of CUD, whereas the 12-month prevalence of CUD in the general population is approximately 2% to 4% (Kerridge et al., 2018). These findings are also consistent with previous research which shows that individuals with anxiety and related disorders are at increased risk of CUD (e.g., Cougle et al., 2011; Kedzior & Laeber, 2014). In summary, the current findings add to the growing literature demonstrating the elevated rate of cannabis use and related problems in this population, as well as the importance of considering mutual maintenance between anxiety disorders and cannabis related symptoms (e.g., withdrawal and craving asosciated with CUD), espsecially in frequent cannabis users.

These results have important clinical implications. The elevated rate of cannabis use and diverse motives reported in the current study highlights the importance of screening for cannabis use and motives in those seeking services for anxiety and related disorders. Motives for cannabis use in those seeking treatment for anxiety and related disorders are important to understand the association between cannabis use and anxiety symptoms, as well as to inform effective interventions. For example, if cannabis is used to cope with anxiety symptoms, providing psychological treatment with alternative skills to manage their anxiety may be needed, or for those with comorbid CUD and anxiety, integrated treatment for both conditions may be necessary to address their mutual maintenance (Buckner et al., 2016, 2019). For those who use for reasons likley unrelated or indirectly related to their anxiety concerns such as enhancement and expansion motives, it may be important to address mediating factors (e.g., stress), include psychoeducation on the effects of cannabis on anxiety (e.g., withdrawal), or provide CUD treatment prior to treating anixety symptoms. It may also be that some motives for use are unrelated to problematic cannabis use or negative impacts on mental health, which would help clinicians better understand when cannabis use is and is not of clinical concern. However further research is needed as the literature reports conflicting findings (Lee et al., 2007; Moitra et al., 2015).

The current study has important limitations to be considered. First, unlike alcohol, there are no standardized recommended consumption guidelines to identify a concerning amount of cannabis use, therefore defining cannabis user groups is inconsistent across studies. The current study used frequency of cannabis use to define groups but also reported amount used (daily and weekly) so that studies can be compared on definitions of cannabis user groups and consider these definitions in interpreting findings. Notably, a long-standing challenge in cannabis

research, which was faced in the current study, are the lack of measures to accurately capture the various forms of cannabis consumption (e.g., smoking, eating, drinking), products (e.g., dried plant leaves, oils, concentrates), and delta-9-tetrahydrocannabinol (THC) and CBD concentrations (Freeman & Winstock, 2015; Goodman et al., 2020). Although challenging, there is a need for measures that capture these variables as well as for studies that control for these variables to better represent nuances in cannabis use patterns. Additionally, not all participants responded to the cannabis use screening questionnaire, therefore we do not know if these were non-users or if they were users who chose not to report their use for particular reasons. Moreover, motives for cannabis use were not compared across specific anxiety and related disorders. Limiting factors were that individuals in the current sample had several comorbidities and the sample size was not large enough to compared motives across each anxiety and related disorder. Although the current study provides an ecologically valid representation of motives for cannabis use in a mixed anxiety and related disorder sample, future research should attempt to compare motives between particular disorders as there may be key differences. For example, in the current mixed anxiety disorder sample, conformity and social motives were not considered particularly notable. However, research has shown that both conformity and coping motives have been positively associated with cannabis problems in men with social anxiety symptoms, and social motives have been positively associated with cannabis problems in women (Buckner et al., 2012). Additionally, in the alcohol use literature, PTSD symptom severity in firefighters has been positively associated with not only coping motives but also enhancement, conformity, and social motives (Lebeaut et al., 2020). These findings highlight the complex relationship between motives for cannabis use and substance use in general, where there is a need for further research examining motives for cannabis use across anxiety disorders while simultaneously considering

other variables (e.g., gender, culture). Further, the sample was ethnically homogenous and therefore not representative of motives for use across diverse ethnicities. Some studies have shown differences in motives for cannabis use in other ethnic groups (Buckner et al., 2016; Davis et al., 2020). For example, Black participants have been shown to endorse more social motives for cannabis use than White participants and Native American youth have been shown to endorse more coping motives for cannabis use than White youth, who endorsed more recreational and expansion motives (Buckner et al., 2016; Davis et al., 2020). Future research should closely examine differences in motives endorsed across various ethnic groups as well as moderating factors (e.g., minority stress, cultural social norms), specifically in those with anxiety and related disorders, to inform inclusive screening and treatment protocols. Another limitation of the current study was the cross-sectional design and therefore we were not able to examine the temporal relationships between cannabis use and motives for use. Future research should examine these variables using a longitudinal research design (e.g., experience sampling) to understand more specifically how these variables may be associated and in what direction. Further, although the self-report measures used have been previously validated, self-report measures in general run the risk of biased reporting (e.g., under or over reporting cannabis use or anxiety symptoms).

In summary, the current findings suggest that coping and enhancement motives for cannabis use are most frequently endorsed compared to other motives by those with anxiety and related disorders. Further, coping and expansion motives were more frequently endorsed in frequent users than infrequent users. These findings suggest that individuals with anxiety and related disorders use for various reasons, some of which may be unrelated to their mental health concerns. Future research is needed to examine the associations between various motives for

cannabis use, patterns of cannabis use, and anxiety and related disorder symptoms specifically. Clinically, these findings highlight the need for screening protocols for cannabis motives in this population to inform effective treatment.

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Table 1

Demographics

Variable	Non-User (*n* = 172)	Infrequent User (*n* = 54)	Frequent User (*n* = 90)	Chi-squared Comparison
Gender				χ2(4) = 4.13, *p* = .389
Male	21.5%	24.1%	30.0%	
Female	77.3%	74.1%	66.7%	
Transgender	1.2%	1.9%	3.3%	
Relationship status				χ2(2) = 1.84, *p* = .40
Single	41.9%	42.6%	51.1%	
In a relationship	55.8%	51.9%	47.8%	
Education				χ2(4) = 5.19, *p* = .269
Some or completed high school	16.3%	11.1%	21.1%	
Some or completed post-secondary education	68.6%	70.4%	70.0%	
Some or completed graduate school	7.6%	13.0%	4.4%	

Ethnicity				$\chi 2(12) = 11.79, p = .463$
White	83.1%	87.0%	84.4%	
Indigenous	0.6%	3.7%	1.1%	
Black/Afro-Caribbean/African	N/A	N/A	1.1%	
Hispanic/Latin American	0.6%	N/A	1.1%	
Asian	2.3%	1.9%	N/A	
Biracial/Multiracial	4.7%	1.9%	1.1%	
Other	0.6%	N/A	1.1%	

Table 2

Diagnostics

	Non-User (n = 172)	Infrequent User (n = 54)	Frequent User (n = 90)
Principal			
Generalized Anxiety Disorder	27.9%	18.5%	18.9%
Social Anxiety Disorder	15.7%	13.0%	20.0%
Posttraumatic Stress Disorder	14.0%	18.5%	14.4%
Panic Disorder/Agoraphobia	9.9%	9.3%	5.6%
Other (e.g., anxiety and related disorders, mood disorders, personality disorders)	8.7%	7.4%	11.1%
Additional			
Major Depressive Disorder	23.3%	18.5%	28.9%
Persistent Depressive Disorder	9.9%	13.0%	21.1%
Generalized Anxiety Disorder	19.2%	14.8%	16.7%
Social Anxiety Disorder	18.6%	22.2%	17.8%
Panic Disorder/Agoraphobia	16.9%	11.1%	20.0%

Other (e.g., anxiety and related disorders, mood disorders, personality disorders)	28.5%	37.0%	51.1%

Note. Principal diagnosis = A mental health condition that is the patient's most pressing concern; Additional diagnosis = Mental health conditions secondary to the principal diagnosis; Diagnostic data for principal diagnoses were available for 73% ($n = 230$) of individuals

Figure 1

MMM Subscale Mean Ranks
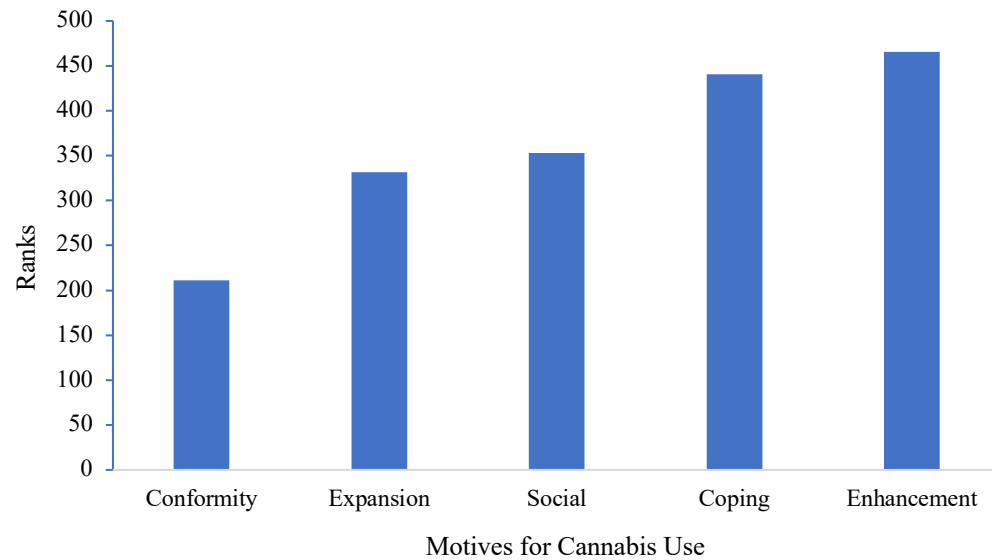
Note. MMM subscale ranks for the pairwise comparisons of motives analysis. Only Expansion and Social motives and Coping and Enhancement respectively, are non-significantly different. All other comparisons statistically significantly differ (see Table 3).

Table 3

Pairwise Comparisons of Motives

Comparison	Test Statistic	Standard Test Statistic	*p*
Conformity < Expansion	-120.99	-5.41	<.001
Conformity < Social	142.39	6.37	<.001
Conformity < Coping	230.07	10.29	<.001
Conformity < Enhancement	254.98	11.41	<.001
Expansion = Social	21.40	.957	.338
Expansion < Coping	109.08	4.88	<.001
Expansion < Enhancement	134.00	6.00	<.001
Social < Coping	87.68	3.92	< .001
Social < Enhancement	-112.60	-5.04	<.001
Coping = Enhancement	-24.92	-1.12	.265

Note. Bonferroni correction adjusted for multiple comparisons was .05/10 = .005.

Table 4

Comparing Motives Between Infrequent and Frequent Users

Motives	Mean Ranks of Median MMM subscales		Mann-Whitney U	p Values (Bonferroni correction: .05/5 = .001)	Comparisons
	Infrequent users	Frequent users			
Coping	47.73	87.36	1092.50	<.001*	Infrequent < Frequent users
Social	70.44	73.74	2318.50	.612	Infrequent = Frequent users
Enhancement	64.61	77.23	2004.00	.070	Infrequent = Frequent users
Conformity	74.36	71.38	2329.50	.266	Infrequent = Frequent users
Expansion	59.76	80.14	1742.00	.001*	Infrequent < Frequent users

Table 5

Comparing Motives Between Individuals Who Identified Their Gender as Either "Man" or "Woman"

Motives	Mean Ranks of Median MMM subscales		Mann-Whitney U	p Values (Bonferroni correction: .05/5 = .001)
	"Man" ($n = 40$)	"Woman" ($n = 100$)		
Coping	72.72	69.61	1911.00	.675
Social	76.46	68.11	1761.50	.223
Enhancement	84.08	65.07	1457.00	.010
Conformity	68.74	71.21	1929.50	.389
Expansion	77.21	67.82	1731.50	.158

CHAPTER 4: THE RELATIONSHIP BETWEEN MARIJUANA USE, ANXIETY, AFFECT, AND CRAVING IN INDIVIDUALS WITH CLINICAL ANXIETY: A PRELIMINARY EXAMINATION USING EXPERIENCE SAMPLING

Chapter link: This study has not yet been accepted for publication and is not currently submitted to a journal.

The previous chapter demonstrated motives for cannabis use in those with anxiety and related disorders. Given that coping motives were prevalent, and may represent that individuals with anxiety and related disorders are using cannabis to manage anxiety, another study was designed to examine this relationship more closely. This chapter examined the temporal relationship between marijuana use and anxiety symptoms (i.e., anxiety and worry), affect, and marijuana craving in individuals with anxiety disorders and anxiety-related disorders using experience sampling.

The relationship between marijuana use, anxiety, affect, and craving in individuals with clinical anxiety: A preliminary examination using experience sampling

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Abstract

Objectives: This study examined the temporal relationship between marijuana use and anxiety symptoms (i.e., anxiety and worry), affect, and marijuana craving in individuals with anxiety disorders and anxiety-related disorders using experience sampling. It was hypothesized that anxiety symptoms and negative affect, would be associated with increased likelihood of subsequent marijuana use, but anxiety symptoms would not reliably decrease following marijuana use. Marijuana craving was predicted to be associated with anxiety.

Methods: Forty participants, all of which were assessed and diagnosed with an anxiety disorder or anxiety-related disorder, who reported having used marijuana at least once in the past two weeks via inhalation, were recruited. After attending a baseline appointment, participants completed 14 days of experience sampling via their smart-phones. Participants were prompted to respond to a questionnaire four times daily about their level of anxiety symptoms, affect, marijuana craving, and if they were currently using marijuana.

Results: Greater worry, but not anxiety, was significantly associated with increased likelihood of subsequent marijuana use. Marijuana use was not associated with subsequent change in worry or anxiety. Neither positive nor negative affect was associated with subsequent marijuana use. Marijuana craving was significantly positively associated with anxiety and worry.

Conclusions: The findings suggest that worry was associated with increased likelihood of subsequent marijuana use, however marijuana use was not associated with decreased subsequent worry or anxiety. Craving also appeared to play a role in anxiety-related experiences. Given that the current findings are preliminary, future research would benefit from exploring these relationships further.

Keywords: Marijuana, Anxiety Disorders, Experience Sampling, Ecological Momentary

Assessment

The relationship between marijuana use, anxiety, affect, and craving in individuals with clinical anxiety: A preliminary examination using experience sampling

1.0 Introduction

There is a growing body of research which suggests a positive association between cannabis use and anxiety (e.g., Kedzior & Laeber, 2014; Spalletta et al., 2007). Individuals with anxiety disorders and anxiety-related disorders (i.e., Obsessive-Compulsive Disorder; OCD; Posttraumatic Stress Disorder; PTSD) have been shown to use cannabis at elevated rates and are more likely to experience Cannabis Use Disorder (CUD) than individuals with low anxiety (e.g., without clinical diagnoses of anxiety disorders; low state anxiety; Kedzior & Laeber, 2014; Spalletta et al., 2007). Frequent cannabis use has been associated with increased likelihood of having an anxiety disorder compared to non-cannabis users (Cheung et al., 2010). Additionally, research has found positive associations between cannabis use and specific subclinical anxiety disorder symptoms, as well as some clinically significant symptoms. For example, in a non-clinical sample, symptoms of Social Anxiety Disorder (SAD) were associated with an increased likelihood of cannabis use (Buckner, Crosby, Wonderlich, et al., 2012). OCD symptom severity in a non-clinical sample has also been positively related to risky use and misuse of cannabis (Bakhshaie et al., 2020; Spradlin et al., 2017). PTSD has been associated with increased odds of frequent cannabis use and CUD (Cougle et al., 2011; Kevorkian et al., 2015). Given the apparent positive association between cannabis use and anxiety and anxiety-related disorder symptoms, but scarce research examining this association in clinical anxiety and anxiety-related disorder populations in general (i.e., those whose symptoms meet diagnostic threshold for a disorder according to the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders'; DSM-

5; American Psychiatric Association [APA], 2013), further research is needed to better understand *why* and *how* individuals with these diagnoses use cannabis.

A negative reinforcement approach is commonly used to contextualize why individuals use substances in general and why individuals with anxiety use cannabis (Baker et al., 2004; Conger, 1956; Greeley & Oei, 1999). This approach explains that substances are used to reduce distress or negative affect, which is rewarding and reinforcing (Baker et al., 2004; Conger, 1956; Greeley & Oei, 1999). Broadly, this suggests that cannabis is consumed to cope with anxiety (e.g., de Dios et al., 2010; Foster et al., 2015; Walukevich-Dienst et al., 2019). Further, coping motives (i.e., using cannabis to manage distress; Simons et al., 1998) have been specifically observed in anxious cannabis using samples. For example, in a sample of 316 individuals seeking clinical services for anxiety disorders and anxiety-related disorders, cannabis users endorsed coping motives significantly more than all other motives (i.e., expansion, social, and conformity motives; Simons et al., 1998) except for enhancement motives (i.e., using for fun or the feeling), which were reported at the same rate (Ouellette et al., 2022). Further, behavioural avoidance (i.e., avoidance of distressing situations) has been found to mediate the association between coping motives and social anxiety symptoms (Buckner et al., 2014). Similarly, individuals with PTSD symptoms use cannabis to manage their symptoms (Bonn-Miller et al., 2014; Metrik et al., 2016) and are more likely to report cannabis coping motives than those without PTSD (Boden et al., 2013).

In addition to cross-sectional studies that suggest a relationship between negative affect and cannabis use in individuals with elevated anxiety, temporal relationships between cannabis use and state anxiety symptoms have been observed in some studies using experience sampling (Csikszentmihalyi & Larson, 1987). Experience sampling involves collecting several samples of

an individual's experiences in real-time and aims to reduce biases of retrospective self-report data, as well as facilitate ecologically valid data (Csikszentmihalyi & Larson, 1987; Csikszentmihalyi, Larson, & Prescott, 2014; Shiffman, Stone, & Hufford, 2008). For example, Buckner, Crosby, Silgado, et al., (2012) used experience sampling and found that state anxiety was related to cannabis craving, and that craving but not anxiety, decreased after cannabis use in college students (Buckner, Crosby, et al., 2012). In a sample of individuals with PTSD symptoms, those with elevated hyperarousal symptoms and elevated state anxiety were more likely to use cannabis and experience a decrease in anxiety following use as compared to individuals with other types of PTSD symptoms such as avoidance and re-experiencing; Buckner, Jefferies et al., 2018). Taken together, these findings suggest that cannabis may be used in response to symptoms of anxiety but that it may not reliably reduce anxiety. However, other experience sampling studies do not support these results, finding no significant relationship between state anxiety and cannabis use in a university population (Tournier et al., 2003) or finding that positive affect predicted cannabis use in university students (Sznitman et al., 2022). In summary, there have been mixed results regarding the association between cannabis use and state anxiety using experience sampling, and little research conducted in clinical samples entirely made up of individuals with anxiety disorders and anxiety-related disorders. Further research is needed to clarify the temporal association between cannabis use and anxiety symptoms in individuals with an anxiety disorder or anxiety-related disorder.

The purpose of the current study was to extend previous research by examining the temporal association between cannabis use and anxiety symptoms in a sample of individuals diagnosed with an anxiety disorder or anxiety-related disorder. Given that previous research has generally suggested that coping motives play an important role in cannabis use in individuals

with high anxiety, it was hypothesized that heightened state anxiety, worry, and negative affect would predict subsequent cannabis use in those with anxiety disorders and anxiety-related disorders. It was also predicted that anxiety and worry would not reliably decrease following cannabis use given that previous research has demonstrated mixed results (Buckner, Crosby, et al., 2012; Buckner et al., 2018). As a secondary aim, the association between cannabis craving and anxiety was examined. It was hypothesized that anxiety would predict subsequent cannabis craving, and craving would predict subsequent anxiety, given that this pattern has been found previously in a subclinical anxiety sample (see Buckner, Crosby, Silgado, et al., 2012).

2.0 Methods

2.1 Participants

Participants were 40 adults referred to a Canadian specialty anxiety disorders clinic by healthcare professionals (e.g., family physician) for anxiety disorder and anxiety-related disorder (i.e., OCD-and related, PTSD-and related disorders) services. They received a diagnostic assessment and an anxiety disorder or anxiety-related disorder diagnosis from a mental health professional (e.g., psychiatrist, psychologist) or supervised clinician or doctoral level psychology student. Assessments were conducted using the Diagnostic Assessment Research Tool (DART; a semi-structured modular interview based on DSM-5; see McCabe et al., 2017; Schneider et al., 2021) or via a psychiatric consult.

The inclusion criteria for participation in the study were: (1) a diagnosis of an anxiety disorder or anxiety-related disorder (principal or additional), according to DSM-5 criteria (APA, 2013); (2) not currently receiving treatment for anxiety disorders or anxiety-related disorders; (3) endorsed recreational marijuana use (i.e., the most commonly-known form of cannabis—dried

cannabis plant leaves and flowers; Goodman et al., 2020; Health Canada, 2019) via inhalation (e.g., smoking, vaping), the most common method of consumption (Borodovsky et al., 2016; Knapp et al., 2019; Ouellette et al., 2019) at least once in the past 2 weeks; (4) marijuana was not prescribed by a medical professional for specific time and amount of use; (5) access to a smartphone with a data plan for completing questionnaires.

2.2 Procedure

Participants were screened for the inclusion criteria before completing the study. They attended a baseline appointment with a research assistant in-person or virtually to complete informed consent procedures and baseline questionnaires about their cannabis and marijuana use, as well as demographics to characterize the sample. Baseline questionnaires were completed privately at a computer to promote honest responding, although the research assistant was nearby to answer questions as needed and verbally clarify instructions for some questionnaires to ensure participant understanding.

The research assistant then explained the experience sampling procedures. The experience sampling period was 14 consecutive days during which time participants answered brief questionnaires about their marijuana use and emotions four times per day, at random intervals (i.e., signal-contingent data collection). The random intervals were set to accommodate individual waking hours and occurred within a 12-hour timespan, with a minimum distance between signals of 90 minutes. Questionnaires were sent to participants' smart phone via text message using SurveySignal (Hofmann & Patel, 2015), a web-based application. The text messages contained a link that directed the participant to complete the online questionnaire via Research Electronic Data Capture (REDCap; Harris et al., 2009), a secure web-

based application for surveys and databases.

Participants were asked to keep their volume up on their phone to be able to hear the text message notification and answer it within 15 minutes of receiving it. Seventy-five percent of the sample received questionnaire links that automatically expired after 15 minutes, as well as reminder text messages sent after 5 minutes of the original text message having been sent. Twenty five percent of the sample did not have these features due to compatibility challenges with the SurveySignal and REDCap platforms. For the portion of the sample that did not receive questionnaire links that expired automatically, any data collected past 15 minutes of the text having been sent to them was manually removed from the data set for consistency across participants. Of the 56 texts sent to each participant throughout the experience sampling period, participants were missing an average of 28% and median of 25% of total scores across the experience sampling measures, with an average response rate of 72% and median response rate of 75%. This response rate is comparable or higher than published experience sampling studies (e.g., Buckner, Crosby, Wonderlich, & Schmidt, 2012; Buckner, Crosby, Silgado, Wonderlich, & Schmidt, 2012; Van Berkel, Ferreira, & Kostakos, 2017).

During the baseline appointment, participants trialed receiving the text message and responding to the questionnaire. Participants had the opportunity to review the questionnaire, ask questions, and ensure the technology was compatible with their smart phone. Participants were encouraged to reach out to the research assistant if any difficulties arose during the study period. The experience sampling began the following day.

Participants were called following the experience sampling period to debrief and were provided with a debrief form for their own records. The debrief call and form included a summary of the purpose of the study, appreciation for their participation, the researcher's contact

information in case they were to have additional questions or concerns, a request not to disclose the purpose of the experiment to others who may want to take-part in the study to maintain the integrity of the research, and substance use resources in case they wanted support. Participants received an honorarium in the form of a $100 gift card. They were entered into two draws for another $100 gift card if they completed at least 85% of the questionnaires. The collection and use of this information was approved by the institution's local research ethics board, and all participants provided written and informed consent.

2.3 Measures

The Cannabis Use Disorder Identification Test-Revised (CUDIT-R) is a self-report screening tool for CUD in the past 6 months, composed of 8 Likert-scale items (Adamson et al., 2010). Item scores are summed to produce a total score. Total scores of 13 or above suggest likely CUD, with a high sensitivity (91%) and specificity (90%; Adamson et al., 2010). The current study's Cronbach's alpha on the CUDIT-R was .76, indicating good internal consistency. It was administered at baseline.

Marijuana History Questionnaire (MHQ) is a 32-item, self-report cannabis use history data collection tool (Metrik et al., 2009). The current study used items 5 "In a typical SESSION, how much marijuana do you personally use (grams)?" and 6 "On a typical DAY you use marijuana, how much do you personally use (grams)?" to characterize amounts of marijuana used in grams at baseline.

Positive and Negative Affect Schedule (PANAS) is a self-report measure of affect comprised of two, 10-item scales measuring positive (e.g., excited, strong; PA) and negative affect (e.g., distressed, nervous; NA; Watson et al., 1988). The measure asked participants to

report their affect "right now" (i.e., current affect) and each item was rated on a 5-point Likert scale ranging from "Very slightly or not at all" to "Extremely", at each experience sampling time point. Both PANAS scales have demonstrated good internal consistency, with a Cronbach's alpha of .89 for the PA scale and .85 for the NA scale when asked to rate their affect "right now" (Watson et al., 1988). They have also shown good convergent and discriminant validity (Watson et al., 1988).

Cannabis use. "Are you currently using marijuana?" was asked at each experience sampling time point, with answer options of "Yes" or "No" similar to previously published studies (e.g., Buckner, Crosby, Wonderlich, et al., 2012).

Level of worry, anxiety, and marijuana craving. Rating scales from 0 to 100 were used to measure worry, anxiety, and craving, where 0 represented "No" and 100 represented "Extreme" affective state. The following questions were posed at each experience sampling time point: "How ANXIOUS do you feel right now?", "How WORRIED do you feel right now?", "Rate your current level of CRAVING to use marijuana:". This approach to measuring these factors is similar to previously published studies (e.g., Buckner, Crosby, Wonderlich, et al., 2012; Buckner, Silgado, & Schmidt, 2011).

2.4 Data analysis plan

The signal-contingent data was analyzed using hierarchical linear modelling (HLM; Raudenbush & Byrk, 2002). Temporal associations between variables at time (t) and at subsequent time points (t+1) were examined. Primary analyses examined the temporal association between marijuana use, anxiety, worry, and affect over the experience sampling period. Secondary analyses were conducted to examine the temporal association between

craving, worry, anxiety, and marijuana use. HLM can model missing Level-1 data of participants who have some missing data. Restricted maximum likelihood (REML) was used to estimate missing data. Of the 56 possible experience sampling data points, the mean number of total scores missing was: 15.78 (28%) for PANAS, 15.75 (28%) for anxiety, 15.83 (28%) for worry, 15.75 (28%) for craving, and 15.93 (28%) for current marijuana use. The range of missing total scores across participants for the PANAS, anxiety ratings, worry ratings, craving ratings, and current marijuana use responses was 1 (2%) to 43 (77%) throughout the experience sampling period.

3.0 Results

3.1 Descriptive Statistics

Forty participants were included in the study. The mean age was 32 years old ($SD =$ 10.35) and ranged from age 17 to 61. Demographics are summarized in Table 1. Participants were diagnosed with an anxiety disorder or anxiety-related disorder (i.e., OCD-and related, PTSD-and related disorders). Participant mental health symptoms were assessed using the DART (McCabe et al., 2017; Schneider et al., 2021; 87.5%) or via psychiatric consultation (12.5%) to establish diagnoses. The mean number of additional diagnoses was 2.15 ($SD = 1.55$) and ranged from 0 to 6 additional diagnoses. Participant diagnoses are summarized in Table 2.

Of the 39[1] individuals who completed the CUDIT-R, the mean total score was 13.62 ($SD = 6.67$), with a range from 4 to 27, and 52.5% ($n = 21$) of the sample scored 13 or above on the CUDIT-R, suggesting likely CUD. Frequency of cannabis use was examined using item 1 of the

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[1] Although 40 participants were included in the study, there was an error in the completion of one participant's CUDIT-R

CUDIT-R ("How often do you use cannabis?"). Seventy-two percent ($n = 28$) reported using "4 or more times a week", 18% ($n = 7$) reported using "2-3 times a week", and 10% ($n = 4$) reported using "2-4 times a month". All participants completed items 5 and 6 of the MHQ, which asked "In a typical SESSION, how much marijuana do you personally use (grams)?" and "On a typical DAY you use marijuana, how much do you personally use (grams)?", respectively. Based on the MHQ, the mean number of grams reportedly used in a typical session was 0.58 ($SD = 0.70$), ranging from 0.013 grams to 4 grams. The mean number of grams reportedly used in a typical day was 1.51 grams ($SD = 1.77$), ranging from 0.013 to 8 grams.

3.2 The temporal relationship between marijuana use and anxiety, worry, and affect

Anxiety. Anxiety ratings at time t were not significantly associated with marijuana use at t+1 ($b = 0.001$, $SE = 0.001$ $t = 1.065$, $df = 39$, $p = .293$, $d = 0.168$), and marijuana use at t was not significantly associated with anxiety at t+1 ($b = -1.320$, $SE = 1.105$, $t = -1.195$, $df = 39$, $p = .239$, $d = -0.189$). Anxiety was not significantly associated with marijuana use at the same time (t+1; $b = -0.000$, $SE = 0.001$, $t = -0.214$, $df = 39$, $p = .832$, $d = -0.034$).

Worry. Marijuana use at t was not significantly associated with worry ratings at t+1 ($b = .877$, $SE = 1.018$, $t = 0.862$, $df = 39$, $p = .394$, $d = 0.136$). However, greater worry at t was significantly associated with a greater likelihood of marijuana use at t+1, although the effect was small ($b = 0.001$, $SE = 0.001$, $t = 2.089$, $df = 39$, $p = .043$, $d = 0.330$). The effect remained statistically significant when worry at t+1 was controlled. These results suggest that greater worry was associated with greater likelihood of marijuana use at a subsequent time point, but that marijuana use was not followed by a change in worry (i.e., increase or decrease in worry intensity). Additionally, worry was not significantly associated with marijuana use at the same

time (t+1) while controlling for prior marijuana use (b = -0.001, SE = .0008, t = -1.58, df = 39, p = .121, d = -0.250).

Positive affect and negative affect. Positive affect (according to the PANAS) at t was not significantly associated with marijuana use at t+1 (b = 0.000, SE = 0.002, t = 0.023, df = 39, p = 0.982, d = 0.004) and neither was negative affect (b = 0.001, SE = 0.002, t = 0.556, df = 39, p = 0.581, d = 0.088). Marijuana use at t did not predict subsequent positive affect (b = -0.865, SE = 0.594, t = -1.458, df = 39, p = .153, d = -0.231) or negative affect (b = -0.564, SE = 0.435, t = -1.297, df = 39, p = .202, d = -0.205) at t+1.

3.3 The temporal role of marijuana craving in anxiety, worry, and marijuana use

Anxiety. Greater anxiety at t was significantly associated with greater marijuana craving at t+1, with a medium effect (b = 0.144, SE = 0.043, t = 3.384, df = 39, p = 0.002, d = 0.535). This effect did not remain significant (p = .628) when controlling for anxiety at t+1. There was a statistically significant effect of anxiety on craving at t+1, with a large effect (b = 0.364, SE = 0.049, t = 7.479, df = 39, p <0.001, d = 1.183). Greater marijuana craving at t was significantly associated with greater anxiety at t+1 (b = 0.199, SE = 0.043, t = 4.591, df = 39, p <0.001, d = 0.726), with a medium effect. This effect remained significant when controlling for craving at t+1. There was also a significant effect of craving on anxiety at t+1, with a large effect (b = 0.362, SE = 0.047, t = 7.719, df = 39, p <0.001, d = 1.221).

Worry. Greater worry at t was significantly associated with greater marijuana craving at t+1, with a medium to large effect (b = 0.173, SE = 0.039, t = 4.435, df = 39, p <0.001, d = 0.701) and remained statistically significant when worry at t+1 was controlled. Marijuana craving at t was significantly associated with worry at t+1, with a medium effect (b = 0.187, SE =

0.049, $t = 3.851$, $df = 39$, $p <0.001$, $d = 0.609$). This effect remained significant when craving at t+1 was controlled. There was also a significant effect of craving on worry at t+1 with a large effect ($b = 0.311$, $SE = 0.044$, $t = 7.072$, $df = 39$, $p <0.001$, $d = 1.118$).

Marijuana craving. Marijuana craving at t was not significantly associated with marijuana use at t+1. There was a significant negative association between marijuana use at t and marijuana craving at t+1 with a small to medium effect ($b = -3.472$, $SE = 1.456$, $t = -2.384$, $df = 39$, $p = 0.022$, $d = -0.377$), which remained significant when controlling for marijuana use at t+1. There was also a positive association between marijuana use and craving at t+1, with a medium effect ($b = 8.295$, $SE = 2.930$, $t = 2.831$, $df = 39$, $p = 0.007$, $d = 0.448$).

4.0 Discussion

4.1 Overview of the current findings

The aim of this study was to examine the temporal association between marijuana use and anxiety, worry, and affect in a clinical sample of individuals with anxiety disorders and anxiety-related disorders (i.e., OCD-and related, PTSD-and related disorders) who regularly use marijuana, using experience sampling to gather rich clinical data. In contrast to our hypothesis, state anxiety and marijuana use were not temporally associated. However, consistent with our hypotheses, heightened worry was associated with greater likelihood of subsequent marijuana use, and anxiety and worry did not decrease reliably following marijuana use. Further, relationships between marijuana craving and variables of interest were explored. Partially in-line with our hypothesis, craving was associated with later worry and anxiety, and worry but not anxiety was associated with later craving.

4.2 Worry, anxiety, affect and marijuana use

The finding that worry was associated with subsequent marijuana use may be conceptualized as partially consistent with negative reinforcement conceptualizations of cannabis and substance use (Baker et al., 2004; Conger, 1956; Greeley & Oei, 1999) and research which suggests that coping motives are strongly endorsed by individuals with anxiety disorders and anxiety-related disorders disorders (e.g., Boden et al., 2013; Ouellette et al., 2022). Notably, the current study found that marijuana use was not significantly associated with later worry, similar to Tournier et al. (2003) and Buckner, Crosby, Silgado, et al. (2012). These current findings suggest that marijuana may be used to manage worry specifically (i.e., the cognitive component of anxiety), rather than physical symptoms of anxiety, but marijuana use does not appear to be a sustainable solution to managing worry. Perhaps individuals with anxiety disorders and anxiety-related disorders find the acute cognitive effects of marijuana use (e.g., memory and attention impairments; Broyd et al., 2016) helpful in disrupting worry thoughts. Alternatively, expansion motives (i.e., to change one's thinking), in addition to coping motives, have previously been found to be most commonly reported by individuals seeking clinical anxiety services and who frequently use cannabis (Ouellette et al., 2022)—it may be that individuals use cannabis to help them change their worry-related thoughts. Further research is needed to explore these hypotheses.

Moreover, the current data is limited in that we did not measure immediate effects of marijuana use on worry; thus, this data does not shed light on whether there are brief, short-term effects of marijuana use on worry or anxiety, either negative or positive effects. However, there is some laboratory-based evidence suggesting that CBD may have anxiolytic effects while THC may have anxiogenic effects following consumption of capsules (Fusar-Poli et al., 2009),

therefore individuals may have differing experiences of cannabis use on anxiety depending on the products they consume. Future research should examine the immediate effects of marijuana on worry and anxiety, ideally while accounting for specific product characteristics.

Additionally, neither positive nor negative affect was temporally associated with marijuana use. It is unclear why affect was unrelated to marijuana use, and particularly surprising that negative affect was not associated with marijuana use as would be predicted based on negative reinforcement models. It is possible that regular marijuana users with an anxiety disorders or anxiety-related disorder may not be using marijuana to change their general affect, and are using for more specific reasons (e.g., managing worry, avoiding withdrawal symptoms), however future research is needed to further examine this hypothesis.

4.3 Marijuana craving and anxiety, worry, and marijuana use

The temporal associations between marijuana craving, anxiety, worry, and marijuana use were examined. Worry but not anxiety was significantly positively associated with subsequent craving. Worry and anxiety were significantly positively associated with craving at the same time. Craving was significantly positively associated with subsequent anxiety and worry, but not with subsequent marijuana use, which is partially inconsistent with previous research that found that elevated social anxiety and cannabis craving interacted to predict increased likelihood of cannabis use (Buckner, Crosby, Wonderlich, et al., 2012). Craving was significantly positively associated with marijuana use at the same time, and marijuana use was associated with a reduction in subsequent craving. Taken together, it is possible that individuals with anxiety use cannabis to manage heightened worry and craving symptoms due to low distress tolerance, which has been related to coping motives for cannabis use (Buckner, Crosby, Wonderlich, et al.,

2012; Keough et al., 2010; Zvolensky et al., 2009). Distress tolerance tends to be low in individuals with anxiety disorders and anxiety-related disorders (Michel et al., 2015) and predicts daily worry, unidirectionally (Macatee et al., 2015). This explanation is speculative as the current study did not measure distress tolerance, but is an interesting avenue for future research.

Additionally, the current study's finding that marijuana craving was associated with subsequent anxiety and worry, is consistent with previous research that found anxiety was prospectively associated with marijuana craving (Buckner, Crosby Silgado, et al., 2012). As previously suggested by Buckner, Crosby, Silgado, et al., (2012), it may be that individuals begin to experience withdrawal symptoms (which includes anxiety; APA, 2013; Cornelius et al., 2008) if craving is not addressed by using marijuana. This idea may extend to worry, such that individuals may be worried about experiencing withdrawal symptoms if marijuana is not used soon enough.

Further, partially inconsistent with the Buckner, Crosby Silgado, et al., (2012) study that demonstrated elevated marijuana craving prior to marijuana use, the current study found that craving was not associated with subsequent marijuana use, but did find a significant positive association between marijuana use and craving at the same time. Given the time between experience sampling questionnaires (i.e., minimum of 90 minutes), it is possible that the onset of craving associated with current use was not reliably captured at the prior experience sampling questionnaire (and began sometime in between questionnaires). Further, consistent with previous findings (Buckner, Crosby Silgado, et al., 2012), marijuana use was associated with decreased subsequent craving, suggesting that marijuana use may be associated with attenuated cravings and in turn, may negatively reinforce marijuana use (Conger, 1956; Greeley & Oei, 1999).

4.4 Clinical implications

With replication of the findings, there are potential clinical implications. Specifically, clinicians working with this population should gather information about individuals' marijuana use patterns and how marijuana use may or may not be related to worry and craving. Understanding these relationships may help optimize treatment planning. For example, if marijuana use is a subtle avoidance strategy in response to worry, it would be important for clinicians treating anxiety-disorders and anxiety-related disorders to provide psychoeducation and address this specifically, as subtle avoidance strategies are known to perpetuate anxiety in the long-term (Buckner et al., 2019; McManus et al., 2008; Salkovskis et al., 1999). There may also be a need to use cognitive intervention strategies to directly target worry, including worry associated with cannabis use (e.g., worry about experiencing cannabis withdrawal symptoms). Further, if marijuana craving is often driving use, clinicians should consider integrating specific intervention strategies to address craving (Buckner et al., 2019) or recommend resources to help reduce marijuana use.

4.5 Limitations

Given the preliminary nature of these findings, they should be interpreted within the context of some limitations. First, the current sample was not large enough to compare marijuana use across different anxiety disorders and anxiety-related disorders, however this would be an important area of future research to determine whether marijuana use patterns and associations with anxiety, worry, affect, and craving differ depending on the particular principal anxiety or anxiety-related disorder. Second, due to the lack of comprehensive and valid cannabis measures (Loflin et al., 2020), as well as the diverse products and methods of consumption available

(Goodman et al., 2020), it is possible that participants were using cannabis products other than marijuana, using marijuana of differing THC:CBD ratios, and consuming marijuana using various methods (Freeman & Winstock, 2015; Goodman et al., 2020). Although participants were screened for the inclusion criteria of using marijuana via inhalation at least once in the past two weeks for some standardization in marijuana consumption, and our experience sampling questionnaire asked about marijuana use specifically, participants were not excluded from the study for additionally using other products and methods of consumption as this population often uses more than one approach (Ouellette et al., 2019). Ideally, future experience sampling studies would further capture these various factors, how they may interact, and how they may differentially relate to affective states. Third, affective states were not necessarily measured immediately following marijuana use, and therefore it is unclear if there was an initial short-term effect of marijuana use on affective states. Future research should attempt to measure anxiety, worry, and craving, immediately after use as there may be short-term, negatively reinforcing changes in these factors (Conger, 1956; Greeley & Oei, 1999). It may be that marijuana is used as a safety behaviour (i.e., subtle avoidance strategy that relieves anxiety in the short-term), which would perpetuate anxiety disorder and anxiety-related disorder symptoms in the long-term (Buckner et al., 2019; Salkovskis et al., 1999). Fourth, the current sample was also predominantly White, and therefore the findings may not be representative of diverse ethnic and racial groups. Some research has demonstrated differences in cannabis use patterns and motives for cannabis use among various racial groups, and therefore it is plausible that there may be differing temporal associations between marijuana use and affective states among various demographic groups (Buckner et al., 2016; Davis et al., 2020; Wu et al., 2016). For example, Indigenous participants have been found to more likely endorse using cannabis for coping

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motives than White participants, whereas White participants have been more likely to use for recreational/expansion motives (Davis et al., 2020). As such, it is possible that there would be stronger associations between worry and marijuana use in racialized groups with anxiety disorders and anxiety-related disorders compared to the current study's results, however future research is needed to examine this hypothesis, as well as further examine systematic measurement error as indicated by Davis et al., (2020). Finally, as previously mentioned, due to compatibility challenges with the SurveySignal and REDCap platforms, experience sampling text reminders were not sent to one quarter of the participants, however the response rate remained high.

4.6 Conclusion

In conclusion, the current study examined the temporal association between anxiety, worry, affective states, marijuana craving, and marijuana use in individuals diagnosed with an anxiety disorder or anxiety-related disorder who regularly reported using marijuana. Notably, the findings suggest that worry is associated with increased likelihood of subsequent marijuana use, but that marijuana use is not significantly associated with subsequent worry (i.e., increased or decreased worry). Marijuana craving and marijuana use were positively associated at the same time, and marijuana use was associated with a subsequent decrease in craving. Taken together, individuals with anxiety disorders and anxiety-related disorders may be using marijuana to manage worry and craving, however marijuana use was only shown to consistently decrease craving, and not worry. Future investigations will be needed to understand these complex relationships and clarify mixed results in the literature (Wycoff et al., 2018).

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Table 1

Sample Demographics

Variable	Proportion ($N = 40$)
Gender	
Female	70% ($n = 28$)
Male	25% ($n = 10$)
Transgender	5% ($n = 2$)
Ethnicity	
Black/Afro-Caribbean/African	2.5% ($n = 1$)
Indigenous	5% ($n = 2$)
White/European	92.5% ($n = 37$)
Hispanic/Latin American; Asian; Biracial/Multiracial, Other	0% ($n = 0$)
Relationship Status	
Single	55% ($n = 22$)
In a relationship	45% ($n = 18$)
Education	
Highschool	20% ($n = 8$)
College or University	80% ($n = 32$)
Employment Status	
Unemployed	32.5% ($n = 13$)
Employed	55% ($n = 22$)
Other (e.g., disability support)	12.5% ($n = 5$)

Table 2

Sample Diagnostics

Principal Diagnosis	Proportion ($N = 40$)
Social Anxiety Disorder	30% ($n = 12$)
Generalized Anxiety Disorder	22.5% ($n = 9$)
Posttraumatic Stress Disorder	20% ($n = 8$)
Panic Disorder	10% ($n = 4$)
Obsessive-Compulsive Disorder	7.5% ($n = 3$)
Other (i.e., Other specified trauma and stressor related disorder, Persistent Depressive Disorder, Attention-Deficit Hyperactivity Disorder, Somatic Symptom Disorder)	10% ($n = 4$)
Additional Diagnoses	
Social Anxiety Disorder	37.5% ($n = 15$)
Generalized Anxiety Disorder	22.5% ($n = 9$)
Posttraumatic Stress Disorder	7.5% ($n = 3$)
Panic Disorder	7.5% ($n = 3$)
Agoraphobia	5% ($n = 2$)
Obsessive-Compulsive Disorder	2.5% ($n = 1$)
Major Depressive Disorder	32.5% ($n = 13$)
Persistent Depressive Disorder	32.5% ($n = 13$)
Cannabis Use Disorder	22.5% ($n = 9$)
Alcohol Use Disorder	5% ($n = 2$)

Other (e.g., personality disorders, adjustment disorder, other anxiety disorders and anxiety-related disorders)	42.5% ($n = 17$)

Note. Principal diagnosis = A mental health condition that is the most pressing concern; Additional diagnoses = Mental health conditions secondary to the principal diagnosis

CHAPTER 5: DOES CANNABIS USE IMPACT COGNITIVE BEHAVIOURAL THERAPY OUTCOMES FOR ANXIETY AND RELATED DISORDERS? A PRELIMINARY EXAMINATION

Chapter link:

Ouellette, M. J., Rowa, K., Cameron, D. H., Elcock, A., Soreni, N., Pawluk, E. J., & McCabe, R. E. (2022). Does cannabis use impact cognitive behavioural therapy outcomes for anxiety and related disorders? A preliminary examination. *Journal of Psychiatric Research*, 690-697. doi: 10.1016/j.jpsychires.2022.10.054

The version of the article presented here has been altered for the purpose of the dissertation and a portion of this study was published in Journal of Psychiatric Research. The copyright holder of this article is *Journal of Psychiatric Research* published by Elsevier.

The previous chapter's findings suggest that individuals with anxiety disorders and anxiety-related disorders may be using marijuana to manage worry and craving, however marijuana use was only shown to consistently decrease craving, and not worry. Given that there may be a relationship between cannabis use and anxiety symptoms (e.g., worry), which would have notable clinical implications, another study was designed to explore the potential impact of cannabis use on CBT outcomes for anxiety and related disorders.

Does Cannabis Use Impact Cognitive Behavioural Therapy Outcomes for Anxiety and Related Disorders? A Preliminary Examination

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Abstract

Objectives: The current study examined whether cannabis use frequency and Cannabis Use Disorder (CUD) symptom severity predicted outcomes of cognitive behavioural therapy (CBT) for anxiety and related disorders. It was predicted that more frequent cannabis use and more severe CUD symptoms would be associated with dampened treatment outcomes compared to less severe cannabis use presentations.

Methods: Two-hundred and fifty-three participants seeking treatment for anxiety and related disorders were categorized as non-cannabis users ($n = 135$), infrequent cannabis users ($n = 45$), and frequent cannabis users ($n = 73$). Measures of cannabis use and CUD symptoms were administered before starting a CBT group matching their most pressing anxiety or related disorder at the time. Participants also completed a weekly symptom-specific measure of anxiety symptoms throughout CBT.

Results: As hypothesized, cannabis use frequency was associated with poorer outcomes in CBT for anxiety and related disorders compared to non-use. Despite this finding, frequent users still experienced a significant decrease in their anxiety symptoms from pre- to post-CBT, with a large effect size ($d = -0.87$). CUD symptom severity was not a significant predictor of CBT outcomes.

Conclusions: Cannabis use frequency was associated with poorer CBT outcomes for anxiety and related disorders, however the mechanism driving this relationship remains unclear. Future studies should attempt to replicate the current findings, examine possible mechanisms, and compare the impact of cannabis use frequency on CBT outcomes for particular symptom presentations.

Keywords: Cannabis, Marijuana, cognitive behavioural therapy (CBT), Anxiety and Related Disorders

Does Cannabis Use Impact Cognitive Behavioural Therapy Outcomes for Anxiety and Related Disorders? A Preliminary Examination

1.0 Introduction

Cognitive behavioural therapy (CBT) is a well-established, empirically supported psychological treatment for various mental health concerns, and is considered the gold standard treatment for anxiety and related disorders (Beck, 1993; Otte, 2011). Individuals with anxiety and related disorders who have participated in CBT have shown statistically and clinically significant symptom improvements (Asnaani et al., 2020). CBT protocols tend to include 12 weekly treatment sessions, each one to two hours in duration (Erickson, 2003; Rowa et al., 2019). Each treatment session provides patients with cognitive and behavioural skills to manage their anxiety and related disorder symptoms, which are then practiced between sessions to enhance outcomes (Kazantzis et al., 2010; Rowa et al., 2019).

Individuals seeking treatment for anxiety and related disorders often endorse cannabis use (Ouellette et al., 2019). A previous study by Ouellette et al., (2019) reported that 39% of individuals seeking treatment for anxiety and related disorders used cannabis in the past six months, 43% of which reported using multiple times per week. Additionally, research has demonstrated a significant positive association between anxiety, cannabis use, and cannabis use disorder (CUD), where those with high anxiety are more likely to use cannabis and experience CUD compared to individuals with low anxiety (Kedzior & Laeber, 2014; Spalletta et al., 2007). It has been suggested that cannabis may be used to manage anxiety and related disorder symptoms in this population (Cooper et al., 1995; Cox & Klinger, 1988; Simons et al., 1998; Skalisky et al., 2019) and that cannabis use and anxiety may be mutually maintaining (Buckner,

Crosby, Wonderlich et al., 2012; Buckner et al., 2007; Fox et al., 2011; Stewart & Conrod, 2008). Additionally, anxiety post-psychotherapy for cannabis dependence has been associated with poorer cannabis use treatment outcomes, while reduced anxiety has been associated with better cannabis use treatment outcomes, suggesting that anxiety may increase the risk of cannabis relapse (Buckner & Carroll, 2010; Stewart & Conrod, 2008). Taken together, there appears to be an association between cannabis use and anxiety which may be important to consider in psychological treatment planning.

It may be that cannabis is used to cope with distress by avoiding or escaping from negative emotions, given that avoidance is a construct well understood to be associated with anxiety that also maintains anxiety (Borkovec et al., 2004; Maner & Schmidt, 2006; McManus et al., 2008; Salkovskis et al., 1999). For example, behavioural avoidance has been shown to mediate the relationship between social anxiety and cannabis coping motives (where cannabis coping motives were significantly and positively correlated with social anxiety and avoidance, and social anxiety was significantly and positively correlated with avoidance; Buckner et al., 2014). Notably, a core feature of CBT for anxiety is to approach, rather than avoid, anxiety-inducing stimuli and situations (Aderka et al., 2013; Riccardi et al., 2017); therefore it is plausible that cannabis used as an avoidance strategy may dampen treatment outcomes for anxiety and related disorders if left unaddressed in treatment. Recently, integrated treatment protocols for both CUD and anxiety disorders, where participants were taught to identify instances in which cannabis use is an anxiety avoidance strategy (i.e., known as safety behaviours or false safety behaviour), have shown some promise in reducing cannabis use and anxiety (Buckner et al., 2016, 2019, 2021). Safety behaviours are used to temporarily alleviate anxiety when faced with an anxiety-inducing stimuli or situation but maintain anxiety disorders

in the long-term, therefore they need to be reduced and eliminated during CBT for optimal outcomes (Salkovskis et al., 1999).

There is also evidence of cognitive and behavioural impairment associated with cannabis use. In terms of cognitive effects, verbal learning, memory, and attention show the most consistent impairment with acute and chronic use (see reviews by Broyd et al., 2016; Ranganathan & D'Souza, 2006). CBT is cognitively demanding, with new information to learn each session and skills to be applied between sessions. It is plausible that cannabis users may have more difficulty attending to and remembering information taught in sessions than non-users, which may subsequently dampen treatment outcomes. Additionally, cannabis use has also been associated with amotivation (Lane et al., 2005; Meier & White, 2018; Petrucci et al., 2020). For example, informants have reported significantly higher amotivation in young adult cannabis users who used 52 or more days in the past year than those who used less than 52 days in the past year (Meier & White, 2018). Acute amotivation has also been associated with cannabis use, likely due to tetrahydrocannabinol (THC; Lawn et al., 2016). CBT requires a substantial amount of motivation as individuals need to attend sessions and complete self-driven weekly home practice of the skills. Given that home practice enhances treatment outcomes, amotivation may interfere with homework completion and dampen treatment outcomes compared to non-users (Kazantzis et al., 2010).

There is some research that has examined the association between anxiety and cannabis use in the context of a psychological treatment that suggests there could be an effect of cannabis use on anxiety treatment outcomes. For example, some studies have found that decreases in anxiety during motivational enhancement therapy combined with CBT (MET-CBT) for cannabis dependence were associated with less cannabis use (Buckner & Carroll, 2010). These results

may reflect the mutually maintaining relationship between cannabis and anxiety which has led to integrated CBT protocols for both anxiety and cannabis use that have been effective in reducing cannabis and anxiety thus far (Buckner et al., 2016, 2019). Recently, a study by Buckner et al., (2021) compared the efficaciousness of MET-CBT and integrated cannabis and anxiety reduction treatment (ICART), which combines transdiagnostic CBT for anxiety disorders with MET-CBT for CUD. Fifty-five participants, all of whom met DSM-5 criteria for CUD and an anxiety disorder, were randomly assigned to either MET-CBT or ICART. Results suggested that ICART led to better outcomes than MET-CBT for those who had more severe baseline cannabis use and cannabis-related problems, and vice versa for those with less severe baseline cannabis use and related problems. This suggests that cannabis use and related problems may play a role in psychological treatment outcomes. However, there is a lack of research examining the impact of cannabis use on psychological treatment outcomes for anxiety and related disorders specifically, using full CBT disorder-specific protocols.

Some studies have examined the impact of cannabis use on partial psychological interventions (i.e., brief CBT for anxiety and depression, integrated CBT for anxiety and substance use) for anxiety and related disorders and have not found an effect of cannabis use on treatment outcomes (Bricker et al., 2007; Ruglass et al., 2017). For example, a study by Bricker et al., (2007) randomized 203 less than monthly cannabis users and 29 monthly cannabis users to care as usual or an intervention which included six CBT sessions for panic disorder (PD) as well as anxiety and depression symptoms, with medication. Importantly and in contrast to the Buckner et al., (2021) study described above, participants were excluded if their symptoms met criteria for cannabis abuse or dependence or if they used cannabis more than once per week. Participants who used cannabis at least once in the past month or less were included in the study.

Bricker et al., (2007) did not find an impact of cannabis use on combined CBT-pharmacotherapy outcomes for PD and associated social anxiety and depressive symptoms. Although the results from Bricker et al., (2007) are not directly comparable to Buckner et al., (2021) due to differing treatment protocols, it is important to note that these studies included participants with different cannabis use severity, which may be an important mediating factor of CBT outcomes. Further, a study by Ruglass et al., (2017) used data from two previous clinical trials with 104 non-cannabis users and 32 cannabis users. The first trial included 12 CBT sessions for substance use disorder (SUD) and posttraumatic stress disorder (PTSD) either with sertraline or a placebo. The second trial included 12 weeks of prolonged exposure with relapse prevention to address PTSD and SUDs, respectfully. Cannabis users were defined as participants who reported using cannabis in the past seven days; however, individuals with CUD as their primary SUD were excluded. The results of this study did not show an association between baseline cannabis use and PTSD symptom severity post-treatment. The variation in study designs (e.g., treatment provided), inclusion criteria related to cannabis use, and small sample sizes, may reflect the conflicting findings across studies thus far. Additional research is needed to examine whether there may be an impact of cannabis use on standard 12-week CBT for disorder-specific anxiety and related disorders.

In summary, it is unclear whether cannabis use has significant impacts on CBT outcomes for anxiety and related disorders. To our knowledge, research has not examined the impact of cannabis use on standard 12-week CBT protocols for anxiety and related disorders specifically. Given that anxiety disorders are some of the most prevalent mental health concerns, and that a substantial proportion of individuals seeking treatment for anxiety and related disorders endorse

cannabis use, it is important to understand whether cannabis impacts anxiety and related disorder treatment outcomes (Baxter, Patton, et al., 2013; Baxter, Scott, et al., 2013).

The purpose of the current study is to examine whether frequency of cannabis use and severity of CUD symptoms at baseline are associated with CBT outcomes for anxiety and related disorders. It was predicted that higher cannabis use frequency would be associated with poorer CBT treatment outcomes than for those who deny cannabis use given the apparently mutually maintaining relationship between cannabis use and anxiety, as well as the cognitive and motivational impairments that have been associated with cannabis use. It was also predicted that individuals with more severe CUD symptoms would likely reflect more severe cannabis-related functional impairment (e.g., memory difficulties, failing to do what is expected), which would also dampen CBT outcomes. Secondary exploratory analyses examined motives for cannabis use as possible predictors of CBT for anxiety and related disorder outcomes. In addition, change in anxiety-related impairment was examined from pre- to post- treatment between non-users and cannabis users to determine if cannabis use frequency was differentially associated with change in anxiety-related functional impairment. Motives for cannabis use have been differentially associated with cannabis use frequency in individuals with anxiety and related disorders (see chapter 3) and therefore may be associated with different CBT outcomes. Anxiety-related functional impairment was examined as it may be that more frequent cannabis use is associated with less reduction in anxiety-related functional impairment.

2.0 Methods

2.1 Participants

Two-hundred and fifty-three ($N = 253$) adults seeking treatment for anxiety (i.e., generalized anxiety disorder, social anxiety disorder, panic disorder/agoraphobia) and related disorders (i.e., obsessive-compulsive disorder, posttraumatic stress disorder) participated in the current study. To be included in the study, participants had to have been referred to a symptom-specific anxiety or related disorder CBT group at the clinic, based on the results of a diagnostic assessment by a psychiatrist, clinical psychologist, graduate-level clinical psychology student, or other mental health professional. Although some diagnostic assessment data were unavailable (principal diagnoses were available for 74% of the sample), it is the clinic policy that any individual referred to a symptom-specific CBT group at the clinic also has a matching anxiety disorder diagnosis (whether it is a principal or additional diagnosis). Further, to support this assumption, participants completed a symptom-specific measure matching the CBT group they were referred to. To be included in the study, their total score on the symptom-specific measures had to be equal to or above the cut off score for that measure indicating clinically significant symptoms. Notably, participants who completed their CBT group as the COVID-19 pandemic began were excluded, as treatment protocols were disrupted partway through the protocol.

Participants were categorized into non-cannabis users, infrequent cannabis users, and frequent cannabis users in the same way as in Chapter 3. The first question of the Cannabis Use Disorder Identification Test-Revised (CUDIT-R; "How often do you use cannabis?") was used to categorize infrequent and frequent users. Participants who answered "Monthly or less" or "2-4 times a month" were categorized as infrequent users, whereas those who answered "2-3 times a week" or "4 or more times a week" were categorized as frequent users. Cannabis use frequency categories were chosen to be similar to other studies (e.g., Buckner & Schmidt, 2008; Henry et al., 2014). Non-users were operationalized as those who answered "No" to having used in the

past 6 months (a screening question preceding the CUDIT-R). Participants who answered "No" to the screening question but reported cannabis use on the first question of the CUDIT-R were still considered non-users, as they were likely reporting historical patterns of use. Those who answered "yes" to the screening question but reported "never" on the first question of the CUDIT-R were also considered non-users. One-hundred and thirty-five non-users, 45 infrequent users, and 73 frequent users were identified.

2.2 Procedure

Participants were referred to a hospital-based clinic that specializes in anxiety and related disorders by a healthcare professional (e.g., family physician, psychiatrist). Participants' mental health symptoms were assessed by trained clinicians (e.g., psychologist, psychiatrist, graduate students). Sixty-eight percent of participants were assessed using the Diagnostic Assessment and Research Tool (DART; a semi-structured modular interview based on DSM-5 criteria; see McCabe et al., 2017; Schneider et al., 2021), 22% received a psychiatric consult, and 4% received an assessment with a nurse specialized in anxiety and related disorders. To address their presenting concerns, individuals were referred to a symptom-specific CBT group for either social anxiety disorder (SAD), generalized anxiety disorder (GAD), panic disorder (PD) and/or agoraphobia, obsessive-compulsive disorder (OCD), and posttraumatic stress disorder (PTSD). CBT groups were composed of 12, two-hour sessions, which occurred once per week. Group sizes were generally limited to a maximum of 8-12 participants. CBT protocols included psychoeducation, cognitive skills, and behavioural skills (e.g., exposure to anxiety-inducing situations) tailored to the respective disorder being treated. The PTSD group was the only protocol without behavioural skills as the type of CBT used was Cognitive Processing Therapy

(Resick et al., 2016). Prior to beginning group CBT, participants completed measures of cannabis use patterns, CUD symptom severity, motives for cannabis use, anxiety-related functional impairment, and disorder-specific symptom measures. They also completed weekly anxiety and related disorder symptom measures throughout CBT. The institution's local research ethics board approved the collection and use of this data, and all participants provided written and informed consent.

2.3 Measures

   The Cannabis Use Disorder Identification Test-Revised. The Cannabis Use Disorder Identification Test-Revised (CUDIT-R) is a self-report screening tool for CUD in the past 6 months (Adamson et al., 2010). It is composed of 8 items relating to cannabis consumption, problems, dependence, and psychological features. Total scores of 13 or above indicate likely CUD, with a high sensitivity (91%) and specificity (90%; Adamson et al., 2010). The current study's Cronbach alpha on the CUDIT-R at baseline was .81, suggesting good internal consistency.

   Marijuana Motives Measure. The Marijuana Motives Measure (MMM) is a self-report measure of motives for cannabis use. It is composed of 5 motive subscales: coping (e.g., "I use marijuana because it helps me when I feel depressed or nervous"), social (e.g., "I use marijuana to be sociable"), enhancement (e.g., "I use marijuana to get high"), conformity (e.g., "I use marijuana to fit in with the group I like"), and expansion (e.g., "I use marijuana so I can understand things differently"; Simons et al., 1998). There are 25 items, each of which is scored using a 5-point scale, where *1 = Almost never/Never* and *5 = Almost always/Always*. The MMM has demonstrated good discriminant validity and MMM subscales have shown strong internal

consistency with Cronbach alphas of .84 to .94 (Simons et al., 1998). The current study's

Cronbach alpha values across the motive subscales at baseline were .86 for conformity, .89 for

social, .91 for enhancement, .94 for coping, and .93 for expansion.

Illness Intrusiveness Rating Scale. The Illness Intrusiveness Rating Scale (IIRS) is a

13-item self-report measure of illness-related daily life disruptions (Devins, 2010; Devins et al.,

1983). It has been adapted to measure the functional impact of anxiety specifically with the

question stem of "How much does your anxiety and/or its treatment interfere with your:". Areas

of impairment assessed include occupational, recreational activities, relationships, and health.

Items are rated from 1 = *Not very much* to 7 = *Very much*. The IIRS generally has good internal

reliability with alpha values in the .80's and .90's (Devins, 2010). The current study's pre-

treatment alpha value was .83 and post-treatment value was .90.

The Social Phobia Inventory. The Social Phobia Inventory (SPIN) is a self-report

measure of SAD symptoms (Connor et al., 2000). It is composed of 17 items, which are rated

from 0 = *Not at all* to 4 = *Extremely*. Total scores on the SPIN can reflect none, mild, moderate,

severe, and very severe SAD symptoms. The current study included only those who scored

within the moderate range and above (total scores of 31 and above; Moscovitch et al., 2011;

Moser et al., 2008). The SPIN has shown good divergent and convergent validity (Antony et al.,

2006; Connor et al., 2000) as well as internal consistency which was reflected by a Cronbach

alpha that ranged from .74 to .95 from pre- to post-treatment in the current study.

The Penn State Worry Questionnaire. The Penn State Worry Questionnaire (PSWQ), a

self-report measure of trait worry and a screener for symptoms of GAD, was administered at pre-

and post-treatment (Fresco et al., 2003; Meyer et al., 1990). It is composed of 16 items, rated

from 1= *Not at all typical of me* to 5 = *very typical of me*. A total cut off score of 45 or above is

considered to reflect clinically significant worry, with a sensitivity and specificity for a GAD diagnosis of 99% and 98% respectively (Behar et al., 2003). The PSWQ has shown sound psychometric properties, with good internal consistency and discriminant validity (Meyer et al., 1990). The PSWQ-Past Week (PSWQ-PW) version of the questionnaire was also administered each week throughout CBT. The PSWQ-PW is a 15-item self-report questionnaire of worry in the past week, with response options of 0 = *Never* and 6 = *Almost always* (Stöber & Bittencourt, 1998). The PSWQ and PSWQ-PW demonstrated good internal consistency in the current study, with Cronbach alphas ranging from .85 to .97 from pre- to post-treatment.

  The Panic Disorder Severity Scale. The Panic Disorder Severity Scale (PDSS) is a self-report measure of PD (Furukawa et al., 2009; Shear et al., 1997). It is composed of 7 items, rated on a scale from 0 to 4. A total cut off score of 8 and above indicates clinically significant PD symptoms, with a sensitivity of 83% and specificity of 64% (Shear et al., 2001). The PDSS has also demonstrated sound psychometric properties, with good internal consistency and discriminant validity (Shear et al., 2001). The internal consistency of the current study's PDSS was good, reflected by a Cronbach alpha range of .76 (acceptable) to .97 (excellent).

  The Obsessive-Compulsive Inventory-Revised. The Obsessive-Compulsive Inventory - Revised (OCI-R) is a measure of OCD symptoms (Foa et al., 2002). Each of the 18 items are rated from 0 = *Not at all* to 4 = *Extremely*, with total scores of 21 and above indicating likely OCD, with a sensitivity of 65.6% and specificity of 63.9% (Foa et al., 2002). The OCI-R has shown good internal consistency and convergent validity in previous studies (Foa et al., 2002). The current study's Cronbach alpha ranged from .55 to .83 for the OCI-R, which is likely a reflection of the small sample size.

  The PTSD Checklist for DSM-5. The PTSD Checklist for DSM-5 (PCL-5) measures

PTSD symptoms (Weathers et al., 2013). It is composed of 20 items, rated from 0 = *Not at all* to 4 = *Extremely*, with total scores between 31 and 33 and above indicating likely PTSD (Bovin et al., 2016). To be conservative, the current study used the cut off score of 33 to be included in the study. The PCL-5 has shown good convergent and discriminant validity in previous studies (Blevins et al., 2015), as well as good internal consistency in the current study with a Cronbach alpha ranging from .86 to .97 from pre- to post-treatment.

2.4 Data analysis

Primary outcomes examining the association between frequency of cannabis use and CBT outcomes as well as CUD symptom severity and CBT outcomes were analyzed using hierarchical linear modelling (HLM; Raudenbush & Byrk, 2002). HLM was used because of its ability to address missing data at Level-1 (i.e., the outcome variable assessing anxiety and related disorder symptoms) and because it is relatively robust to unbalanced designs (i.e., unequal number of participants between the non-user, infrequent user, and frequent user groups). Restricted maximum likelihood (REML) was used as the estimation method.

To determine if cannabis use frequency groups significantly differed in rates of change in anxiety and related disorder symptom severity over the course of treatment, an HLM was conducted with time (coded with the unit of measurement as one week) at Level-1 and cannabis use frequency at Level-2 (where non-users were the reference category, and infrequent users and frequent users were incorporated as individually dummy-coded variables). Follow-up individual one-level HLMs were also performed to assess change in symptom severity (i.e., the specific rate of change in anxiety and related disorder symptom severity over time) within each cannabis use category. An additional HLM analysis was completed to determine the effect of CUD symptoms,

as assessed by the CUDIT-R (at Level-2), on change in anxiety and related disorder symptom severity over the course of treatment. This analysis was performed in a sample of all cannabis users (i.e., both frequent and infrequent) to determine if problems due to cannabis use had an impact on treatment outcomes. Effect size for primary analyses is reported as Cohen's *d*, to be interpreted as small = 0.20, medium = 0.50, and large = 0.80 (Cohen, 2013).

Given that motives for cannabis use can differ between infrequent and frequent users, as noted in Chapter 3, the effect of motives for use on change in anxiety and related disorder symptom severity over the course of CBT was assessed. Additional analyses were performed within cannabis users only (dummy coded as 0 = infrequent users, 1 = frequent users) at Level-2, along with motives for cannabis use, as assessed by the MMM, as well as the interaction between cannabis use frequency and motives for use, each at Level-2.

Finally, a single (3 cannabis frequency user group X 2 Time) repeated-measures ANOVA was used to assess the impact of cannabis use status on improvement in anxiety-related illness intrusiveness, as measured by the IIRS, from pre- to post-treatment.

An intent-to-treat approach was taken for the above analyses to maximize sample size and external validity of results. Data were collected weekly from pre-treatment, through twelve weeks of treatment, to post-treatment, for a total of 14 time points. The amount of missing anxiety and related disorder symptom data ranged from 0.0% at pre-treatment to a maximum of 49.4% at post-treatment, and the overall level of missing data points in the dataset was 32.4%. These data were estimated using REML. Missing data was not imputed for Level-2 variables, and only individuals who had complete data at Level-2 were used in the analysis. Data was not imputed for the repeated measures ANOVA.

The uneven samples sizes across disorder-specific CBT groups, and the relatively low sample sizes for the OCD and PD/agoraphobia groups in particular, precluded a meaningful analysis within or across specific disorders. We therefore collapsed participants across diagnostic groups by calculating z-scores for each symptom measure, using available sample norms from related validation studies for each questionnaire. Given the differences in methodology between validation studies and anxiety and related disorder symptom-specific questionnaires, z-scores were only used for the full-sample analysis, whereas raw scores were used for individual group analyses (i.e., descriptive information). Where possible, sample means for non-anxious controls were used to calculate z-scores to represent the general population mean. These were 48.8 ($SD =$ 13.8) for the PSWQ (Meyer et al., 1990), 18.82 ($SD = 11.10$) for the OCI-R (Foa et al., 2002), and 6.10 ($SD = 6.00$) for the PDSS-SR (Shear et al., 2001). The two exceptions were the PSWQ-PW and the SPIN. No control sample was available, to our knowledge, for the PSWQ-PW. Given that the baseline PSWQ and PSWQ-PW scores were comparable between baseline and session 1, and session 12 and post-treatment (ps > .05), we therefore elected to use a comparable score from its validation study (Stöber & Bittencourt, 1998) which was the mid-treatment mean of 45.43 ($SD = 16.48$). The SPIN score for non-anxious controls is 12.10 ($SD = 9.30$). Given that this score is low relative to sample means for SAD, this value results in overly-inflated z-scores relative to the other disorder-specific samples in the present study. Furthermore, some researchers also support a higher cut-off value of 30 on the SPIN, relative to the proposed cut-off of 22.10 (Moscovitch et al., 2011; Moser et al., 2008). As such, the sample mean of 22.70 ($SD =$ 10.00) for the "mildly-impaired" subsample was used (Connor et al., 2000).

3.0 Results

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3.1 Descriptive Statistics

The mean total scores on all anxiety and related disorder symptom-specific measures were above the clinical cut off scores, supporting that participants were experiencing clinically significant symptoms. The mean total score on the OCI-R was 30.00 ($SD = 8.63$), PCL-5 was 55.47 ($SD = 10.81$), PDSS was 15.30 ($SD = 4.37$), PSWQ was 67.54 ($SD = 8.42$), and SPIN was 46.27 ($SD = 8.45$). Importantly, there was no significant difference between non-users, infrequent, and frequent users on the primary outcome variable (z-scores representing anxiety and related disorder symptom severity) at baseline [$F(2,250) = 0.96, p = .386$], indicating that the groups started at roughly equal levels of symptom severity. Specifically, mean z-scores were 1.72 ($SD = .86$) for non-users, 1.72 ($SD = .91$) for infrequent users, and 1.90 ($SD = .99$) for frequent users.

Participant age ranged from 17 to 70 years old, with the mean age of the sample being 35.53 years old ($SD = 11.80$). Given that assumptions of normality and homogeneity of variance for ANOVA analyses were violated, a Kruskall-Wallis test was applied to examine whether there were any significant differences in age between non-users, infrequent users, and frequent users. There was no significant difference in age between groups $H(2) = 4.94 \, p = .085$, with mean ranks of 129.76 for non-users, 103.23 for infrequent users, and 130.79 for frequent users. There were also no significant differences in other demographic factors across these groups (Table 1). Principal diagnoses were primarily anxiety and related disorders, and no participants had a principal diagnosis of CUD (Table 2). The number of additional diagnoses ranged from 1 to 5 for non-users and infrequent users, and 1 to 6 for frequent users. Non-users, infrequent users, and frequent users had an average of 2.01 ($SD = 1.04$), 2.04 ($SD = 1.20$), and 2.52 ($SD = 1.64$) additional diagnoses, respectfully. There was no significant difference in number of additional

diagnoses across groups $H(2) = 1.89$, $p = .388$, with mean ranks of 71.59, 70.42, and 81.16 for non-users, infrequent users, and frequent users respectively. Additionally, 4.44% of infrequent users and 10.96% of frequent users had an additional diagnosis of CUD based on diagnostic assessments using the DART. Mean total CUDIT-R scores were 3.71 ($SD = 2.96$) for infrequent users (with a range of 1 to 12) and 11.03 ($SD = 5.69$) for frequent users (with a range of 3 to 27).

3.2 Symptom Change over Time as a Function of Cannabis Use

Table 3 presents the full results for all HLM models for the primary analysis assessing the effect of cannabis use frequency or CUD symptoms on the trajectory of change in anxiety and related disorder symptom severity over the course of CBT. As seen in the table, there was a significant effect of frequent cannabis use on change in symptoms over time ($b = 0.04$, $SE = 0.02$, $t = 2.72$, $df = 250$, $p = .007$, $d = 0.17$) but not infrequent use ($b = 0.02$, $SE = 0.01$, $t = 1.52$, $df = 250$, $p = .129$, $d = 0.10$), relative to non-users. Infrequent users also did not demonstrate a significant effect when compared against frequent users ($b = -0.17$, $SE = 0.02$, $t = -0.89$, $df = 250$, $p = .376$, $d = -0.06$). These results indicate that frequent cannabis use is associated with less improvement in anxiety and related disorder symptom severity over the course of treatment compared to non-users, albeit with a small effect. This result is represented in Figure 1. Individual one-level HLMs confirmed that each of the non-user ($b = -0.13$, $SE = .01$, $t = -13.73$, $df = 135$, $p < .001$, $d = -1.18$), infrequent user ($b = -0.10$, $SE = .01$, $t = -8.59$, $df = 44$, $p < .001$, $d = -1.28$), and frequent user ($b = -0.09$, $SE = .01$, $t = -7.42$, $df = 71$, $p < .001$, $d = -0.87$) groups demonstrated significant reductions in symptom severity over the course of treatment. Therefore, although all three groups experience significant improvements in their anxiety and related

disorder symptoms from pre- to post-treatment, the rate of change was significantly slower in frequent cannabis users than non-users.

CUD symptoms, as assessed by the CUDIT-R, were not a significant predictor of anxiety and related disorder symptom change in the sample of users only (b = -0.09, SE = .00, t = .15, df = 115, p = .879, d = 0.02). These results indicate that CUD symptoms do not appear to have a significant effect on the trajectory of change in anxiety and related disorder symptom severity over the course of CBT.

3.3 Symptom Change over Time as a Function of Motives for Cannabis Use

The effect of different motives for cannabis use on trajectory of change in anxiety and related disorder symptom severity over the course of treatment was assessed within the sample of cannabis users only. The full results of the HLM for each MMM subscale are presented in Table 4. As can be seen in the table, none of the motives for cannabis use showed a significant effect on trajectory of change in symptoms over time (ps > .05). Furthermore, the lack of significance in any of the motive X group (infrequent vs. frequent) interactions demonstrates that motives for use did not differentially impact trajectory of change in anxiety and related disorder symptom severity for infrequent compared to frequent users. These results suggest that motives for cannabis use did not affect CBT outcomes.

Separate analyses were also performed with frequent and infrequent user groups merged together to determine whether motives for cannabis use had any effect on change in anxiety and related disorder symptom severity over the course of CBT in all cannabis users. None of the MMM subscales significantly predicted change in z-score over time in the full cannabis user sample (ps > .05), suggesting that motives for cannabis use did not have any significant effect on

CBT outcomes.

3.4 Changes in Illness Intrusiveness across Frequency of Cannabis Use Groups

Complete pre- and post-treatment data for the IIRS were only available for a sample of n = 126; see Table 5 for means and standard deviations for the IIRS across groups. We first assessed whether the IIRS total score improved significantly from pre- to post-treatment across non-users, infrequent users, and frequent users. There was a significant main effect of Time [$F(1,123) = 27.20, p < .001, \eta^2_p = .18$], but the main effect of Group [$F(2,123) = 0.72, p = .488, \eta^2_p = .01$] and the Group X Time interaction [$F(2,123) = 2.00, p = .140, \eta^2_p = .03$] were not significant. Given that the IIRS scores for the non-users and infrequent users appeared more similar relative to those of the frequent users group, a second ANOVA was performed with the non-users and infrequent users merged. Here, there was again a significant main effect of Time [$F(1,124) = 15.71, p < .001, \eta^2_p = .11$], but neither the effect of group [$F(1,124) = 1.00, p = .319, \eta^2_p = .01$] nor the interaction [$F(1,124) = 3.20, p = .076, \eta^2_p = .03$] were significant. These results indicate that changes in anxiety-related illness intrusiveness from pre- to post-treatment did not depend on frequency of cannabis use.

4.0 Discussion

To our knowledge, the current study is one of the first to explicitly examine the impact of cannabis use on CBT outcomes for anxiety and related disorders. First, consistent with our hypothesis, frequent cannabis use predicted dampened CBT outcomes throughout treatment compared to non-users. This finding is consistent with previous findings. For example, a study that compared the efficaciousness of MET-CBT and integrated cannabis and anxiety reduction treatment (ICART) found that ICART led to better outcomes than MET-CBT for those who used

more baseline cannabis use (number of joints used per day), and vise versa for those with less severe baseline cannabis use (Buckner at al., 2021). Although this study is not directly comparable to the current study as different measures of cannabis use were used (i.e., amount of cannabis used in joints versus frequency of cannabis use), both results suggest that cannabis use may be associated with poorer CBT treatment outcomes.

It is possible that there is a third variable at play, associated with both cannabis use frequency and CBT outcomes. For example, it may be that the negative cognitive impacts of cannabis use (e.g., memory, attention, verbal learning impairment; Broyd et al., 2016; Ranganathan & D'Souza, 2006) or amotivation (e.g., Meier & White, 2018) would account for more of the variation in CBT outcomes than frequency of cannabis use. Research has shown that engaging in homework (i.e., practicing CBT skills between sessions) enhances treatment outcomes (Kazantzis et al., 2010). If participants are unable to attend to the in-session teachings or remember how to apply the skills at home, as well as if they experience amotivation, frequent cannabis users may not be able to learn or practice the CBT skills as effectively as infrequent users or non-users. Research is needed to examine the possible association between cognitive and behavioural impacts of cannabis use and CBT outcomes, as well as homework completion. Another third variable that may impact CBT outcomes is avoidance, which is associated with anxiety and maintains anxiety (Borkovec et al., 2004; Maner & Schmidt, 2006; McManus et al., 2008; Salkovskis et al., 1999). There is also evidence that behavioural avoidance mediates the relationship between social anxiety and coping motives (Buckner et al., 2014). If participants are using cannabis to cope with their anxiety (i.e., avoid anxiety), rather than implementing CBT coping skills and facing their anxiety, it may lead to dampened treatment outcomes. Future studies should measure cannabis use throughout treatment to determine whether there is a

reduction in cannabis use coinciding with effects of CBT. Interestingly, the current study examined various motives for cannabis use in this sample, including coping motives, as a predictor of CBT outcomes, however there was no significant effect. Although previous research has shown that this population uses for various reasons, coping motives being one of the most common ones (see Chapter 3), it may be that motives for cannabis use change throughout treatment, which was not examined in the current study. It is possible that there is an association between motives for cannabis use and anxiety symptoms throughout treatment, which future studies should seek to examine.

Additionally, the current study found that infrequent cannabis use did not dampen CBT for anxiety and related disorders treatment outcomes. This finding is in line with previous research. For example, a study by Bricker at al., (2007) did not find an impact of cannabis use on combined CBT-pharmacotherapy outcomes for PD and associated social anxiety and depressive symptoms, however they excluded participants who met criteria for cannabis abuse or dependence or used cannabis more than once per week. Collectively, it appears that infrequent cannabis use may not dampen CBT outcomes for anxiety and related disorders, although further replication studies are needed to clarify this finding.

Further, inconsistent with our hypothesis, CUD symptoms did not predict dampened CBT outcomes for anxiety and related disorders—there are several possible explanations for this finding. First, it is possible that participants underreported the functional impact of cannabis use. Positive beliefs about cannabis have been associated with cannabis use (Holm et al., 2015), and therefore participants may be less willing to admit the negative aspects of cannabis use listed on the CUDIT-R (e.g., problems related to cognition, functional impairment). Previous research has suggested that individuals who use cannabis more problematically (i.e., higher scores on the

CUDIT-R) tend to minimize the negative impacts of cannabis use on other measures (e.g., agree with the belief "cannabis use safer than alcohol" and it is "safe to drive under the influence of cannabis" while disagreeing with beliefs such as "cannabis can be addictive" and "cannabis is risky") more so than individuals who use less problematically (Hellemans et al., 2019). Some of the questions on the CUDIT-R also appear to imply that certain symptoms or behaviours are problematic, which may bias the respondents reporting (e.g., "How often in the past 6 months have you had a problem with your memory or concentration after using cannabis?", "How often do you use cannabis in situations that could be physically hazardous, such as driving, operating machinery, or caring for children?"). Additional research examining beliefs associated with cannabis use in those with clinical anxiety would be helpful in furthering our understanding of cannabis use problems in this population. Another possible explanation for the current study's results is that CUD symptoms were not severe enough to predict dampened treatment outcomes as most participants in the sample did not have a formal diagnosis of CUD and the mean CUDIT-R score for frequent users was below the 13 total cut off score indicating likely CUD (Adamson et al., 2010). Therefore, although some participants were using frequently, perhaps there are other factors involved in their use that prevents it from being problematic enough to interfere in their day-to-day lives, including treatment (e.g., using larger amounts of cannabis in the evening rather than in the morning as to reduce impairment in their ability to complete daily functional tasks; using frequently but in small amounts at a time).

The current study's findings could have several clinical implications upon replication of the results. Overall, it seems that cannabis use is not necessarily detrimental to CBT outcomes given that all groups, including frequent users, experienced significant improvement in anxiety and related disorder symptoms from pre- to post-treatment. However, it may be worth including

screening protocols for cannabis use frequency in patients seeking CBT for anxiety and related disorders to inform treatment planning for optimal CBT outcomes. For example, clinicians may recommend that frequent cannabis users attempt to reduce their use prior to starting CBT for anxiety and related disorders, and if the patient does not feel this is possible, provide some supports or resources to facilitate this. Alternatively, if patients are reluctant to consider reducing their cannabis use, psychoeducation about the possible effect of frequent cannabis use on CBT outcomes can be provided. Individuals who use cannabis may have positive beliefs about cannabis use (Holm et al., 2015) or may be unaware of the effects cannabis use may have on treatment outcomes, and therefore psychoeducation may be important to optimize the likelihood of positive CBT outcomes. Alternatively, if patients are unwilling or unable to change their cannabis use prior to beginning CBT for anxiety and related disorders and have been provided with this psychoeducation as part of the informed consent process, frequent cannabis use without a diagnosis of CUD should not warrant exclusion from access to CBT for anxiety and related disorders as patients generally benefit from CBT despite their cannabis use.

There are several limitations to consider when interpreting the current results. First, there is no standardized method of categorizing patterns of cannabis use. Differences in definitions of cannabis use across studies complicates comparisons of results between them. The current study used cannabis use frequency and CUD symptoms severity to attempt to gain a more specific understanding of the impact of cannabis use on treatment outcomes. Ideally, studies would further capture the various factors involved in cannabis use (e.g., product, method of ingestion, amount consumed, delta-9-tetrahydrocannabinol; THC to CBD concentrations) to identify variables that contribute most of the variance in CBT outcomes, and which are negligible. Additionally, the cannabis literature generally, including the current study, lacks measures to

accurately measure various cannabis forms, methods of consumption, products, and THC and CBD concentrations (Freeman & Winstock, 2015; Goodman et al., 2020). Future studies should attempt to develop better measures of cannabis use to be able to examine the effects of these variables on treatment outcomes (e.g., it may be that only certain products impact treatment outcomes while others do not; there may be a differential effect of prescribed medical cannabis used in specified amounts at particular times compared to recreational use). Other variables that would be worth controlling in future studies include medication use and other substance use to reduce the noise in the data and possible extraneous findings. Additionally, the impact of cannabis on CBT outcomes was not compared between particular anxiety and related disorders due to small sub-sample sizes and comorbid conditions, which may interact with treatment outcomes. Research examining whether cannabis use has different effects on treatment outcomes across anxiety and related disorder CBT protocols would be particularly valuable for a more nuanced understanding of the association between cannabis use and CBT outcomes. Given differences in reported frequency of use across anxiety disorder groups, treatment outcomes may be impacted more among certain anxiety disorder groups (e.g., SAD) than others (e.g., PD). Moreover, the current sample was ethnically homogenous and therefore the results may not reflect CBT outcomes across diverse groups. There has been research showing differences in cannabis use patterns and motives for cannabis use across racial groups (Buckner et al., 2016; Davis et al., 2020; Wu et al., 2016). Therefore, there may be important differences in treatment outcomes related to cannabis use across racial groups. Future studies should replicate the current study with diverse populations of cannabis users. Other factors that would be important to examine in future research are cannabis use and anxiety at long-term, post-CBT for anxiety and related disorder follow-ups. Generally, treatment gains from CBT for anxiety are maintained

long-term, post-treatment (DiMauro et al., 2013); however, given that the relationship between cannabis use and anxiety can be mutually maintaining, there may be an impact of cannabis use on long-term anxiety outcomes. Finally, the current study relied on self-report measures. Although these measures were previously validated and have sound psychometric properties, an inherent limitation of self-report measures are that they are subjective to biased reporting. Notably, it is possible that some participants misrepresented their cannabis use (e.g., over-, under-reporting, inconsistently reporting across measures, or reporting an estimation of their use that may not be accurate), however it is unclear why this may be.

In summary, the current study is one of the first to examine the relationship between cannabis use and CBT outcomes for anxiety and related disorder outcomes. Results indicated that frequent cannabis use predicted dampened CBT outcomes for anxiety and related disorders compared to non-users. Despite this, frequent users experience significant improvements in anxiety and related disorder symptoms from pre- to post-treatment. Interestingly, CUD symptom severity did not predict dampened CBT outcomes. Future research should attempt to replicate the current study findings and compare the association between cannabis use and CBT outcomes across specific anxiety and related disorders.

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Table 1. Demographics

Variable	Non-User (*n* = 135)	Infrequent User (*n* = 45)	Frequent User (*n* = 73)	Chi-squared Comparison
Gender				$\chi2(4) = 2.18, p = .70$
Male	22.2%	26.7%	30.1%	
Female	76.3%	71.1%	67.1%	
Transgender	1.5%	2.2%	2.7%	
Relationship status				$\chi2(2) = .76, p = .68$

Single	41.5%	33.3%	42.5%	
In a relationship	57.8%	62.2%	57.5%	
Education				$\chi2(4) = 4.70, p = .32$
Some or completed high school	18.5%	8.9%	23.3%	
Some or completed post-secondary education	65.9%	73.3%	65.8%	
Some or completed graduate school	8.9%	13.3%	6.9%	
Ethnicity				$\chi2(10) = 8.73, p = .56$
White	84.4%	88.9%	84.9%	
Indigenous	0.7%	2.2%	1.4%	

Black/Afro-Caribbean/African	0.0%	0.0%	1.4%
Asian	3.0%	2.2%	0.0%
Biracial/Multiracial	3.7%	2.2%	0.0%
Other	0.7%	0.0%	1.4%

Table 2. Diagnostics

	Non-User (*n* = 135)	Infrequent User (*n* = 45)	Frequent User (*n* = 73)
Principal			
Generalized Anxiety Disorder	28.9%	22.2%	17.8%
Social Anxiety Disorder	17.8%	13.3%	21.9%
Posttraumatic Stress Disorder	13.3%	20.0%	16.4%
Panic Disorder/Agoraphobia	8.9%	6.7%	4.1%
Other (e.g., anxiety and related disorders, mood disorders, personality disorders)	8.9%	4.4%	12.3%

Additional

Major Depressive Disorder	24.4%	17.8%	28.77%
Persistent Depressive Disorder	8.15%	11.1%	23.29%
Generalized Anxiety Disorder	19.26%	15.6%	20.55%
Social Anxiety Disorder	18.52%	17.8%	20.55%
Panic Disorder/Agoraphobia	13.3%	6.7%	20.55%
Other (e.g., anxiety and related disorders, mood disorders, personality disorders)	29.6%	40.0%	52.1%

Note. Principal diagnosis = A mental health condition that is the patient's most pressing concern; Additional diagnosis = Mental health

conditions secondary to the principal diagnosis; Diagnostic data for principal diagnoses were available for 74% ($n = 188$) of individuals

Figure 1. Change in symptom severity (*z*-score) across levels of cannabis use (non-users, infrequent users, and frequent users)
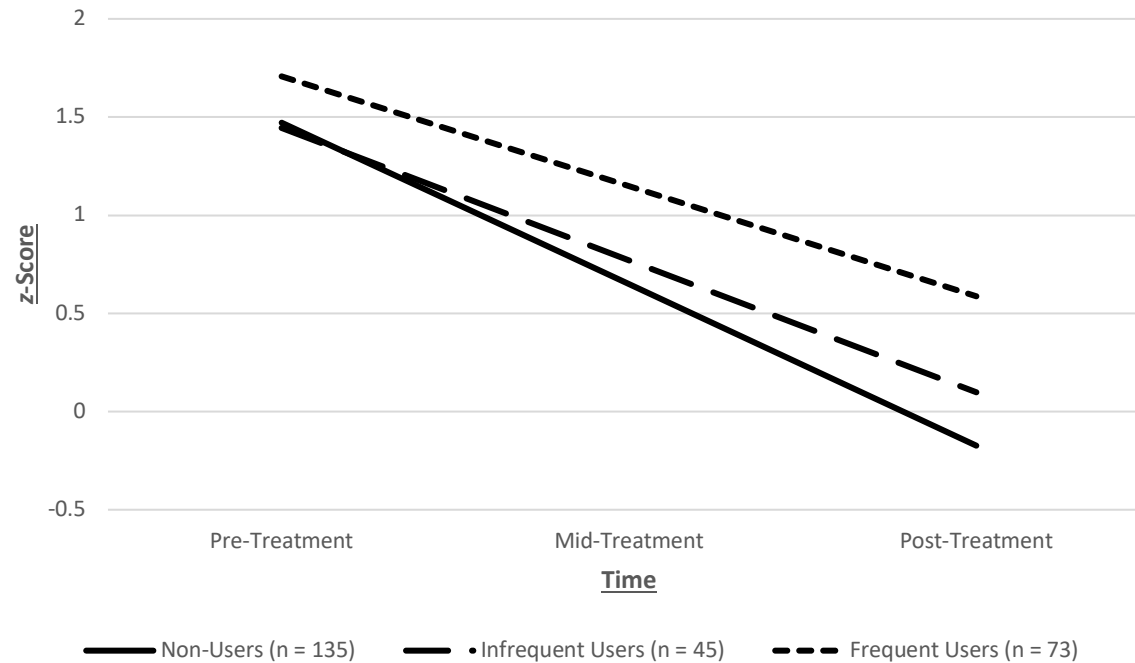
Note. The unit of time is coded as one week, and treatment occurs over the course of 12 weeks, adding pre- and post-treatment for a total of 14 time points. See data analysis section for detail on how *z*-scores were calculated for each diagnostic measure.

Table 3. Results of hierarchical linear modelling assessing the effect of cannabis use status (non-users, infrequent users and frequent users) and problems due to cannabis (CUDIT-R) on trajectory of change in symptom severity (*z*-score) over the course of treatment

	Full Sample z-score					
Effect	*b*	*SE*	*t*	*df*	*p*	*d*
Initial *z*-score (Intercept)	1.47	0.09	15.83	250	<.001	
Infrequent Users	-0.03	0.19	-0.14	250	.886	-0.01
Frequent Users	0.24	0.16	1.49	250	.137	0.09
z-score Over Time (Slope)	-0.13	0.01	-14.74	250	<.001	-0.93
Infrequent Users	0.02	0.02	1.31	250	.190	0.08
Frequent Users	0.04	0.02	2.68	250	.008	0.17
	CUDIT-R in Cannabis Users Only (n = 118)					
Effect	*b*	*SE*	*t*	*df*	*p*	*d*
Initial *z*-score (Intercept)	1.60	0.10	16.15	116	<.001	
CUDIT-R	0.02	0.02	1.43	116	.157	0.13
z-score Over Time (Slope)	-0.09	0.01	-10.86	116	<.001	-1.00
CUDIT-R	0.00	0.00	.15	116	.879	0.01

Table 4. Results of hierarchical linear modelling assessing effect of motives for cannabis use (MMM subscales) on trajectory of change in symptom severity (*z*-score) over the course of treatment.

MMM Coping Subscale						
Effect	*b*	*SE*	*t*	*df*	*p*	*d*
Initial *z*-score (Intercept)	1.10	0.39	2.85	113	.005	
Frequent Users	-0.16	0.48	-0.33	113	.739	-0.03
Coping	0.22	0.23	0.94	113	.348	0.09
Coping X Frequent Users	0.07	0.25	0.27	113	.787	0.02
z-score Over Time (Slope)	-0.09	0.02	-4.42	113	<.001	-0.41
Frequent Users	0.02	0.04	0.49	113	.626	0.05
Coping	-0.01	0.01	-1.13	113	.260	-0.10
Coping X Frequent Users	0.00	0.01	0.26	113	.796	0.02
MMM Social Subscale						
Effect	*b*	*SE*	*t*	*df*	*p*	*d*
Initial *z*-score (Intercept)	1.39	0.36	3.80	113	<.001	

Frequent Users	0.38	0.46	0.82	113	.413	0.08
Social	0.03	0.19	0.19	113	.854	0.02
Social X Frequent Users	-0.07	0.23	-0.29	113	.771	-0.03
z-score Over Time (Slope)	-0.07	0.03	-2.61	113	.010	-0.24
Frequent Users	0.00	0.04	0.08	113	.937	0.01
Social	-0.02	0.01	-1.32	113	.190	0.12
Social X Frequent Users	0.01	0.02	0.48	113	.636	0.04

MMM Enhancement Subscale

Effect	b	SE	t	df	p	d
Initial z-score (Intercept)	1.35	0.36	3.79	113	<.001	
Frequent Users	0.17	0.46	0.37	113	.714	0.03
Enhancement	0.04	0.12	0.34	113	.733	0.03
Enhancement X Frequent Users	0.03	0.16	0.18	113	.857	0.02
z-score Over Time (Slope)	-0.07	0.02	-2.69	113	.008	-0.25
Frequent Users	0.00	0.04	0.00	113	1.00	0.00

Enhancement	-0.02	0.01	-1.69	113	.093	-0.16
Enhancement X Frequent Users	0.01	0.01	0.63	113	.531	0.06

MMM Conformity Subscale

Effect	b	SE	t	df	p	d
Initial *z*-score (Intercept)	1.39	0.52	2.70	113	.008	
Frequent Users	0.10	0.84	0.12	113	.904	0.25
Conformity	0.04	0.42	0.10	113	.919	0.01
Conformity X Frequent Users	0.16	0.74	0.21	113	.831	0.01
z-score Over Time (Slope)	-0.11	0.05	-2.17	113	.032	0.02
Frequent Users	-0.10	0.07	-1.34	113	.182	-0.20
Conformity	0.01	0.04	0.13	113	.895	-0.12
Conformity X Frequent Users	0.10	0.06	1.65	113	.103	0.01

MMM Expansion Subscale

Effect	*b*	*SE*	*t*	*df*	*p*	*d*
Initial *z*-score (Intercept)	1.55	0.29	5.40	113	<.001	
Frequent Users	-0.13	0.39	-0.33	113	.745	0.50
Expansion	-0.08	0.14	-0.58	113	.565	-0.03
Expansion X Frequent Users	0.23	0.19	1.25	113	.214	-0.05
z-score Over Time (Slope)	-0.09	0.02	-3.94	113	<.001	0.12
Frequent Users	0.01	0.03	0.15	113	.885	-0.36
Expansion	-0.01	0.01	-0.61	113	.542	0.01
Expansion X Frequent Users	0.01	0.02	0.51	113	.608	-0.06

Note. The "Frequent Users" variable is dummy coded as 0 = infrequent users and 1 = frequent users; infrequent users is the reference category. MMM = Marijuana Motives Measure.

Table 5. Means and standard deviations of IIRS from pre- to post-treatment across groups

Variable	N	Pre-Treatment		Post-Treatment	
		Mean	*SD*	*Mean*	*SD*
IIRS Total Score					
Non-Users		57.30	15.35	48.99	16.83
Infrequent Users		56.71	12.56	45.29	15.18
Frequent Users		57.25	11.82	53.82	17.75
IIRS Total Score					
Non/Infrequent Users	98	57.15	14.66	48.08	16.45
Users	28	57.25	11.81	53.82	17.75

Note. IIRS = Illness Intrusiveness Rating Scale.

CHAPTER 6: GENERAL CONCLUSIONS

Cannabis use has increased since the legalization of recreational cannabis use in Canada (Rotermann, 2020) and may continue to increase as seen in the United States (Weinberger et al., 2020). Further, individuals with anxiety and related disorders use cannabis at an elevated rate and are at increased risk of problematic cannabis use compared to those with low anxiety (e.g., without clinical diagnoses of anxiety disorders; low state anxiety; Kedzior & Laeber, 2014; Spalletta et al., 2007). Although anxiety and related disorders are some of the most common mental health concerns (e.g., Baxter, Patton, et al., 2013), there has been surprisingly little research conducted on the relationship between clinically significant symptoms of anxiety and cannabis use, as most research has focused on subclinical anxiety samples (e.g., college students/undergraduates; Buckner, Crosby, Silgado et al., 2012; Buckner, Crosby, Wonderlich et al., 2012). Given that cannabis use occurs most commonly among adults with anxiety (e.g., individuals who self-report frequent nervousness; Weinberger et al., 2020) who live where recreational cannabis use is legal, compared to those with low anxiety living where cannabis use is illegal (Weinberger et al., 2020), it is imperative to understand the association between cannabis use and anxiety and related disorders in Canada as there may be important clinical implications. The aim of this body of work was to begin addressing four important questions about the association between cannabis use and anxiety and related disorders. The goal in answering these questions was to begin elucidating the role of cannabis use in this population, add to the growing literature on this topic, and consider the related clinical implications.

1.0 Study 1: How do individuals with anxiety and related disorders use cannabis?

The purpose of Study 1 was to describe the patterns of cannabis use in individuals seeking treatment for anxiety disorders and related disorders (e.g., proportion of patients having recently used cannabis, frequency and amount of cannabis used, examine Cannabis Use Disorder; CUD symptoms and if they correlate with measures of psychological distress). The results of Study 1 suggested that cannabis use is common among individuals seeking anxiety and related disorder mental health services, and occurred primarily via smoking joints (vs other forms of cannabis and methods of consumption such as smoking via a bong, using blunts, or edibles). CUD symptoms were also positively associated with various indicators of psychological distress (e.g., stress, depression, anxiety). These results provide a broad overview of patterns of cannabis use in individuals seeking anxiety and related disorder mental health services and the high prevalence highlights the need for further investigations into the various factors involved in the association between cannabis use and clinical anxiety.

1.1 Study 2: What are the motives for cannabis use in individuals with anxiety and related disorders?

The purpose of Study 2 was to examine motives for cannabis use in individuals with anxiety and related disorders. Five motives have been identified in the literature: coping (i.e., use to manage distress), enhancement (i.e., use for fun or for the feeling), expansion (i.e., use to change one's thinking), social (i.e., use for social gatherings), and conformity (i.e., use due to peer pressure; Benschop et al., 2015; Simons et al., 1998; Zvolensky et al., 2007). Given that the findings of Study 1 suggested an association between psychological distress and CUD symptoms, it was hypothesized that coping motives for cannabis use in individuals with anxiety

and related disorders would be more strongly endorsed as opposed to social, expansion, enhancement, or conformity motives—in-line with the tension reduction model (Conger, 1956; Greeley & Oei, 1999). Partially in-line with our hypothesis, cannabis-using individuals with anxiety and related disorders endorsed coping and enhancement motives most often compared to all other motives. Additionally, frequent users (i.e., using 2 times a week or more) reported using cannabis for coping and expansion motives significantly more than did infrequent users (i.e., using monthly or less to 2-4 times a month). These results suggest that individuals with anxiety and related disorders use cannabis for various reasons, some of which may be associated with their mental health symptoms and others may not. These findings raise additional questions for future research about how motives for cannabis use may vary across specific anxiety and related disorders, as well as to the general population of cannabis users (i.e., those without anxiety and related disorders).

1.2 Study 3: Are marijuana use patterns in this population temporally associated with anxiety symptoms?

Given that coping motives were some of the most commonly reported reasons for use among cannabis users, especially frequent users, Study 3 aimed to examine the temporal association between marijuana use (i.e., dried cannabis plant material) and anxiety symptoms using a longitudinal research design (i.e., experience sampling method) in frequent users. It was hypothesized that heightened anxiety, worry, and negative affect at an earlier time would be associated with marijuana use at a subsequent time point. Secondarily, exploratory analyses were conducted examining the temporal associations between marijuana craving, anxiety, worry, and marijuana use. Partially in-line with our hypothesis, the findings suggested that earlier worry, but

not anxiety or negative affect, was associated with increased likelihood of later marijuana use, however no change in worry following marijuana use was observed. Marijuana craving also appeared to play an important role in the experience of anxiety and worry; however craving was surprisingly not temporally predictive of marijuana use. Taken together, these findings extended the findings of Study 3, suggesting that marijuana may be partially used to manage worry specifically, although it does not appear to be an effective worry management strategy in over time.

1.4 Study 4: Does cannabis use impact anxiety and related disorder psychological treatment outcomes?

Study 4 aimed to investigate whether there is an impact of cannabis use on cognitive behavioural therapy (CBT) outcomes for anxiety and related disorders. This was one of the first studies to examine the relationship between various measures of cannabis use/misuse and CBT outcomes for anxiety and related disorders. It was hypothesized that cannabis use frequency and CUD symptom severity would be associated with dampened CBT outcomes. The results suggested that frequent cannabis use, but not CUD symptoms, was associated with significantly dampened CBT outcomes compared to CBT outcomes in non-users. Despite the dampened response in frequent users, both frequent and infrequent cannabis users experienced a significant reduction in clinical anxiety and related disorder symptoms from pre- to post-treatment. These findings suggest an association between cannabis use and CBT outcomes; however the mechanism driving this association remains an area of future research as it was beyond the scope of the study. Additionally, these findings raise other interesting questions to be examined with future research such as possible differences in CBT outcomes across disorder-specific CBT

groups.

2.0 Clinical implications

Taken together, the current findings have important clinical implications related to assessment and intervention for individuals who use cannabis and are seeking anxiety and related disorder services. Given that the findings from Study 1 suggested that cannabis is used at an elevated rate in those seeking anxiety and related disorder services (Ouellette et al., 2019) and Study 4 suggested that high frequency of cannabis use is associated with dampened CBT outcomes for anxiety and related disorders, clinicians should consider screening for cannabis use patterns in individuals seeking anxiety and related disorder mental health services. Screening for cannabis use, rather than CUD only, may allow clinicians to identify individuals at risk of experiencing dampened CBT outcomes for anxiety and related disorders. With an understanding of individual cannabis use patterns, clinicians can tailor treatment plans accordingly to optimize outcomes. For example, frequent cannabis users may benefit from an intervention to reduce their cannabis use prior to beginning CBT for anxiety and related disorders to optimize CBT's effectiveness. Alternatively, clinicians can take an informed consent approach when recommending CBT for anxiety and related disorders to frequent cannabis users, explaining that frequent cannabis use may be associated with dampened CBT outcomes compared to non-users, however they are still likely to experience significant improvement in their anxiety symptoms from pre- to post-treatment. This is an important treatment option for individuals who may not want to reduce or eliminate their cannabis use for various reasons (e.g., positive beliefs about cannabis use; Holm et al., 2016), but are interested in reducing their anxiety symptoms.

Further, Study 2 demonstrated that individuals with anxiety and related disorders use cannabis for various reasons, therefore screening for cannabis use motives would be valuable in determining appropriate psychological interventions. For example, clinicians may want to include specific CBT skills to address cannabis use as a coping behaviour for anxiety or integrate interventions for anxiety and cannabis use (Buckner et al., 2019). They may also determine that the cannabis use is not problematic (e.g., using infrequently for reasons unrelated to their anxiety and related disorder symptoms) and does not require intervention. Study 3 further suggested that worry may play an important role in perpetuating marijuana use in frequent marijuana users who have an anxiety or related disorder, and therefore assessing the nature of these worries may be important to intervene effectively. For example, there may be worries related to their anxiety or related disorders, and to experiencing marijuana withdrawal symptoms, which may need to be specifically addressed in treatment. Additionally, clinicians may consider informing patients that marijuana use has been found not to be associated with sustained reduction in worry. This could be explored in therapy using behavioural experiments (see Bennett-Levy et al., 2004) where marijuana use could be compared to other anxiety coping strategies to see which approaches lead to optimal immediate *and* longer-term worry management.

In summary, the current findings have notable clinical implications. Upon replication of the findings, clinicians working with this population should consider screening for cannabis use, aim to understand motives for cannabis use, and assess whether there is an association between their anxiety symptoms (e.g., worries) and cannabis use patterns. They can then use this information to develop appropriate treatment plans to optimize outcomes.

3.0 Limitations and future directions

Although these studies have provided important insights on the role of cannabis use in anxiety and related disorders, the results should be interpreted within the context of methodological limitations. First, throughout the cannabis literature and the studies included in the current body of work, measuring cannabis use accurately and comprehensively has been challenging (Loflin et al., 2020; Tomko et al., 2019). Cannabis use is highly individualized as there are several varying factors involved in cannabis consumption (e.g., product(s) used, method of consumption, amount consumed, frequency of use, THC:CBD concentrations, and medical or recreational cannabis use; Freeman & Winstock, 2015; Goodman et al., 2020). Measuring and controlling for these variables is a significant challenge faced by the field, which also prevents direct comparisons between studies due to varying inclusion criteria or definitions of cannabis users across studies. Although self-report and biological measures of cannabis use exist, there are significant challenges with available measurement options (see Loflin et al. 2020). In the current body of work, some inconsistencies in self-reported cannabis use were anecdotally observed within participants, supporting the challenging nature of quantifying cannabis use. Future research should attempt to implement cannabis use assessment toolkits combining various measures (e.g., self-report measures, interviews, biological measures) tailored to the population and research question of interest, as well as evaluate how to best address measurement challenges (Loflin et al., 2020; Lorenzetti et al., 2021).

Secondly, there is a lack of research examining cannabis use in specific anxiety and related disorders. Although the current body of work focused on mixed anxiety and related disorders samples which provided a broad perspective of the role of cannabis use in anxiety and related disorders, sample sizes were generally not large enough to compare between principal diagnostic groups. Given that the rate of co-occurrence of cannabis dependence varies across

anxiety and related disorders (Agosti et al., 2002) and that individuals with different anxiety disorders may use cannabis differently (e.g., to manage different symptoms; Bonn-Miller et al., 2014; Buckner, Ecker, et al., 2013; Metrik et al., 2016), it will be important for future studies to examine patterns of cannabis use, motives for cannabis use, the temporal relationships between cannabis use and anxiety, and the impact of cannabis use on CBT outcomes for specific anxiety and related disorders. There may be unique clinical consideration for certain diagnostic groups if results differ substantially between them, however given the elevated rate of co-occurring diagnoses in this population, it may be challenging to observe differences and would likely be less ecologically valid.

Thirdly, the aim of the current body of work was to broadly begin addressing the role of cannabis use in anxiety and related disorders, and therefore, specific mechanisms driving the results were not examined. As such, it is important to avoid overinterpreting the current results. For example, although Study 4 (Chapter 5) showed that frequent cannabis use was associated with dampened CBT outcomes compared to non-users, it remains unclear whether there is a causal relationship between frequency of cannabis use and CBT outcomes as there are several possible mechanisms and variables involved in this finding (e.g., cognitive impact of cannabis use, homework completion, cannabis use as a subtle avoidance strategy, etc.),which warrant further investigation. A better understanding of the mechanisms and variables driving these results would improve clinicians' ability to remediate possible adverse effects associated with cannabis use.

4.0 General conclusions

In summary, the current findings suggest that cannabis use does play a role in perpetuating anxiety and related disorder symptoms. In-line with the aim of this body of work, the results specifically contribute to our understanding of the association between cannabis use and anxiety and related disorders and brings forth important clinical implications. Although questions remain regarding the nuanced relationship between cannabis use and anxiety, and methodological challenges have thus far limited our understanding of this relationship, the findings provide a starting point for further investigations into the role of cannabis use in anxiety and related disorders. Replication of the current findings and an improved understanding of the factors involved in the relationships between cannabis use and anxiety and related disorders will enrich the current findings, on which clinicians could base their standards of care for this growing population.

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