THE INTERACTION BETWEEN FREQUENCY OF CANNABIS USE AND METHOD OF DELIVERY IN PREDICTING LACK OF INTEREST IN EATING

by

Joanne L. Pomeroy

Liberty University

A Dissertation Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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ABSTRACT

Cannabis use, its benefits, and adverse effects are being increasingly studied due to the abundance of existing dispensaries created under recreational and legalization policies. While research is inconclusive, an established association exists between increased cannabis concentration and anorexigenic properties. This study examines the interaction between the frequency of cannabis use and the method of delivery in predicting the lack of interest subtype of Avoidant/Restrictive Food Intake Disorder (ARFID) in emerging adults. Cannabis use was measured by the Cannabis Engagement Assessment (CES). The Generalized Anxiety Disorder Scale-7 (GAD-7) was used to measure anxiety, and the Pica, ARFID, and Rumination Disorder Questionnaire (PARDI-AR-Q 14+) measured restrictive eating disorder symptoms. Cannabis use was measured by self-reported frequency of usage and method of consumption. Anxiety and eating disorder symptoms were measured by self-reported total scores. The sample included 83 participants, ranging in age from 18 – 25. Data analysis was conducted for all variables using a factorial ANOVA to identify interactions, with an alpha level of .05. There was no evidence to conclude that the method of cannabis delivery was able to predict ARFID symptoms in emerging adults.

Keywords: cannabis, THC, potency, restrictive eating, ARFID

Dedication

For my mom; I wish you were here to see the end of my journey. For Dan, Emma, and Ava; You are my inspiration, and I could not have done this without your sacrifice, love, and encouragement.

Acknowledgments

My thanks and appreciation extend to the many professors who have contributed to my academic achievements. Special thanks and gratitude go to my dissertation chair, Dr. Cari Oliver, and committee member, Dr. Florin Coltea, for their unwavering support and guidance, both academically and spiritually.

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CHAPTER 1: INTRODUCTION TO THE STUDY

Introduction

In recent years, the legalization of cannabis for medicinal and recreational purposes in some states across the country has elicited a change in societal perceptions, with many viewing cannabis as recreationally harmless and a medically acceptable means of treating several disorders, including chronic pain and anxiety. While the list of medicinally approved conditions for cannabis consumption continues to grow, so does research that highlights its adverse effects. Complicating research findings are the variability in cannabis concentrations and methods of consumption. Newer concentrates for cannabis vaporization contain exceptionally high concentrations of delta-9-tetrahydrocannabinol (THC) and allow for repeated self-administration. This confounds available information about the effectiveness of cannabis treatment and the extent of any reported adverse effects.

While much of the research on the adverse effects of cannabis focuses on substance use disorders and the exacerbation of existing mental health conditions, less is known about its relationship with appetite and symptoms of restrictive eating disorders. This dissertation seeks to unravel a potential interaction between the frequency of cannabis use and method of delivery on symptoms of Avoidant/Restrictive Food Intake Disorder (ARFID).

Background

Cannabis legalization for medicinal and recreational purposes opens viable treatment options for conditions such as chronic pain and anxiety. However, research supporting its effectiveness is limited by the availability of accurate cannabis concentrations, limiting findings, and implicating dose dependency (Purcell et al., 2022; Rock & Parker, 2020). Nevertheless,

cannabis is becoming increasingly attractive to adolescents and emerging adults due to its variety of consumption methods and decreased risk perception (Hill et al., 2022). Present-day THC concentrations available in edibles and vaporized cannabis oils are as high as 95% (Sabet, 2021; Stuyt, 2019). These elevated concentrations are believed to have reinforcing properties that encourage repeated self-administration and conditioned reward-seeking behavior (Freels et al., 2020). College students report cannabis vaporization at higher rates than young adults, citing its convenience, discreetness, and instant gratification (McKenzie et al., 2022). It is reported as the preferred method of cannabis use, followed by the oral ingestion of edibles and smoked cannabis (Turna et al., 2019).

Corresponding with the higher concentrations of THC are increased reports of adverse effects. Higher concentrations have been associated with neurocognitive impairments, anxiety, depression, psychosis, and dependence (Cuttler et al., 2023). Traditionally, cannabis has produced hyperphagic and orexigenic effects. However, the increased THC in cannabis concentrates used for vaporization is associated with hypophagic and anorexigenic effects (Farokhnia et al., 2020; Keung et al., 2023). The potency of cannabis concentrates has also been associated with increased frequency of usage (Cuttler et al., 2023), creating an impending cyclic rotation of increased cannabis use and decreased appetite and food intake. While directionality cannot be implied at this time, products containing higher THC concentrations have been associated with increased cannabis usage (Prince & Connor, 2019).

College students not only report increased cannabis use by method of vaporization, but they are also at an increased risk for eating disorders (Maynard et al., 2023). ARFID is characterized by significant weight loss, nutritional deficiency, and dependence on nutrition supplementation without the concern of body weight or shape (Cañas et al., 2020). While it was

once almost exclusively diagnosed in young children as a pediatric feeding disorder, it is currently an acceptable diagnosis for adolescents and adults (Bryant-Waugh, 2019).

Of clinical concern is the exposure of a substance with scarce regulation, portrayed as harmless and trendy, to the vulnerable population of emerging adults. This population is already at significant risk for the comorbid development of eating disorders and recreational drug use (Ganson et al., 2021), and the anorexigenic effects associated with higher THC concentrations (Keung et al., 2023) necessitate further research.

The cyclic impact of cannabis consumption by method of vaporization, its increased frequency of use, and the observed hypophagic and anorexigenic effects should be further explored to understand if the clinical symptoms of ARFID are manifesting as adverse effects of chronic cannabis vaporization, leading to ARFID being underdiagnosed.

In the subsequent chapters, this dissertation will delve into a detailed review of the implications for clinical practice and legislative policy. By exploring the relationship between cannabis use by method of vaporization and ARFID, this research contributes valuable insights that can inform interventions, destigmatize misconceptions, and foster a more holistic understanding of the mental health implications associated with contemporary cannabis use patterns.

This research is also rooted in biblical foundations. The Bible teaches many principles, including self-control and avoiding excess. It also advocates for sobriety and clear-mindedness. These principles can be applied to research investigating the loss of control associated with addiction and dependence, which impairs judgment and mental faculties. Encouraging compassion and redemption, the Bible offers hope and transformation that can be implemented in the clinical treatment of cannabis dependence and ARFID.

Problem Statement

Between legalization and medical dispensaries, cannabis is increasingly readily available to young and emerging adults. Safety concerns are developing over its increased potency and the lack of legislation controlling cannabis regulation (Hill et al., 2022). Cannabis legalization may help promote recreational use by decreasing risk perception, even as the risk for adverse outcomes increases (Hill et al., 2022).

Adverse effects of cannabis are associated with higher concentrations of THC, including neurocognitive impairments, anxiety, depression, psychosis, and dependence (Cuttler et al., 2023). Higher concentrations of THC are also believed to have reinforcing properties that encourage repeated self-administration and conditioned reward-seeking behavior (Freels et al., 2020). With college students reporting using the highly concentrated delivery method of cannabis vaporization at higher rates than young adults (McKenzie et al., 2022), increased awareness of potential adverse effects is critical in this population.

What is less known among this population is the association between the frequency and method of cannabis consumption and its effect on appetite. Due to the transition from adolescence to adulthood, college years pose a significant risk for the comorbid development of eating disorders and recreational drug use (Ganson et al., 2021; Maynard et al., 2023; Tavolacci et al., 2020). Although THC has orexigenic effects in low doses, it has been found to cause anorexigenic effects in higher doses (Farokhnia et al., 2020; Keung et al., 2023). It is of great interest to see if the anorexigenic effects of frequent use of highly concentrated THC by the method of vaporization are related to the potential development of what could be clinically classified as an eating disorder, specifically the lack of interest subtype of ARFID.

ARFID leads to significant weight loss, malnutrition, nutrition supplementation, dependence, and psychosocial functioning interference (Nitsch et al., 2023). Therefore, identifying a relationship between ARFID and the frequency of cannabis usage and the method of delivery may significantly improve the physical and mental health outcomes of emerging adults.

Purpose of the Study

The purpose of this quantitative correlational study is to examine the main effects and interaction between the frequency of cannabis use and the method of delivery on restrictive eating disorder symptoms in emerging adults.

Research Questions and Hypotheses

Research Questions

RQ1: Is more frequent cannabis use associated with a lack of interest in eating?

RQ 2: Is the method of cannabis consumption associated with a lack of interest in eating?

RQ 3: Is there an interaction between the frequency of cannabis consumption and the method of cannabis consumption predicting a lack of interest in eating?

Hypotheses

Hypothesis 1: It is hypothesized that more frequent cannabis use will be associated with increased symptoms of lack of interest in eating.

Hypothesis 2: It is hypothesized that cannabis consumption by method of vaporization will be associated with increased symptoms of lack of interest in eating.

Hypothesis 3: It is hypothesized that an interaction will be observed between the frequency of cannabis consumption and consumption by method of vaporization, predicting a lack of interest in eating.

Assumptions and Limitations of the Study

The assumptions for the current study are restricted. While typically, it can be assumed that participants will provide honest answers, truthfulness may be compromised due to the sensitive nature of the questions, making this a limitation.

Several limitations of this study should be mentioned. First, it should be addressed that the author has a previous personal experience with the research topic. However, rigorous criteria will be implemented across all study parameters to control for researcher bias. Next, as previously mentioned, even though it ensures confidentiality, the sensitive content of the study may compromise honesty. The survey questions regarding cannabis usage and eating habits may elicit uncomfortable emotions that could interfere with an honest response, or participants may lack awareness that the situation is applicable to them. Due to time constraints, social trends also limit the study as the survey was only available during a four-week period, and incomplete responses can lead to data skewing. All of these factors could affect the validity and reliability of the results. Generalizability is another concern. The use of convenience sampling limits generalizability to undergraduate college students. Additionally, due to the anonymity of the survey, the authenticity of responses cannot be validated. Lastly, the study lacks a manipulated variable and random assignment, limiting conclusions and eliminating any potential causal

relationship implications. Future research should focus on longitudinal data and true manipulation of variables in order to establish a more casual relationship.

Theoretical Foundations of the Study

While no extant research theory coincides with the variables being examined in the current study, it will be approached from a psychobiological perspective. Considering that cannabis use disrupts homeostasis and alters the hypothalamic-pituitary-adrenal (HPA) axis (Parrott et al., 2017), potentially leading to dysregulated stress responses, allostatic load, and abnormal behavioral coping strategies (Kinlein et al., 2015), it is theorized that increased HPA activation by means of chronic cannabis use affects food intake by producing anorexigenic effects.

This theory can also work within a biblical framework. The Bible speaks of addiction and overindulgence, which are discouraged. The Bible also discusses moderation and self-control. Chronic exposure to addictive substances, or overindulgence, can disrupt the HPA axis, impairing self-control mechanisms. This is not to imply that man does not have free will; the Fall ensured our sinful nature and the vulnerability and susceptibility to behaviors that lead to addiction.

Definition of Terms

The following is a list of definitions of terms that are used in this study.

Anorexia Nervosa (AN) – An eating disorder characterized by restrictive eating and malnutrition, motivated by extreme fear of weight gain and concerns over body weight or shape (Becker et al., 2021).

Anorexigenic – Appetite suppressing (Becker et al., 2021).

Anxiogenic – Producing anxiety (Shalit & Lev-Ran, 2020).

Anxiolytic – Relieving anxiety (Shalit & Lev-Ran, 2020).

Avoidant/Restrictive Food Intake Disorder (ARFID) – An eating disorder characterized by restrictive eating and malnutrition, motivated by food sensitivity, disinterest, or phobia without concerns over body weight or shape (Becker et al., 2021).

Lack of Interest in Eating – A subtype of ARFID.

Delta-9-tetrahydrocannabinol (THC) – The primary psychoactive component in cannabis (Turna et al., 2019).

Endocannabinoid System (ECS) – A biological system that helps regulate physiological conditions in the body, such as balance, energy, and appetite stimulation (Lu & Mackie, 2016).

Hyperphagia – Increased appetite and food intake (Erlbacher & Minnich, 2017).

Hypophagia – Reduced appetite and food intake (Erlbacher & Minnich, 2017).

Hypothalamic-pituitary-adrenal (HPA) axis – The body's primary stress response system (Cservenka et al., 2018).

Orexigenic – Appetite stimulating (Becker et al., 2021).

Significance of the Study

The higher concentrations of THC detected in current cannabis products are of increasing concern due to their availability to emerging adults and the many adverse consequences associated with their physical and mental health. Cannabis vaporization is the preferred method of delivery for college students (McKenzie et al., 2022) at a time when anxiety and eating disorder diagnoses are increasing among this population (Ganson et al., 2021; Maynard et al.,

2023; Tavolacci et al., 2020). Vaporizing cannabis is thought to encourage and reinforce repeated self-administration (Freels et al., 2020), with anxiogenic and anorexigenic effects observed in higher doses (Farokhnia et al., 2020; Keung et al., 2023). Therefore, it is necessary to identify any existing interactions between cannabis vaporization and frequency of use and its effect on restrictive eating disorder symptoms to ensure the health and well-being of emerging adults.

This research also has practical applications. If an interaction is observed, it may help shift the focus to legislation and the importance of regulating the concentration of THC produced and sold medically and recreationally.

Summary

With the increased reports of anxiety and restrictive eating disorders among emerging adults and the accessibility to higher concentrations of THC, further research is necessary to identify a potential interaction between cannabis frequency and method of delivery on restrictive eating disorder symptoms. While research remains mixed surrounding cannabis and its beneficial versus adverse properties, this is the first known study to explore cannabis frequency of use and cannabis consumption by method of vaporization and its direct effect on the lack of interest subtype of Avoidant/Restrictive Food Intake Disorder.

CHAPTER 2: LITERATURE REVIEW

Overview

Between legalization for medicinal and recreational purposes, the variability and accessibility of cannabis are readily available to emerging adults. Current research on cannabis effectiveness and adverse outcomes is mixed; however, significant associations have been established between higher concentrations of THC and increased levels of anxiety and psychotic features. This chapter will attempt to illustrate that the benefits of cannabis are dose-dependent, with higher concentrations of THC predicting more substantial deficits in cognitive functioning and mental health. It will also demonstrate that due to its high THC concentration, cannabis consumption by vaporization puts users at an increased risk of experiencing adverse effects.

A topic that has not been widely discussed is the potential relationship between cannabis consumption by method of vaporization and a reduction in appetite. This chapter will identify research findings that associate highly concentrated THC with anorexigenic symptoms, potentially linking cannabis consumption by method of vaporization to symptoms of Avoidant/Restrictive Food Intake Disorder (ARFID) in emerging adults.

Description of Search Strategy

The databases utilized for the literature search strategy included peer-reviewed literature accessed through Google Scholar and multiple search engines (APA PsycNet, EBSCO, Wiley Online Library, PsycINFO, PubMed, PubMed Central, ScienceDirect, and Wiley Online Library) available in the Jerry Falwell Library at Liberty University. Literature was acquired through search terms, including “cannabis and emerging adults,” “ARFID and cannabis potency,” “ARFID and cannabis frequency,” “cannabis potency,” “methods of cannabis consumption,”

high versus low THC," "benefits of medical marijuana," "adverse effects of cannabis," "cannabis and brain alterations," "addiction hormones," and "appetite hormones." Additional literature was obtained from reference sections in existing literature. The only delimitations placed on the search strategy were articles older than ten years. Biblical research was conducted through Google Scholar, and a word study was employed on the Bible Gateway database. Search terms on both sites included "cannabis in the Bible," "addiction and the Bible," "overindulgence and the Bible, and "the Bible and mental health.

Review of Literature

With the increased availability of cannabis accessible to young adults through legalization or medical dispensaries, concerns are growing over its safety and the lack of legislation controlling cannabis regulation and concentration (Hill et al., 2022; Johnson et al., 2023; Keung et al., 2023). Dronabinol and nabilone are prescription synthetic pill forms of THC and have been approved by the U.S. Food and Drug Administration (FDA) to treat chemotherapy-related nausea and vomiting and to stimulate appetite in cancer patients and those with acquired immunodeficiency syndrome (AIDS) (Erlbacher & Minnich, 2017; Santos et al., 2020). The FDA has not found therapeutic advantages for other forms of cannabis to treat additional conditions (Hill et al., 2022).

However, cannabis remains the most frequently used illicit drug worldwide (Caldeira et al., 2012; Cservenka et al., 2018). The National Institute on Drug Abuse (NIDA) reports that as of 2022, 30.7% of high school seniors reported previous past-year cannabis use, with 6.3% reporting daily use (NIDA, 2020). Legalization may help promote recreational use by decreasing risk perception, even as the risk for adverse outcomes increases (Hill et al., 2022).

Medicinally, cannabis has been used to effectively treat chronic pain (Moreno-Sanz et al., 2022; Rock & Parker, 2020), anxiety (Moreno-Sanz et al., 2022; Sachedina et al., 2022), depression (Martin et al., 2021; Sachedina et al., 2022), stress (Glodosky et al., 2021), and anorexia nervosa (Andries et al., 2013; Rosager et al., 2020). Chronic pain, anxiety, and depression were the most frequent conditions reported when applying for medical cannabis certification, with strong, self-reported efficacy (Glodosky et al., 2021; Mahabir et al., 2020; Sexton et al., 2016).

While cannabis has anxiolytic and orexigenic, or appetite-stimulating, properties, research on its effectiveness in therapeutic settings has mainly focused on controlled doses, implicating dose-dependent effects (Turna et al., 2017; Turna et al., 2019). The risk of adverse effects increases with higher cannabis concentrations and include anxiety, depression, psychosis, hypophagia, neurocognitive impairments, and dependence (Caldeira et al., 2012; Cuttler et al., 2023; Erlbacher & Minnich, 2017; Freeman & Winstock, 2015; NIDA, 2022; Pierre, 2017; Sultan et al., 2023; Turna et al., 2017).

As cannabis is increasingly legalized for recreational and medicinal purposes at the State level, it remains illegal at the Federal level, classified as a Schedule I drug under the Controlled Substances Act. Schedule I drugs have a high potential for abuse and lack currently recognized medical use or safety guidelines for use under medical supervision (Purcell et al., 2022). The classification of cannabis as a Schedule I drug has hindered research in several ways. First, researchers are faced with a highly rigorous application process for cannabis research that is overseen by the Drug Enforcement Agency (DEA) (Purcell et al., 2022). Although recently amended, the National Center for Natural Products Research (NCNPR) at the University of Mississippi has been the only federally contracted source for the production and distribution of

cannabis available for research in the United States. New policy changes have increased the maximum concentration of delta-9-tetrahydrocannabinol (THC), the primary psychoactive compound in cannabis, to 12%, facilitated the pathway for additional growers, and eased restrictions for research applications. However, due to the existing high concentrations of THC and the variety of strains, it has been argued that the cannabis available for research does not contain the pharmacologic properties currently available to patients and consumers, therefore limiting research data (Purcell et al., 2022).

Public health concerns are growing over the adverse effects associated with THC concentration, including decreased cognitive abilities, increased anxiety, a higher risk of depressive and psychotic episodes, and substance use disorders. Also, emergency room visits for cases involving cannabinoid hyperemesis syndrome are rising. These factors are leading to increased research interest and calls for establishing state and federal regulations (Purcell et al., 2022).

Cannabis

Effective Medicinal Treatment

While qualifying conditions vary state-by-state, chronic pain, anxiety, and depression were the medical conditions most reported for the acquisition of medical cannabis (Mahabir et al., 2020). However, in low doses of five to ten milligrams, THC has been reported to be effective in reducing acute, chronic, and neuropathic pain and tics associated with Tourette's syndrome. In five-milligram doses, THC has also been shown to eliminate nightmares and improve sleep in veterans with post-traumatic stress disorder (PTSD) (Rock & Parker, 2020). In longitudinal research, when compared to non-using controls, medicinal cannabis users reported

significant decreases in depressive and anxiety symptoms and significant increases in sleep and quality of life when using low doses of THC (Martin et al., 2019).

Daily cannabis use was perceived to produce positive outcomes, with symptoms of anxiety and depression being positively associated with the amount of cannabis used per day, without any perceived impairment or inability to control use (Turna et al., 2019). Considering it has been reported that 40-60% of those with chronic anxiety conditions who have been treated with psychopharmacology and Cognitive Behavior Therapy (CBT) display residual impairment and medication noncompliance, the anxiolytic effects of medicinal cannabis may prove to be more beneficial (Turna et al., 2019).

However, while research has found that the majority of medicinal cannabis users reported improvement in anxiety and depressive symptoms, results of self-reported tools of measurement indicate a continuing moderate-level symptom severity, with a significant amount reporting cannabis substitution for prescription psychiatric medication (Turna et al., 2019). Cannabis self-medication occurs when cannabis is used to reduce psychological and physical distress (Wallis et al., 2022). In a survey conducted among college students, 76% reported self-medicating with cannabis to reduce symptoms of anxiety, depression, and loneliness and to increase sleep and concentration. Cannabis self-medication is highly unregulated and is a significant risk factor for cannabis use disorder (CUD) (Wallis et al., 2022).

When moderated by a physician, THC can be effective in treating anorexia nervosa (AN). When women with severe AN were provided a 5 mg daily dose of dronabinol, an FDA-approved synthetic prescription cannabinoid, they presented with more weight gain than those in the placebo group (Andries et al., 2013). However, higher doses produced higher incidences of negative psychotropic effects, suggesting that THC is dose-dependent (Andries et al., 2013).

The endocannabinoid system (ECS) is a biological system that is important to central nervous system (CNS) development and helps regulate physiological conditions, such as energy, balance, and appetite stimulation, in the body (Lu & Mackie, 2016). Considering that the ECS is implicated in the physiology of food-related rewards, it is suggested that low doses of THC may improve the psychological symptoms associated with AN prior to weight gain (Avraham et al., 2017).

Patients receiving medicinal cannabis have self-reported improvement in anxiety and restrictive eating disorder symptoms, such as increased appetite and social consumption of food (Sinclair, 2021). However, there is no research or evidence indicating that cannabis is an effective treatment for restrictive eating disorder symptoms. Instead, it is suggested that it may interfere with psychotherapeutic interventions (Thomas & Eddy, 2018).

While the effectiveness of THC appears to be dose-dependent, with low doses producing more desirable effects (Rock & Parker, 2020), improvements may also be affected by cannabidiol (CBD), the non-psychoactive compound found in cannabis. With its anxiolytic properties, lack of cognitive impairment, and absence of abuse potential, CBD may result in better therapeutic outcomes (Martin et al., 2021). Comparing medicinal and recreational cannabis users in existing clinically anxious and depressed populations, symptoms were reduced in medicinal users who used products dominant in CBD with minimal THC (Martin et al., 2021).

Potency and Dose-Related Effects

The average potency of the cannabis flower was close to 3% in the 1970's. Currently, it is close to 20%. Over the years, THC has increased from 8.9% in 2008 to 17.1% in 2017 in the cannabis flower (Sabet, 2021). It is believed that market demand and a change in consumption

methods have led to this increased potency and new forms of cannabis, such as concentrates (Sabet, 2021). Between 2014 and 2016, cannabis concentrate sales increased by 146%, while cannabis flower sales decreased by 22% over the same period (Cuttler et al., 2023).

Newer cannabis concentrates, such as vaping oils, edibles, and "dabs," contain up to 95% THC (Sabet, 2021; Stuyt, 2019). Concentrates are produced by extracting cannabinoids from the cannabis plant, using solvent-based methods, such as liquid butane, or solventless-based methods, such as ice (Bidwell et al., 2021). Both of the methods isolate THC from the natural plant while increasing the potency of the THC. These concentrates can be consumed orally, in the form of edibles or sublingual oil tinctures (Sabet, 2021), or by vaporizing oils or dabs, the most common method of consumption (Bidwell et al., 2021). In vaporization, the use of a heating element to maintain and control temperature protects the integrity of the oil-based THC and increases potency (Bidwell et al., 2021). The convenience and concealability of vape pens also make this method of consumption popular (McKenzie et al., 2022).

Non-regulated synthetic cannabinoids are of increasing concern. Labeled as Novel Psychoactive Substances (NPS), they are advertised as legal hallucinogens and legal cannabis substitutes and can be purchased at retail shops or gas stations (Hervás, 2017). These synthetic compounds do not contain cannabis but are a mixture of herbs sprayed with chemical solvents, such as acetone or methanol. They mimic the effects of THC and are sold under brand names such as Spice and K2 (Hervás, 2017). Synthetic cannabinoids present a greater risk of acute psychotic episodes, and their users are more frequently diagnosed with psychotic disorders when compared to natural cannabis users (Cohen & Weinstein, 2018). Due to their chemical solvents, they are significantly more hazardous and pose greater health risks than natural cannabis (Hervás, 2017).

In contrast to low-potency THC, higher concentrations have been associated with anxiogenic effects and may put cannabis users at an increased risk of dependence and lead to poorer mental health outcomes (Petrilli et al., 2023; Pierre et al., 2016; Rock & Parker, 2020). When compared to other methods of cannabis consumption, concentrate consumption is more likely to be associated with the diagnosis of a psychological disorder (Cuttler et al., 2023). Concentrate consumption has also been associated with an increased frequency of usage, younger age of onset, and increased tolerance (Cuttler et al., 2023).

THC has been found to mitigate the negative emotional responses and duration of acute psychosocial stress in low doses. However, in higher doses, negative mood, subjective distress, and anxiety increased (Childs et al., 2017). In adolescents reporting cannabis use during the previous year, high-potency cannabis was associated with a significant increase in the frequency of cannabis use and an increase in depressive and anxiety disorders (Hines et al., 2020). It is unclear if high-potency THC leads to increased frequency of usage or if the tolerance effects in increased frequency of usage lead to using higher concentrations of THC (Hines et al., 2020). Regardless, more frequent cannabis usage was associated with products containing higher concentrations of THC (Prince & Conner, 2019). However, at the time, there was no observed association between THC concentration and cannabis use disorder (Prince & Connor, 2019).

Adverse outcomes, such as dependence and increased risk of psychosis, appear to increase according to cannabis dose and potency. Although concentrates can be self-titrated, fewer inhalations are required to achieve reported equivalent levels of intoxication. When compared to the cannabis flower, concentrate users display higher plasma levels of THC and cannabis metabolites (Cuttler et al., 2023). Between 2012 and 2018, emergency room visits for acute cannabis toxicity increased in locations that had legalized cannabis, with symptom severity

depending on the amount of cannabis consumed, potency, and individual tolerance (Keung et al., 2023).

The increased concentrations of THC have not been found to be beneficial for any purpose and represent an increased risk for cannabis use disorder (Stuyt, 2019). Considering there is no known research that demonstrates a positive effect with THC concentrations over 10%, and the significant amount of literature available on the adverse effects associated with increased potency, it has been suggested that regulations be initiated to limit THC concentration to 10% or less (Stuyt, 2019).

Conversely, higher concentrations of CBD use appear to mitigate negative THC-related effects and were associated with significant improvements in measurements of executive function, mood, sleep, and anxiety. No behaviors or symptoms associated with problematic cannabis were demonstrated with high amounts of CBD (Sagar et al., 2021).

Method of Consumption

The National Institute on Drug Abuse (NIDA) has reported a significant increase in cannabis consumption by vaporization (NIDA, 2020). Many of these vaporizers contain concentrates such as liquid extracts. These concentrates, which also include THC-rich resins extracted from the cannabis plant, instantaneously deliver extremely large amounts of THC to the body. Higher concentrations of THC increase the risk of physical dependence and addiction and are associated with increased adverse effects such as anxiety, agitation, paranoia, and psychosis (NIDA, 2020). Vaporizing has been reported as the preferred method of cannabis delivery (47.6%), followed by the oral ingestion of edibles (21.4%) and smoked cannabis flower (18.5%) (Turna et al., 2019).

The high concentrations of THC observed in vaporized cannabis are believed to have reinforcing properties that encourage repeated self-administration and conditioned reward-seeking behavior (Freels et al., 2020). Of increased concern is that college students report using vaporized cannabis at higher rates than young adults, citing discreetness and convenience, including portability, low odor, instant gratification, and ability to control consumption (McKenzie et al., 2022).

Vaping cannabis has more than doubled between 2017 and 2019 and has contributed to the increased risk of adverse outcomes, including the increased incidence of anxiety, psychosis, and cardiovascular complications, such as cardiomyopathy (Hill et al., 2022). Between 2015-2018, cannabis vaping and edible use increased and was associated with daily usage, while smoking cannabis flower decreased (Patrick et al., 2020). Daily cannabis use by method of vaporization has been seen to exacerbate existing anxiety symptoms. When used daily for two to three weeks, symptoms extend to grandiosity, mania, paranoia, hallucinations, and catatonia (Manning et al., 2020).

Adolescents in the United States reported significantly higher rates of vaping cannabis oil and consuming concentrates than adolescents in Canada and England. Moreover, adolescents in states that have legalized cannabis for medicinal or recreational purposes reported more frequent use of more potent cannabis products (Fataar & Hammond, 2019). High school seniors in states that had legalized cannabis medicinally reported higher rates of vaping cannabis over the past year than high school seniors in legalized recreational or prohibited states (Maynard & Schwartz, 2023). Regardless of legal context, higher rates of vaping were observed in those with easy access to cannabis cartridges, while decreased rates were observed in adolescents with higher perceived cannabis risks (Maynard & Schwartz, 2023). While some states with medicinal or

recreational cannabis programs only allow access to high-CBD, low-THC products, other states have no restrictions (Mahabir et al., 2020).

In the United Kingdom, medicinal cannabis is limited to the vaporization of dried cannabis flowers or the oral administration of extracts, such as oils. It is moderated by the government, and its maximum concentration is 20% THC (Moreno-Sanz et al., 2022). Here, vaporizing dried cannabis flower was reported as the preferred method of consumption due to the speed of onset and increased symptom relief compared to oral consumption. This is not surprising since orally ingested cannabinoids produce a delayed onset and erratic intestinal absorption, whereas consumption by vaporization is rapidly absorbed into the bloodstream (Moreno-Sanz et al., 2022). Vaporization was associated with improvements in sleep, pain, and anxiety, which was maintained at three and six-month follow-ups. Interestingly, 95% of the sample reported using cannabis illegally to self-medicate prior to the study, and all measures indicated improvement from baseline. Similarly, Canada monitors and limits THC percentages. Canadian research reports clinically significant improvement over 12 months in anxiety and depression scores after using low doses of THC to treat anxiety and depression (Sachedina et al., 2022). This supports the concept that THC can be beneficial in small, moderated doses.

Adverse Effects

Neurocognitive Impairments. THC disrupts the natural functioning of the ECS, which plays a vital role in anxiety, depression, and cognitive functioning (Keung et al., 2023). Cannabis use is associated with impaired learning, memory, attention, motor coordination, and executive function (Hill et al., 2022).

Modern cannabis research is limited due to regulations limiting THC concentration to less than 4% (Curran et al., 2016). However, animal research has provided many insights. In adolescent rats, a single dose of THC resulted in greater acute impairments to spatial and non-spatial learning compared to single doses in adult rats. In contrast, chronic administration resulted in persisting impairments in memory that were not observed in adult rats (Curran et al., 2016).

Cognitive deficits associated with cannabis use have been observed in its flower and concentrate form, with no significant differences found in the scores on memory tests, psychomotor speed, attention, and executive functioning. Significant differences were observed in cognitive testing scores between users and non-users (Cuttler et al., 2023). However, tasks measuring motor control and executive functioning have shown more significant cognitive impairment as THC potency increased (Pierre, 2017). Cannabis use has also been shown to affect intelligence quotient (IQ), with teens who started in early adolescence and used daily losing an average of 8 IQ points, which did not return with progressing age (NIDA, 2022).

The acute effects of cannabis use have been associated with deficits in executive function, such as planning, problem-solving, and decision-making, as well as impairments in learning, memory, attention, and motor coordination (Hill et al., 2022). With the advanced delivery systems available to instantaneously deliver highly potent THC products, the acute symptoms of cannabis use are often related to the route of ingestion (Hill et al., 2022).

Cognitive deficits are more evident with chronic cannabis use, particularly memory, information processing speed, and executive functioning. Chronic, long-term use has also been associated with significantly poorer performance in verbal learning measures (Stuyt, 2019). These deficits appear more pronounced in younger, chronic cannabis users, with those beginning

prior to 16 years old performing more poorly on neurocognitive tests. Adolescents who were heavy, chronic users lost an average of 8 IQ points as adults, which did not fully return upon abstinence (NIDA, 2020). Beginning cannabis use in adolescence has also been associated with greater consumption and frequency compared to those who began using cannabis later in life (Hill et al., 2022).

Anxiety. THC disrupts the natural functioning of the endocannabinoid system, which plays a vital role in anxiety and depression (Keung et al., 2023). Cannabis use has been reported to induce anxiety and exacerbate existing anxiety symptoms (Hill et al., 2022). Research has also identified a significant relationship between cannabis use and the lifetime prevalence of anxiety disorders, although a causal relationship cannot be established (Caldeira et al., 2012; Johnson et al., 2023; Petrilli et al., 2023).

While first-line treatments for anxiety and depression exist in the form of therapy and psychopharmacology, residual, impairing symptoms and non-compliance are among the limitations of such treatments that may result in seeking cannabis as an alternative treatment method (Turna et al., 2019).

Research has shown that among respondents who had substituted cannabis for prescribed psychiatric medication, the large majority reported perceived improvement in anxiety and depressive symptoms, which were positively associated with daily cannabis use. Respondents using more than 3 grams of cannabis daily reported more significant perceived improvement compared to those using less than 3 grams daily. However, severity scores indicated ongoing moderate symptoms. This suggests that personal perception of symptom severity may not be reduced to clinically significant levels (Turna et al., 2019).

Respondents were also asked which cannabis strains were thought to best improve their anxiety and which strains they found to worsen their anxiety. They could select as many of the six prepopulated options available. *Cannabis indica* was more often reported to have a subjective anxiolytic effect (51.5%), while *Cannabis sativa* was the most frequently reported anxiogenic strain (32.3%) (Turna et al., 2019).

Located within the ECS, CB1 receptors are a primary binding site for THC and are widely distributed throughout the brain (Martin et al., 2021). While THC acts as a partial agonist at CB1 receptors, it is reported to induce biphasic effects, with lower doses being anxiolytic and higher doses being anxiogenic (Rock & Parker, 2020; Ruehle et al., 2011). In healthy adults without preexisting anxiety, THC has been associated with anxiogenic effects in high doses and anxiolytic effects in low doses, indicating it is dose-dependent (Turna et al., 2017).

Cannabis-induced anxiety disorder is being increasingly observed across emergency rooms in geographic areas that have legalized cannabis (Keung et al., 2023). Johnson et al. (2023) report a case of primary onset cannabis-associated panic attacks following ten years of cannabis dependence occurring after two years of abstinence, while recent cannabis use was associated with negative therapeutic outcomes in those seeking treatment for anxiety and mood disorders (Mammen et al., 2018). Compared to CBD users, THC users report higher percentages of intoxicating and adverse effects, including anxiety and paranoia, specifically when consuming cannabis through vaporization (Martin et al., 2021). The frequency of cannabis use has also been associated with increased levels of anxiety (Xue et al., 2020).

Depression. A negative association was identified between the frequency of past-week cannabis use and self-reported improvements in overall health, sleep, and anxiety and depression

symptoms (Mooney et al., 2018). When followed over a period of seven years, adolescents who used cannabis at least once a week were twice as likely to develop depression. Daily users were five times more likely to develop depression and anxiety when compared to non-users (Stuyt, 2019). Veterans in the United States reported using medicinal cannabis to relieve combat-related trauma and post-traumatic stress disorder (PTSD) at rates more than double those observed in the general population. However, longitudinal research indicates that trauma-related intrusion symptoms, such as nightmares and repeated, unwanted memories, worsened with more frequent cannabis use (Metrik et al., 2020).

Self-reported depression and anxiety symptoms were significantly reduced following cannabis use, with less cannabis required for the reduction of depression and anxiety symptoms and more cannabis required for perceived stress reduction (Cuttler et al., 2018). A combination of cannabis containing low THC and high CBD was associated with the largest reduction ratings for depression. In contrast, a combination of high THC and high CBD was required for reductions in stress. While depression reduction was initially reported, continued cannabis use appeared to exacerbate depressive symptoms over time (Cuttler et al., 2018) and can interfere with psychiatric treatment by impeding recovery, with improvement rates considerably less among cannabis users when compared to non-cannabis users (Bahorik et al., 2017).

These long-term effects of regular cannabis use are thought to be caused by the downregulation of CB1 receptors in areas implicated in mood and emotion. Chronic cannabis use may alter the endocannabinoid system, resulting in an increased susceptibility to depression and emotion dysregulation (Cuttler et al., 2018).

Psychosis. While the research is complex and, at times, inconsistent, data does support the notion that previous cannabis use predicts treated first-episode psychosis as well as strong associations between THC frequency and potency and first-episode psychosis (Di Forti et al., 2019; Hasin & Walsh, 2021; Ramos et al., 2022). First-episode psychosis has been observed after using highly concentrated THC extracts known as cannabis "wax," "oil," or "dabs" (Pierre et al., 2016). After transitioning from marijuana to vaporizing wax products, symptoms of paranoia, disorganized thoughts, persecutory delusions, and agitation were observed. After being treated with antipsychotics and abstaining from any cannabis products, symptoms slowly resolved between one and six months (Pierre et al., 2016).

Cannabis use is associated with an increased risk of later psychotic disorder, and the risk has been shown to vary geographically, with locations across Europe with the greatest high-potency cannabis consumption being associated with the greatest odds for psychotic disorder development (Di Forti et al., 2019).

Substance-induced psychotic disorder is now recognized by the International Classification of Diseases (ICD) and the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5) as having merit for diagnostic criteria (Ramos et al., 2022). In the case of cannabis-induced psychosis, it is characterized by psychotic symptoms that manifest immediately following cannabis use, typically precipitated by large amounts of or highly concentrated cannabis, and resolves with abstinence (Ramos et al., 2022).

Suicidal Ideation. A recent analysis of survey data from 281,650 young adults ages 18–34 showed that cannabis use was associated with an increased risk of suicidal ideation, suicidal plans, and suicide attempts (Hill et al., 2022). While research has identified an association

between high levels of THC and psychosis, less is known about its association with self-injurious behavior. A systematic review by Escelsior et al. (2021) found that cannabis was significantly associated with self-harm episodes that increased with chronic use and existing mental illness. The use of newer synthetic compounds, which are mixed herbs chemically sprayed to mimic THC, has also been associated with self-harm episodes (Escelsior et al., 2021). While CBD has been considered safe for therapeutic purposes, these chemically altered compounds have been associated with suicidal ideation and suicide attempts. Military veterans and those with existing major depressive or bipolar depressive disorders were at increased risk, with long-term use and heavy consumption further increasing risk (Shamabadi et al., 2023).

While adolescent cannabis consumption has been associated with cognitive impairments and lower IQ and scholastic achievement, there is also an increased likelihood of addiction (Gobbi et al., 2019). Even more concerning is the significantly increased risk of the development of depression and suicidality as young adults. These risks remain high even with the cessation of cannabis in adolescence, suggesting that cannabis may alter the physiological neurodevelopment of the underdeveloped adolescent brain (Gobbi et al., 2019).

Over the past ten years, cannabis use and suicidality have both increased in adults aged 18-34. Cannabis use was associated with increased suicidal ideation and suicide attempts. These associations remained, regardless of whether existing depression was present, and were observed with even moderate use. However, a diagnosis of cannabis use disorder further increased the risk of suicidal ideation (Han et al., 2021). Among young adults with existing mood disorders, cannabis use disorder significantly increases the risk of self-injurious behavior and death by suicide, unintentional overdose, and homicide (Fontanella et al., 2021).

Brain Alterations. Magnetic resonance imaging (MRI) and functional magnetic resonance imaging (fMRI) comparisons between chronic cannabis users and nonusing controls showed gray matter reductions in the orbitofrontal cortex (OFC) of chronic cannabis users. Functional connectivity in the OFC was also different between the groups, with greater connectivity observed in chronic cannabis users, potentially suggesting the need to compensate for OFC liability (Filbey et al., 2014).

Structural changes in the brain have also been observed in recreational cannabis users. Compared to controls, those who consumed cannabis at least once a week exhibited greater left nucleus accumbens volume, which interferes with dopamine channels by releasing excessive amounts of dopamine, and right amygdala surface deformities, which increase emotional arousal (Gilman et al., 2014). Chronic consumption of more than five times per day was associated with bilaterally reduced hippocampal and amygdala volumes, impairing memory, and increasing stress reactivity (Stuyt, 2019). Chronic exposure to THC leads to impairment of synaptic plasticity, decreased CB1 receptor numbers, and desensitization of CB1 receptors, which is implicated in cannabis tolerance. These long-term changes in synaptic plasticity have been seen to persist long after cannabis cessation (Augustin & Lovinger, 2022).

Early and repeated THC exposure has shown a delayed heightened response to other addictive substances in the brain's reward pathway (NIDA, 2020). In animal studies, cannabis consumption during adolescence produced an increased likelihood of anxiety and depression in adulthood, mirrored by a decrease in serotonin and an increase in norepinephrine (Gobbi et al., 2019). In other studies, long-term adolescent cannabis exposure led to less responsive dopamine neurons and a cross-tolerance for morphine, cocaine, and amphetamine. Additionally, as adults, they displayed fewer synaptic contacts and reduced efficiency of hippocampal networks,

potentially mapping the neurobiological basis of the cognitive and behavioral deficits observed in humans (Gobbi et al., 2019).

Cannabis Use Disorder

Research has shown that adverse psychosocial events, such as depression, suicidal ideation, and physical aggression, were approximately four times higher in adolescents with sub-diagnostic cannabis use than in those with cannabis use disorder (CUD), suggesting that adolescent substance use disorders may be underdiagnosed (Sultan et al., 2023).

In the United States, the directionality of medical and recreational cannabis use corresponds with increased reports of CUD (Hasin et al., 2015). Dependence appears to rely on cannabis concentration and frequency of use (Blum et al., 2021), with higher concentrations of THC products being associated with increased frequency of use and severity of dependence, particularly in adolescents and emerging adults. THC in lower concentrations was not associated with dependence (Freeman & Winstock, 2015).

Rates for CUD in adolescents between the ages of 12-20 were significantly higher than in other age groups, and frequency of use was doubled compared to adults in the previous 30 days (Richter et al., 2016). Cannabis use prior to age 18 is up to seven times more likely to lead to CUD (NIDA, 2020), and as of 2021, CUD occurs in 20–30% of cannabis users (Hasin & Walsh, 2021). Studies examining monozygotic twins, pairs that included one twin with CUD and one twin without CUD, found that the twin with CUD was significantly more likely to be diagnosed with major depressive disorder (MDD) than the twin without CUD (Hasin & Walsh, 2021).

Cannabis withdrawal syndrome has been recognized as a true withdrawal syndrome, with symptoms including increased anger, irritability, depression, restlessness, headache, loss of

appetite, insomnia, and severe cannabis cravings, with higher concentrations associated with dependence severity (Stuyt, 2019). Cannabis withdrawal symptoms improve with abstinence, usually resolving after two weeks. However, insomnia tends to persist longer (Metrik et al., 2020).

Cannabis and Comorbidities

Overall, the greatest comorbidity that research has been able to establish is the significant relationship between cannabis use and lifetime panic or anxiety disorders. Johnson et al. (2023) report a case of primary onset cannabis-associated panic attacks following ten years of cannabis dependence occurring after two years of abstinence.

While anxiety disorders are a well-established comorbidity of CUD, the directionality remains unclear (Hasin & Walsh, 2021). While some studies illustrate the risk of the later development of anxiety disorder with cannabis use during adolescence, others suggest that anxiety disorders are present prior to the onset of any signs of dependence (Hasin & Walsh, 2021).

Compared to the general population, cannabis users were more likely to report depression, insomnia, and psychomotor agitation. Those with CUD have a higher prevalence of mood disorders compared to the general population, with CUD predicting a greater number of major depressive disorder (MDD) symptoms and risk of psychosis, anxiety, personality disorders, and illicit substance use (Hasin & Walsh, 2021). Repeated administration of THC in animal studies produced depressive-like symptoms and CB1 receptor impairment (Blum et al., 2021). Also, recent cannabis use was associated with negative therapeutic outcomes in those seeking treatment for anxiety and mood disorders (Mammen et al., 2018).

Cannabis and Hormones

Since daily cannabis use has substantially increased among young adults, the high concentrations of THC found in edibles and cannabis vaping products are raising concerns (Blum et al., 2021). While the association between cannabis use and depression, cognitive deficits, neuroanatomic alterations, and increased dependence in young adults has been well established, reduced brain dopamine synthesis and reward sensitivity have also been observed (Blum et al., 2021).

The endocannabinoid system includes cannabinoid receptors CB1 and CB2, which play a crucial role in modulating neurotransmission. CB1 receptors, primarily found in the brain, are densely located in regions associated with reward processing, including the mesolimbic dopamine system (Lee, 2023). Research indicates that THC, acting as a partial agonist at CB1 receptors, can modulate dopamine release in key brain regions. Animal studies have demonstrated that THC administration increases dopamine levels in the nucleus accumbens, contributing to the euphoric effects associated with cannabis use (Lee, 2023).

While acute THC exposure is linked to a surge in dopamine release, chronic use has been associated with alterations in the endocannabinoid system, including CB1 receptor desensitization. This adaptative response may result in a drop in dopamine synthesis and diminished dopaminergic activity over time, potentially contributing to the development of tolerance and increased usage (Lee, 2023; Volkow et al., 2014).

Cannabis and Weight

Medicinally, cannabis has been approved by the FDA for the treatment of weight loss associated with AN and AIDS, as well as for nausea and vomiting associated with cancer

chemotherapy (Santos et al., 2020). When studying the effect of cannabis on AN, results are mixed. While one study found that high THC concentrations had no effect on weight gain and increased the risk of adverse effects, including severe dysphoria and paranoia, another study using low doses of dronabinol, a synthetic cannabinoid, found that weight gain increased with no adverse side effects (Rosager et al., 2020). It should be noted that cannabis dosage varied across the studies.

Other studies have found that daily administration of THC in obese rats had anorexigenic effects, suppressing weight gain and fat mass gain (Farokhnia et al., 2020). In other research using rat models, THC administered daily at low doses induced a hyperphagic effect, while higher daily doses induced a hypophagic effect, which was reversed upon cessation. Because the rats did not show signs of aversive food intake, the hypophagic effect was thought to have occurred from glucose intolerance or drug absorption effects (Erlbacher & Minnich, 2017).

Cannabis and Appetite

The hypothalamus is primarily responsible for regulating appetite, metabolism, and energy homeostasis by transmitting signals to other systems to coordinate food intake and energy expenditure (Farokhnia et al., 2020). Cannabinoids interfere with the regulation of feeding behavior (Koch, 2017), stimulating the ECS and influencing food intake, appetite, and metabolism (Farokhnia et al., 2020), typically resulting in hyperphagia and overconsumption of food in low doses (Bellocchio et al., 2010). Also, anandamide is a natural, endogenous endocannabinoid that interacts with CB1 and CB2 receptors. THC mimics anandamide, stimulating appetite and heightening sensitivity to food reward. However, with chronic use and higher dosage, the density of the endocannabinoid receptors becomes reduced, producing

hypophagic and anorexigenic effects, which suppress appetite and caloric intake (Augustin & Lovinger, 2022; Bellocchio et al., 2010; Farokhnia et al., 2020).

A descriptive analysis investigating vaping-associated lung illnesses among individuals who used nicotine or cannabis vaping products found that while all individuals reported some form of respiratory symptoms, 40% of the sample who reported utilization of vaping products containing cannabis reported additional symptoms, including poor appetite, weight loss, and gastrointestinal distress such as nausea and diarrhea (Baker et al., 2022).

Cannabinoid Hyperemesis Syndrome

Cannabis Hyperemesis Syndrome (CHS) is a clinical condition and often underreported consequence of chronic, highly concentrated cannabis use (Myran et al., 2022). It is characterized by cyclic episodes of severe nausea, vomiting, and abdominal pain, with symptoms often relieved with hot showers and disappearing with cannabis cessation (Brewerton & Anderson, 2016b). CHS typically occurs in chronic cannabis users, with symptoms divided into three distinct phases: prodromal, hyperemetic, and recovery. The prodromal phase includes early morning nausea and abdominal discomfort, with symptoms escalating to intense vomiting during the hyperemetic phase. The recovery phase is marked by a resolution of symptoms upon cessation of cannabis use (Myran et al., 2022). CHS poses a diagnostic challenge due to its overlap with other gastrointestinal disorders and the potential for delayed diagnosis (Brewerton & Anderson, 2016b).

The pathophysiology of CHS remains unclear. However, it is thought to involve dysregulation of the endocannabinoid system, with chronic cannabis use resulting in the desensitization of CB1 receptors, which disrupts the homeostatic balance of the gastrointestinal

tract (Perisetti et al., 2020). The endocannabinoid system is involved with motility, satiety, and emesis, and CHS appears to have a biphasic response, with lower THC concentrations producing anti-emetic effects and pro-emetic effects occurring with higher THC concentrations, changing in response to the HPA axis and its interaction with active cannabis metabolites and its potency (Perisetti et al., 2020).

Avoidant/Restrictive Food Intake Disorder

College students report cannabis usage at higher rates than young adults (McKenzie et al., 2022), and college years pose a significant risk for the comorbid development of eating disorders and recreational drug use (Ganson et al., 2021; Maynard et al., 2023; Tavolacci et al., 2020). While the cognitive deficits and poorer psychiatric outcomes associated with cannabis use are more widely studied, less is known about the effects of cannabis on appetite.

Avoidant/Restrictive Food Intake Disorder (ARFID) was added to the DSM-5 in 2013 to account for the expansion of what was once considered a pediatric feeding disorder (Bryant-Waugh, 2019). Currently, it is a widely accepted diagnosis in adolescents and adults. ARFID presents with significant weight loss, nutritional deficiency, dependence on nutrition supplementation, and interference in psychosocial functioning (Bryant-Waugh, 2019; Cañas et al., 2020; Kambanis et al., 2019; Nitsch et al., 2023). Although it shares many clinical symptoms with anorexia nervosa, the defining difference is the lack of concern with body weight or shape (Cañas et al., 2020).

The three subtypes of ARFID include sensory concerns, lack of interest, and fear of adverse consequences. The sensory subtype includes sensitivity issues with texture, taste, or smell. The lack of interest subtype consists of a general lack of interest in food or a significantly

reduced motivation to eat, and the fear of adverse consequences subtype is associated with a fear of choking or vomiting while eating (Bryant-Waugh, 2019; Cañas et al., 2020; Kambanis et al., 2019; Nitsch et al., 2023).

While ARFID may be diagnosed at any age (Cañas et al., 2020), the sensory subtype is more often diagnosed in the young adolescent population, with fear of adverse consequences and lack of interest more frequently observed in the adult population (Nitsch et al., 2023). The lasting effects of malnutrition and psychopathological symptoms can be observed years after ARFID diagnosis (Bryant-Waugh, 2019).

Emerging Adults

The college years are commonly known as the transition from adolescence to emerging adulthood (Ganson et al., 2021). Unfortunately, this transition is also associated with the highest risk for the development of eating disorders (Ganson et al., 2021; Tavolacci et al., 2020). The frequency of eating disorders among college students increased significantly from 2013 to 2020, with approximately 24% meeting the diagnostic criteria for eating disorders in 2020 (Maynard et al., 2023). Interesting research is emerging, showing that patients with restrictive eating disorders show limbic dysregulation, which is associated with increased anxiety (Ziv et al., 2020). While anxiety disorders are the most frequently occurring comorbid psychiatric disorder (Tavolacci et al., 2020), those with eating disorders are also at an increased risk for cannabis use disorder (CUD) (Ganson et al., 2021; Maynard et al., 2023; Scharmer et al., 2020).

Hormonal Effects

Cannabis affects the hypothalamic-pituitary-adrenal (HPA) axis, the body's main stress response system (Cservenka et al., 2018). Cannabis, regardless of the delivery method, raises cortisol levels. More frequent cannabis users have shown blunted adrenocorticotropic hormone and cortisol reactivity in response to acute stress, suggesting dysregulated HPA axis activity (Cservenka et al., 2018). However, less is known about the more frequent use of highly concentrated THC and its effect on the HPA axis. If chronic use and increased potency lead to persistently high cortisol levels, this could have devastating effects on the adrenal system (Cservenka et al., 2018). Activation of the HPA axis is also commonly associated with hypophagia and weight loss (Rabasa & Dickson, 2016), offering a potential explanation for the anorexigenic effects observed in restrictive eating disorders.

Another hormone, ghrelin, is an orexigenic hormone secreted in the stomach and gastrointestinal tract and is important for feeding behavior (Becker et al., 2021; Sestan-Pesa et al., 2023). Typically, ghrelin levels increase with fasting and decrease after eating during the postprandial period. Studies have shown that females with AN have elevated postprandial ghrelin levels compared to healthy controls. In contrast, females with ARFID ate less and had lower levels of total ghrelin compared to those with AN, even when eating early in the day (Becker et al., 2021). This could potentially contribute to the continued lack of interest in eating observed in ARFID patients (Becker et al., 2021). Lower ghrelin levels have also been associated with increased anxiety levels, particularly in those with an ARFID diagnosis (Sella et al., 2023).

Biblical Foundations of the Study

There is much controversy surrounding the biblical grounds of cannabis and its purpose. We know that God created everything, including plants and herbs. The question remains: What

did its purpose become after the fall? Genesis 1:29 states, “And God said, “Behold, I have given you every plant yielding seed that is on the face of all the earth, and every tree with seed in its fruit. You shall have them for food (English Standard Version Bible, 2001). Ezekiel 47:12 states, “And on the banks, on both sides of the river, there will grow all kinds of trees for food. Their leaves will not wither, nor their fruit fail, but they will bear fresh fruit every month, because the water for them flows from the sanctuary. Their fruit will be for food, and their leaves for healing” (English Standard Version Bible, 2001).

It appears that prior to the fall, the Lord’s purpose was for food consumption and healing. After the fall, however, now in the hands of sinners, the Lord’s purpose may have been altered to one of personal pleasure. An analysis of burnt organic material collected from an ancient 8th-century shrine in Israel confirmed that THC was present on an altar. It is assumed that it was inhaled to induce a mind-altering experience during a possible sacrifice or ritual (Arie et al., 2020).

Far removed from the Lord’s initial purpose, cannabis has been manipulated into a tool for personal pleasure, used in excess, and altered to allow for addiction or dependence. While the Bible does not address addiction directly, it teaches self-control, moderation, and the dangers of being enslaved by harmful behaviors.

The importance of self-control is discussed in 1 Corinthians 7:5, encouraging Christians to exercise discipline over their desires and impulses: “Do not deprive one another, except perhaps by agreement for a limited time, that you may devote yourselves to prayer; but then come together again, so that Satan may not tempt you because of your lack of self-control” (English Standard Version Bible, 2001). The Bible also warns against becoming enslaved to anything that hinders one's relationship with God. “All things are lawful for me,’ but not all

things are helpful. ‘All things are lawful for me,’ but I will not be dominated by anything” (1 Cor. 6:12, English Standard Version Bible, 2001). Additionally, the Bible acknowledges the destructive nature of excessive behaviors. Proverbs 20:1 cautions, "Wine is a mocker, strong drink a brawler, and whosoever is led astray by it is not wise" (English Standard Version Bible, 2001). While this verse specifically addresses alcohol, the underlying principle can be applied to any substance or behavior that has the potential to lead to addiction.

Indirectly, the Bible addresses mental health. Luke 21:34 states, “Be careful, or your hearts will be weighed down with carousing, drunkenness and the anxieties of life, and that day will close on you suddenly like a trap” (New International Version Bible, 2011). Philippians 4:6-7 reminds us, “Do not be anxious about anything, but in every situation, by prayer and petition, with thanksgiving, present your requests to God. And the peace of God, which transcends all understanding, will guard your hearts and your minds in Christ Jesus” (New International Version, 2011). “Or do you not know that your body is a temple of the Holy Spirit within you, whom you have from God? You are not your own, for you were bought with a price. So glorify God in your body” (1 Cor. 6:19-20, English Standard Version Bible, 2001). These verses support a holistic approach to health, encompassing physical, mental, and spiritual well-being, and are reminders to lean on God in times of trouble or overwhelming emotion.

Summary

Although THC has been shown to be beneficial in low doses, the adverse effects of highly concentrated THC should not be ignored. With adolescents and emerging adults preferring vaporization as their method of consumption, they are especially at an increased risk of experiencing these adverse effects. Additionally, the legalization of medical and recreational

use, combined with marketing strategies, lends to the perception that cannabis is safe in any form.

While the majority of cannabis' adverse effects have been well documented, more research needs to address the anorexigenic effects resulting from chronic use. Emerging adults using vaporization as their method of cannabis consumption should be aware of the potential for increased usage and the development of ARFID symptomology to avoid malnutrition and its damaging effects.

CHAPTER 3: RESEARCH METHOD

Overview

The following chapter will reintroduce the research questions and hypotheses and detail the research methods, including the research design, participants, procedures, and measurement tools.

Research Questions and Hypotheses

Research Questions

RQ1: Is more frequent cannabis use associated with increased symptoms of restrictive eating disorder in emerging adults?

RQ 2: Does the method of cannabis consumption affect symptoms of restrictive eating disorder in emerging adults?

RQ 3: Is there an interaction between the method of cannabis consumption and symptoms of restrictive eating disorder in emerging adults?

Hypotheses

Hypothesis 1: It is hypothesized that more frequent cannabis use will be associated with increased symptoms of restrictive eating disorder in emerging adults.

Hypothesis 2: It is hypothesized that cannabis consumption by method of vaporization will be associated with increased symptoms of restrictive eating disorder in emerging adults.

Hypothesis 3: It is hypothesized that an interaction will be observed between cannabis consumption by method of vaporization and symptoms of restrictive eating disorder in emerging adults.

Research Design

This study adopts a unique approach by following a grounded theory methodology. While this approach is typically associated with qualitative studies, grounded theory methodology can also be used in quantitative studies (Johnson, 2008; Tie et al., 2019). The goal of grounded theory is to develop an explanatory theory based on the data provided in the research rather than testing an existing theory. It also attempts to account for the behaviors and experiences of participants and whether they are influenced by social processes and circumstances (Birks & Mills, 2011). By constructing theories from data, grounded theory uses comparative analysis, systematically gathering data, organizing it, and drawing meaningful conclusions (Tie et al., 2019).

The present study utilizes the experiences of participants through surveys, attempting to develop a theory about a topic that is relatively unstudied. Grounded theory is important to the understanding of this research in that it attempts to answer whether behavior (restrictive eating) is influenced by social processes and circumstances (cannabis use). Surveys were chosen to represent data in this quantitative research study to allow for the examination of relationships between variables. The survey and study design were approved by Liberty University's Institutional Review Board.

Participants

The present study included 83 participants. Inclusion criteria included undergraduate students currently enrolled in a college or university between the ages of 18-25. Exclusion criteria included a clinical diagnosis of psychosis but not an isolated psychotic episode.

Participants were recruited from social media platforms using convenience sampling. Informed consent was obtained from each participant prior to participation. No compensation was provided. A priori power analysis was conducted using G*Power. The calculated effect size of .30 in an a priori power analysis with an alpha level of .05 demonstrated that a total sample size of 115 would be sufficient to achieve a moderate effect.

Study Procedures

Since it has been reported that Instagram is among the most popular social media platforms for young adults, it was selected as the main dissemination platform for this study. Facebook was also used for survey dissemination. Information regarding the study was posted on the researcher's personal Instagram and Facebook accounts with an embedded link requesting participation. Once participants clicked on the hyperlink, they were redirected to the Qualtrics platform, where full instructions for the survey were provided. All participant information is anonymous, and any data collected will remain confidential.

Instrumentation and Measurement

The measures for this study included demographic data, the Generalized Anxiety Disorder Scale – 7 (GAD-7), the Cannabis Engagement Assessment (CEA), and the PARDI ARFID Questionnaire (PARDI-AR-Q).

Demographic Data

Demographic questions were included to describe the population sample and gathered information regarding age, gender, race, and year in college (See Appendix A).

Tools of Measurement

The Generalized Anxiety Disorder Scale - 7

The Generalized Anxiety Disorder Scale - 7 (GAD-7; Spitzer et al., 2006) is a 7-item self-report, Likert-based measure of anxiety, with scores ranging from 0 - 3 (0 = not at all, 3 = nearly every day). Scores were summed to obtain an overall score ranging from 0 - 21, with higher scores indicating higher levels of anxiety (See Appendix B). This scale has shown good validity and test-retest reliability.

The Cannabis Engagement Assessment

The Cannabis Engagement Assessment (CEA; Schluter & Hodgins, 2022) is a 30-item self-report measure of cannabis use, including frequency and method of consumption across flower, concentrate, and edible products over the previous 30 days (See Appendix C). Nominal answers are "yes" or "no," and various options exist for forms and methods of cannabis consumption. Frequency of use measures range from Likert-based responses a – f (a = 1, f = more than 5) and several fill-in-the-blank options. Ratio responses were used to report the amount of cannabis and THC concentration. Scores were coded as numerical values, and predetermined formulas were used to distinguish between estimates of cannabis flower, concentrates, and edibles. These formulas were also reported in the appendix. Although this is a newer measurement tool, it has shown good validity and test-retest reliability.

The PARDI ARFID Questionnaire 14+

The Pica, ARFID, and Rumination Disorder Interview (PARDI-AR-Q; Bryant-Waugh et al., 2022) 14+ version is a 32-item self-report, mixed Likert-based and nominal measure of ARFID symptom severity (See Appendix D). Nominal answers are “yes” or “no,” and Likert-based measures range from 0 – 6 (0 = no difficulty, 6 = extremely difficult). Scores were added and divided by three, with higher scores indicating increased severity of symptoms. This scale has shown good validity and test-retest reliability.

Operationalization of Variables

Age - This is a nominal variable that will be measured by the researcher created demographic questionnaire asking participants to select the category they fall within.

Anxiety Levels – This is an interval/ratio variable and will be measured by total score on the GAD-7 (Spitzer et al., 2006).

Cannabis Amount - This is a ratio variable and will be measured by participants' self-reported responses on the CEA (Schluter & Hodgins, 2022).

Frequency of Cannabis Use – This is an interval/ratio variable and will be measured by the total number of sessions reported on the CEA (Schluter & Hodgins, 2022).

Gender – This is a nominal variable that will be measured by the researcher created demographic questionnaire asking participants to select the category they fall within.

Grade Level - This is a nominal variable that will be measured by the researcher created demographic questionnaire asking participants to select the category they fall within.

Method of cannabis delivery – This is a nominal variable measured by the CEA (Schluter & Hodgins, 2022) with self-reported responses.

Race - This is a nominal variable that will be measured by the researcher created demographic questionnaire asking participants to select the category they fall within.

Lack of Interest – This is an interval/ratio variable and will be measured by total lack of interest subscale score on the PARDI-AR-Q 14+ (Bryant-Waugh et al., 2022).

Data Analysis

Data processing began with an initial sweep to ensure that whole data was used. Initial data was gathered from 94 respondents. Participant #5 was excluded due to age criteria. Participants #73, 74, 75, 76, 81, 84, 85, 90, 92, and 94 completed less than 12 questions, leaving 92% of questions unanswered. The researcher chose to exclude this data due to a large amount of data missing from these participants, leaving the total participant sample at 83.

Data analysis was conducted using grounded theory methodology for all variables in IBM SPSS Statistics 27. Data analysis included a 2 x 3 factorial analysis of variance (ANOVA) to identify main effects and interactions, with an alpha level of .05.

A factorial ANOVA is a statistical analysis method used to examine the influence of two different categorical independent variables on one continuous dependent variable. It can also determine whether there is an interaction effect between the two independent variables on the dependent variable. The values of categorical variables are non-numeric and descriptive, with each variable representing a distinct category. Continuous variables can take on an infinite number of values within a given range. The values of continuous variables are typically numerical and are not restricted to fixed categories or levels.

In order to meet the assumption of normal distribution, the data for frequency of use was recoded into an ordinal variable and divided into three equal groups (occasionally, frequently,

and very frequently). The data showed that cannabis concentrates were reported more frequently as a delivery method than were other forms of cannabis, so the analysis focused on the data for cannabis concentrates. There were many potential answers for this variable and the data was skewed and recoded into a binary variable (other, vaping).

Delimitations, Assumptions, and Limitations

Delimitations placed in this study were college students between the ages of 18 – 25. This group was selected due to the high comorbidities identified between substance use and eating disorders in this population.

As previously stated, the assumptions for the current study are restricted. While typically, it can be assumed that participants will provide honest answers, truthfulness may be compromised due to the sensitive nature of the questions, making this a limitation.

Several limitations of this study should be mentioned. First, it should be addressed that the author has a previous personal experience with the research topic. However, rigorous criteria will be implemented across all study parameters to control for researcher bias. Next, as previously mentioned, even though it ensures confidentiality, the sensitive content of the study may compromise honesty. The survey questions regarding cannabis usage and eating habits may elicit uncomfortable emotions that could interfere with an honest response, or participants may lack awareness that the situation is applicable to them. Social trends also limit the study as the surveys were only available during a four-week period. All of these factors could affect the validity and reliability of the results. Generalizability is another concern. The use of convenience sampling limits generalizability to undergraduate college students. Additionally, due to the anonymity of the survey, the authenticity of responses cannot be validated. Lastly, the study

lacks a manipulated variable and random assignment, limiting conclusions and eliminating any potential causal relationship implications. Future research should focus on longitudinal data and true manipulation of variables in order to establish a more casual relationship.

Summary

This study included 83 research participants recruited by convenience sampling from the Instagram and Facebook social media platforms. The GAD-7 (Spitzer et al., 2006) was used to measure anxiety levels. The CEA (Schluter & Hodgins, 2022) was used to measure cannabis frequency and method of delivery, and the PARDI-ARFID-Q 14+ (Bryant-Waugh et al., 2022) was used to measure symptoms of ARFID. Statistical analysis was conducted with IBM SPSS Statistics 27, using a 2 x 3 factorial ANOVA to identify main effects and interactions, with an alpha level of .05.

CHAPTER 4: RESULTS

Overview

The purpose of this study was to examine the main effects and interaction between the frequency of cannabis use and the method of delivery on restrictive eating disorder symptoms in emerging adults. Online surveys distributed through social media platforms served as the source of data collection. The research questions that guided the study were:

RQ1: Is more frequent cannabis use associated with a lack of interest in eating?

RQ 2: Is the method of consumption associated with a lack of interest in eating?

RQ 3: Is there an interaction between the frequency of cannabis consumption and the method of cannabis consumption predicting a lack of interest in eating?

The remainder of the chapter will present sample demographics and the results of the research questions.

Descriptive Results

A total of 83 undergraduate college students were included in this study (M = 19.9 years of age, 69.9% female, 83.1% Caucasian, 38.6% freshman). Sociodemographic characteristics are presented in Table 1. A considerable portion of the population sample reported never using cannabis (See Table 2).

Study Findings

A 2 x 3 factorial ANOVA was conducted to assess the effects of the frequency of cannabis use (occasionally, frequently, very frequently) and the method of cannabis consumption (other, vape) on lack of interest in eating scores. The means and standard deviations for lack of interest in eating scores are presented in Table 3. As shown in Table 4, there was no main effect

of the method of cannabis consumption [$F(1, 25) = 1.07$, $p = .311$, partial $\eta^2 = .04$] and no main effect of the frequency of cannabis consumption [$F(2, 25) = .75$, $p = .483$, partial $\eta^2 = .06$]. The interaction of cannabis method and cannabis frequency was not significant [$F(1,25) = .28$, $p = .601$, partial $\eta^2 = .061$].

Summary

While it was hypothesized that the method of cannabis consumption and the frequency of cannabis use would have an effect on lack of interest in eating scores, the results were not significant, and no main effects or interactions were identified. However, this does not mean that the purpose of the study is any less significant. The following chapter will expand upon these findings and illustrate factors contributing to these results. Recommendations for future research will also be discussed.

CHAPTER 5: DISCUSSION

Overview

The purpose of this quantitative correlational study was to examine the main effects and interaction between the frequency of cannabis use and the method of delivery on restrictive eating disorder symptoms in emerging adults. The following chapter will review the research and consider its implications and limitations.

Summary of Findings

Data for this study was collected from undergraduate college students between the ages of 18 and 25 without an existing diagnosis of psychosis. Participants were recruited through the social media platforms Instagram and Facebook. Participants completed an online survey that was comprised of three separate tools of measurement (GAD-7, PARDI-ARFID 14+, and CEA). The GAD-7 was used to measure anxiety symptoms and severity, while the PARDI-ARFID 14+ was used to measure restrictive eating disorder symptoms. The CEA was used to assess the frequency of cannabis use and the method of delivery.

The data was cleaned by looking for errors, outliers, and missing data. There was a large volume of missing data, primarily due to nonresponse, and listwise deletion was used to exclude participants who did not answer questions regarding their age, gender, college year, and lack of interest in eating. In total, 11 participants were excluded, leaving a total sample of 83 participants.

Because the assumption of normal distribution could not be met, the variable frequency of use was recoded into an ordinal variable and divided into three equal groups (occasionally, frequently, and very frequently). The data showed that cannabis concentrates were reported more

frequently as a delivery method than were other forms of cannabis, so the analysis focused on the data for cannabis concentrates. Also, because there were many potential answers for this variable, the data was skewed and recoded into a binary variable (other, vaping). All variables now met the assumption for a factorial ANOVA.

A 2 x 3 factorial ANOVA was conducted to assess the main effects and interactions of the method of cannabis consumption (other, vape) and frequency of cannabis use (occasionally, frequently, very frequently) on lack of interest in eating scores. There was no main effect of the method of cannabis consumption [$F(1, 25) = 1.07$, $p = .311$, partial $\eta^2 = .04$] and no main effect of the frequency of cannabis use [$F(2, 25) = .75$, $p = .483$, partial $\eta^2 = .06$]. The interaction of cannabis method and cannabis frequency was not significant [$F(1,25) = .28$, $p = .601$, partial $\eta^2 = .061$].

Discussion of Findings

Contrary to previous research, these findings do not illustrate any relationship between cannabis use and appetite. While this was the first known study to investigate the relationship between cannabis and ARFID symptoms, other research has identified a relationship between cannabis consumption and hypophagia, where more frequent cannabis use produced a reduction in appetite and caloric intake (Augustin & Lovinger, 2022; Bellocchio et al., 2010; Farokhnia et al., 2020). However, consistent with other research, this study did find that vaporization was the preferred method of cannabis consumption among college students (See Table 5).

This study used grounded theory methodology to assess participants' experiences while attempting to develop an explanatory theory for an underdeveloped topic. Surveys were used to answer whether behavior (restrictive eating) is influenced by social processes and circumstances (cannabis use). While the results were not significant, the theoretical foundation remains

essential. Cannabis use by method of vaporization is reported as the method of choice among young and emerging adults. Although this study was unable to identify a correlation between vaping cannabis and restrictive eating, other research has identified a correlation between the amount of THC and appetite, with higher THC concentrations having increased anorexigenic and hypophagic effects. These established studies utilized THC concentrations between .03 and .15 percent. With THC concentrations in vaping products as high as .97 percent, it would be reasonable to suggest that the increased THC concentrations seen in cannabis concentrates would result in a decreased appetite and possibly the clinical symptoms of ARFID. Therefore, the theoretical concepts of this study and its results remain integral to additional research on this topic.

Implications

While the results of this study could not identify any significant differences, the foundation of the study remains important. Considering the many adverse effects of cannabis concentrates that have been established in previous research and literature, this study was able to replicate data showing that cannabis consumption by the method of vaporization was the preferred method of use among college students and emerging adults.

One of the hypotheses of this study was that cannabis consumption by method of vaporization would be related to increased symptoms of restrictive eating. Previous research that established a relationship between cannabis consumption and a reduction in appetite (Augustin & Lovinger, 2022; Bellocchio et al., 2010; Farokhnia et al., 2020) mainly focused on the amount of THC consumed, with greater concentrations associated with a more significant reduction in appetite. While THC concentration was addressed, this study focused primarily on vaping

devices, where high concentrations of THC are already implicated. Since THC concentration percentage was not reported in the majority of the participants, data regarding THC concentrations may have yielded important information and altered the outcome of the results.

Although this study was not able to establish a relationship between cannabis concentrates and ARFID, the data confirming the popularity of cannabis vaporization among college students and emerging adults remains significant. With revisions, the concept of this study may produce different results that can be related to the practical application of treating eating disorders.

Limitations

The limitations of this study were abundant. The sensitive content of the study may have compromised honesty. The survey questions regarding cannabis usage and eating habits may have elicited uncomfortable emotions that could interfere with an honest response or a desire to answer specific questions.

Although it has been validated, the Cannabis Engagement Assessment (CEA) was extremely specific and may provide more complete data in an interview format. Additionally, the scoring system was complicated. Initially, this study was designed to include the THC content of cannabis products and their relationship to a lack of interest in eating. However, in the CEA, questions regarding THC were answered by only 11 participants (0.13%). Also, those who did not smoke cannabis (n = 27) were ultimately excluded, further skewing the data.

Social trends also limited the study. The data was collected over a four-week period due to the time constraints of college semesters. Since access to Liberty University students was denied by the IRB and 12 other colleges and universities in Pennsylvania declined participation,

the decision was made to make the surveys available on two social media platforms. This presented its own limitation because verifying whether participants were actually undergraduate college students was impossible. All of these factors could affect the validity and reliability of the results.

Generalizability is another concern. The use of convenience sampling limits generalizability to undergraduate college students. Additionally, due to the anonymity of the survey, the authenticity of responses cannot be validated. Lastly, the study lacks a manipulated variable and random assignment, limiting conclusions and eliminating any potential causal relationship implications.

Recommendations for Future Research

Considering the large volume of missing data, recommendations for future research would revolve around population sampling and methodology. Since many of the participants in the current study were not cannabis users, future research may consider soliciting only those who already use cannabis. Also, although the CEA has been previously validated and used successfully in other research, most of the missing data in this study came from that assessment tool. It is unclear if the participants found the questions confusing or if they were too specific and the answers were unknown (i.e., the amount of THC concentration in each product). Therefore, a different tool of measurement for cannabis frequency and method of consumption would be recommended for future studies.

Also, this study limited the subtypes of ARFID to restrictive eating. It would be interesting to see if other subtypes, particularly the sensory subtype (i.e., texture), would be

affected by cannabis concentrates. Ideally, future research would focus on longitudinal data and true manipulation of variables in order to establish a more casual relationship.

Summary

While this study was unable to contribute to the existing research illustrating the potential anorexigenic effects resulting from cannabis use, it was able to replicate findings that cannabis vaporization was the most frequently reported method of consumption among college students and emerging adults. Therefore, more research is required to address the relationship between cannabis concentrates and the potential development of restrictive eating and other ARFID symptomology. While redefining the methods, the purpose of the study is imperative enough to be kept intact and should continue to be studied.

Finally, with the amount of existing research highlighting the adverse effects associated with cannabis products containing higher concentrations of THC, more effort should be taken to educate young and emerging adults about the amount of THC in vaping devices and the possible adverse effects associated with its use.

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APPENDIX A: DEMOGRAPHIC DATA

1. What is your age? _____

2. What is your gender? _____

3. What is your race/ethnicity? _____

4. What year are you in college? _____

APPENDIX B: GENERALIZED ANXIETY DISORDER SCALE -7

Over the **last two weeks**, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid, as if something awful might happen	0	1	2	3

Column totals _____ + _____ + _____ + _____ =

Total score _____

If you checked any problems, how difficult have they made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

APPENDIX C: THE CANNABIS ENGAGEMENT ASSESSMENT

The following questions ask about your cannabis use **in the past month** (30 days). Cannabis includes marijuana, weed, grass, bud, oil, or any other use of the cannabis plant.

Part I – Types and Methods of Cannabis Use

1a. Have you ever used cannabis?

YES NO *end survey*

1b. Have you used cannabis in the past month?

YES NO *end survey*

1c. When did you last use cannabis?

a. Today
b. Yesterday
c. In the past week
d. 1 to 2 weeks ago
e. 2 to 3 weeks ago
f. 3 to 4 weeks ago

Bud, weed, and other dried cannabis leaf products (**NOT including concentrates or edibles**)

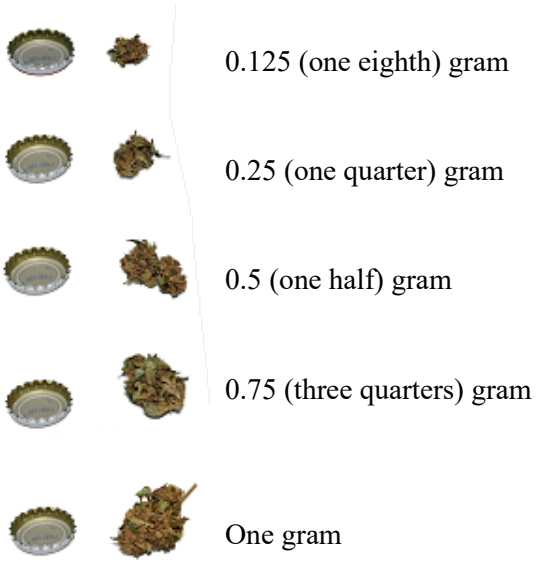
2. How many **days** in the past month did you use weed, bud, or other dried cannabis leaf products (excluding concentrates and edibles)?

____ *If 0, skip to Question 3*

3. In the past month, what is the **main way** that you used bud, weed, or other dried cannabis leaf products (not including edibles)?
   a. Pipe/one-hitter
   b. Bong/hookah
   c. Joint/blunt
   d. Hot knives
   e. Parachute
   f. Dried herb vape pen
   g. Other: _____

4. On the days that you used bud, weed, or other dried leaf cannabis in the past month, how many **sessions** (blocks of time separated by at least 2-hours where you did not use cannabis) did you typically have **in a single day**?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. More than 5 (specify number): __

Please refer to the image below depicting various quantities of marijuana. The image is not to scale; The bottle cap is included to help provide size perspective.



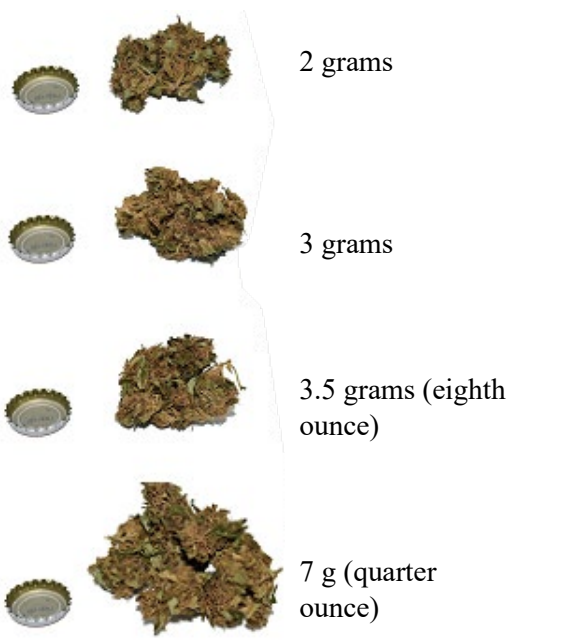
0.125 (one eighth) gram

0.25 (one quarter) gram

0.5 (one half) gram

0.75 (three quarters) gram

One gram



2 grams

3 grams

3.5 grams (eighth ounce)

7 g (quarter ounce)

5. In the past month, how much bud, weed, or other dried products did you typically use **in a single day**?

   a. .25g (quarter gram)
   b. .5g (half gram)
   c. .75g (three quarters gram)
   d. 1g
   e. 1.5g
   f. 2g
   g. 2.5g
   h. 3g
   i. 3.5g
   j. 4g
   k. 4.5g
   l. 5g
   m. Other. *Specify amount:* _____

6. In the past month, what was the **THC content** of the bud, weed, or other leaf products that you typically used?

   a. _____%
   b. Don't know
   c. Prefer not to answer

7. In the past month, what was the **strain** of the cannabis that you typically used?
   a. _____
   b. Don't know
   c. Prefer not to answer

<u>Concentrated cannabis products (e.g. oils, vaping cartridges, resin, hash)</u>

8. How many **days** in the past month did you use concentrated cannabis products (e.g. oil, resin)?

____ *If 0, skip to Question 4*

Please refer to the image below depicting various quantities of marijuana. The image is not to scale; The bottle cap is included to help provide size perspective

9. How many **days** in the past month did you use the following types of concentrated cannabis products?

a. Oil: __
b. Resin: __
c. Shatter: __
d. Hash: __
e. Other (please specify): _____ days: __
f. NA - did not use any *skip to question 5*

10. On the days in the past month that you used concentrated products, how many **sessions** (blocks of time separated by at least 2-hours where you did not use cannabis) did you typically have in a **single day**?

a. 1
b. 2
c. 3
d. 4
e. 5
f. More than 5 (specify number): __

11. In the past month, what is the **main way** that you used cannabis concentrates?

g. Pipe
h. Bong
i. Joint
j. Vaping/Shatter pen
k. Ingestion
l. Dabbing
m. Hot knives
n. Other: _____
o. NA – I did not use this type

12. In the past month, how many hits (1 hit = 1 puff, 1 drop) of concentrated cannabis products did you typically use **in a single day**?

_____ puff/drop/other:_____

12a. If you used drops, how much THC is in the product?
_____mg of THC per 1mL

13. In the past month, how much **THC** was typically in the concentrated cannabis products that you used?
d. _____%
e. Don't know
f. Prefer not to answer

Edibles

14. How many **days** in the past month did you consume edibles?
___ *If 0, skip to end of section*

15. How many **days** in the past month did you consume the following types of edibles?

d. Candy (e.g. gummies, mints): __
e. Beverages (e.g. soda, teas, tinctures): __
f. Chocolates: __
g. Cookies or other baked goods: __

16. On the days that you used edibles in the past month, how many **sessions** (blocks of time separated by at least 2-hours where you did not use cannabis) did you typically have **in a single day**?

a. 1
b. 2

c. 3
d. 4
e. 5
f. More than 5 (specify number): __

17. In the past month, how much cannabis (in grams) did you typically consume through edibles **in a single day**?

    a. ___ g
    b. Don't know
    c. Prefer not to answer

18. How many milligrams of THC did you typically ingest from edibles **in a single day**?

    a. _____mg
    b. Don't know
    c. Prefer not to answer

19. In the past month, did you typically use store bought or homemade edible products?

    a. Always store bought
    b. Store bought most of the time (75% or more)
    c. Store bought half the time
    d. Homemade most of the time (75% or more)
    e. Always homemade

20. How many separate **days** in the past month did you use <u>any</u> cannabis product (0 to 31)?

    ____

Part II – Other Factors Associated with Cannabis Use

21. Do you typically use cannabis alone or with other people?

    a. Always or almost always alone
    b. Alone half the time
    c. Always or almost always with other people
    d. Prefer not to answer

22. How do you usually obtain your cannabis?

    g. Dealer
    h. Whatever friends have
    i. Home grown
    j. From a government-run cannabis store (online or in-person)
    k. From a non-regulated store (online or in person)
    l. Prefer not to answer

23. Do you typically use cannabis with alcohol or other substances?

    a. YES (specify substance): _____
    b. NO
    c. Prefer not to answer

Part III – History

24. How old were you when you first used cannabis?

25. How old were you when you started using it occasionally (i.e. once or twice a month)?

26. How many years altogether have you been using cannabis occasionally (i.e. once or twice a month)?

27. How old were you when you started using it regularly (i.e. at least weekly)?

28. How many years altogether have you been using cannabis regularly (i.e., at least weekly)?

29. Have you ever attempted to cut down or reduce your cannabis use?
    a. NO
    b. YES

30. Have you ever sought treatment from a physician, another health provider or counsellor, or informal support to reduce your cannabis use?
    a. NO
    b. YES

Scoring: To calculate overall estimates of cannabis and THC used in the previous month, the following questions must be coded as numerical values:

Q4, Q5, Q6 (if provided), Q10, Q13 (if provided), Q16, Q17 (if provided), Q18 (if provided)

The following estimates can then be calculated:

<u>Dry leaf</u>

Sessions per day = Q4
Total sessions = Q2 * Q4
Amount per day =Q5
THC per day = (Q6/100) * Q5
Total cannabis = Q5 * Q2
Total THC = THC per day * Q2

Concentrates

Total sessions = Q8 * Q10
THC per day
If reported hits in puffs
THC per day (in grams) = ((Q13/100) * 5.2) / 1000
if reported in drops (note: 1mL = 20 drops)
THC per day (in grams) = ((Q12*0.025)*12a)/1000
Total THC = THC per day*Q8

Edibles

Total sessions = Q14 * Q16
Total cannabis = Q17*Q14
Total THC (in grams) = (Q18*Q14)/1000

APPENDIX D: PARDI-ARFID QUESTIONNAIRE 14+

The following questions are about your eating – some ask about how things currently are, others ask about things over the past month or the past 3 months. Please tick the boxes that apply to you, or enter the information requested. **Please read each question carefully. Please answer all the questions. Thank you.**

1. Please fill in today's date:_____/___/_____(day/month/year)

2. Please fill in your date of birth: ____/_____/_____(day/month/year)

3. Are you? Male ☐ Female ☐ Other ☐

4. What is your current height? (please enter numbers): feet ☐ in ☐ **/OR** metres ☐ cm ☐

5. What is your current weight? (please enter numbers): lbs ☐ **/OR** stones ☐ lbs ☐ **/OR** ☐

6. Do you think you have a problem with eating, involving avoidance or restriction of foods or your eating overall? Yes ☐ No ☐

7. Have other people (for example, doctors, family members, significant others) said that you have a problem with eating, involving avoidance or restriction of foods or your eating overall? Yes No

8. Have your eating habits led to difficulty maintaining a sufficient weight or, if you are still growing, difficulty gaining enough weight to keep pace with your growth? Yes ☐ No ☐

9. Have your eating habits led to you losing weight (in other words, if you have lost weight, this is because of avoidance or restriction and not because of a medical illness, or other reason)? Yes No

10. If yes to #9 above, how much weight have you lost in the past 3 months? (please enter numbers): lbs ☐ **/OR** stones ☐ lbs ☐ **/OR** kg ☐ **OR** No weight loss over past 3 months ☐

11. Have others (for example, doctors, family members) been concerned about your weight loss, or been concerned that you are having difficulty gaining enough weight to grow, or having difficulty maintaining your weight due to your eating habits? Yes No

12. Have others (for example, doctors, family members) been concerned that you are not growing taller as you should due to your eating habits? Yes ☐ No ☐ I have finished growing ☐

13. Have you ever been told by **any health professional** that due to your eating habits you were not growing as expected, or that your height was less than it

should be? Yes No

14. Over the past month, has **any health professional** said that you have a nutritional deficiency due to your eating habits (for example, low iron, low vitamin B12, low vitamin C)? Yes ☐ No ☐

15. Over the past month, has **a healthcare professional prescribed** special supplements (for example, pills, capsules, powders, or drinks containing vitamins and/or minerals and other micronutrients) **specifically to help with your nutrition?** Yes No

16. If yes to #15 above, what have you been prescribed and how much do you take each day?

_____

17. Over the past month, has **a healthcare professional prescribed** special supplements (for example, high-calorie drinks or 'shots', or dessert-style high-calorie supplements) **specifically to help you maintain or gain weight?** Yes No

18. If yes to #17 above, what have you been prescribed and how much do you take each day?

19. Are you currently receiving any tube feeding (receiving food or fluid via a tube in your nose or into your stomach)? Yes No

20. If yes to #19 above, what is the name of the **food or fluid product you take via the tube** and how much do you take each day?

_____

21. Does your eating cause you difficulties in daily functioning - that is, in how you are able to go about things each day? This might be at school/college/work or when you are at home. Yes No

22. Does your eating cause you difficulties in interactions with other people (for example, disagreements or arguments with parents, siblings, significant others, co-workers), or difficulty making or sustaining friendships or other close relationships?
Please circle a number on the line below how difficult **interactions with other people** are for you because of your eating, ranging from 0 (= no difficulty) to 6 (= extremely difficult)

0 1 2 3 4 5 6

23. Does your eating cause you difficulties in social situations, for example does it make it difficult for you to go out with friends, eat at school/college/work, or stay away from home?

Please circle a number on the line below how difficult **social situations** are for you because of your eating, ranging from 0 (= no difficulty) to 6 (= extreme difficulties/try to avoid all social situations)

0 1 2 3 4 5 6

24. Over the past month, have you been particularly sensitive to variation in taste (for example, noticing slight differences in the taste of foods), which has put you off eating any foods or trying any new foods?

Please circle a number on the line below how much **sensitivity to taste** has affected your eating, ranging from 0 (= no negative effect/no particular sensitivity to taste) to 6 (= extremely negative effect, for example, leading to refusal to eat many foods, sticking only to a limited number of preferred foods, or extreme caution when eating)

0 1 2 3 4 5 6

25. Over the past month have you been particularly sensitive to the texture or consistency of food, which has put you off eating any foods or trying any new foods (for example, do you stick to foods of a certain texture only or have you had difficulty eating foods that have different textures mixed together such as pasta with sauce or sandwiches)?

Please circle a number on the line below how much **sensitivity to texture or consistency** has affected your eating, ranging from 0 (= no negative effect/no particular sensitivity) to 6 (=extremely negative effect, for example, leading to refusal to eat many foods, sticking only to a limited number of preferred foods, or extreme caution when eating)

0 1 2 3 4 5 6

26. Over the past month, have you been particularly sensitive to the appearance of food, which has put you off eating any foods or trying any new foods (for example, if food does not look "right", such as burnt ends of chips/fries, broken biscuits/cookies, or being the "wrong" colour)?

Please circle a number on the line below how much **sensitivity to the appearance of food** has affected your eating, ranging from 0 (= no negative effect/no particular sensitivity) to 6 (=extremely negative effect, for example, leading to refusal to eat many foods, sticking only to a limited number of preferred foods, or extreme caution when eating)

0 1 2 3 4 5 6

27. Over the past month, how often have you forgotten to eat or found it difficult to make time to eat? Please circle a number of the line below how often you have **forgotten to eat or found it difficult to make time to eat**, ranging from 0 (= never) to 6 (=always)

0 1 2 3 4 5 6

28. Over the past month, how often have you lacked enjoyment in food or eating (even if only certain foods)?

Please circle a number on the line below how often you **have lacked enjoyment in food or eating**, ranging from 0 (= never) to 6 (=always)

0 1 2 3 4 5 6

29. Over the past month, how often have you felt full before your meal is finished, or stopped eating sooner than others because you had had enough?

Please circle a number on the line below how often you have **felt full or stopped eating early**, ranging from 0 (= never) to 6 (=always)

0 1 2 3 4 5 6

30. Over the past month have you been avoiding or restricting the amount or type of food you eat, because you were afraid that something bad might happen, like being sick, choking, having an allergic reaction, or being in pain?

Please circle a number on the line below how often being **afraid something bad might happen** has affected your eating, ranging from 0 (= never) to 6 (=always)

0 1 2 3 4 5 6

Table 1

Sociodemographic Characteristics

Variable	N	%
Gender		
Male	23	27.7%
Female	58	69.9%
Non-binary / Other	2	2.4%
Race / Ethnicity		
American Indian / Alaskan	1	1.2%
Asian / Pacific Islander	2	2.4%
Black / African American	3	3.6%
Hispanic	1	1.2%
White / Caucasian	69	83.1%
Mixed Races	2	2.4%
Other	5	6.0%
Year in College		
Freshman	32	38.6%
Sophomore	22	26.5%
Junior	8	9.6%
Senior	21	25.3%

	M	SD
Age	19.87	1.67

Table 2

Frequency Table for Reported Cannabis Use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	56	67.5	71.8	71.8
	No	22	26.5	28.2	100.0
	Total	78	94.0	100.0	
Missing	System	5	6.0		
Total		83	100.0		

Table 3

Descriptive Statistics for Total Lack of Interest in Eating Scores

Main Way Used Concentrates	Total Sessions	M	SD	N
Other	Occasionally	2.7222	1.43630	6
	Frequently	2.3333	.47140	2
	Total	2.6250	1.24004	8
Vaping	Occasionally	1.6889	1.16474	15
	Frequently	2.0000	.72008	4
	Very Frequently	2.8889	2.58915	3
	Total	1.9091	1.33801	22
Total	Occasionally	1.9841	1.30161	21
	Frequently	2.1111	.62063	6
	Very Frequently	2.8889	2.58915	3
	Total	2.1000	1.33089	30

Note. Mean Lack of Interest Scores by method of delivery and frequency of use.

Table 4

Tests of Between-Subject Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6.874[a]	4	1.719	.966	.444	.134
Intercept	92.882	1	92.882	52.190	<.001	.676
Main_Way_Used_ Concentrates_Binary	1.899	1	1.899	1.067	.311	.041
New_Total_Sessions_Ord	2.669	2	1.335	.750	.483	.057
Main_Way_Used_Concentrates_Binary * New_Total_sessions_Ord	.498	1	.498	.280	.601	.011
Error	44.493	25	1.780			
Total	183.667	30				
Corrected Total	51.367	29				

a. R Squared = .134 (Adjusted R Squared = -005)

Note. Dependent variable: Total Lack of Interest score

Table 5

Frequency Table for the Main way Cannabis was Used

Variable	N	%
Dried Cannabis Leaf		
Pipe / One-hitter	8	21.6%
Bong / Hookah	2	5.4%
Joint / Blunt	17	45.9%
Dried Herb Vape Pen	10	27.0%
Cannabis Concentrates		
Pipe	3	10.0%
Joint	2	6.7%
Vaping / Shatter Pen	22	73.3%
Ingestion	1	3.3%
Dabbing	1	3.3%
Other	1	3.3%

Note. Frequency of the type of cannabis use over 30 days