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Patterns of the Use and Perception of Cannabis among College Students in Tennessee

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Patterns of the Use and Perception of Cannabis among College Students in Tennessee

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ABSTRACT

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Cannabis has been historically difficult to research due to its federal scheduling. However, as legalization of cannabis medically, recreationally, or both in states across the country has increased, so has the need to address the research gaps that persist. The purpose of this study was to explore the patterns of cannabis use and perceptions of college students in Tennessee, which encompass a demographic of mainly young adults who are typically associated with high usage patterns. The study uses quantitative data collected from an online survey sent to a university in East Tennessee to evaluate associations between students’ age, gender, race/ethnicity, class cohort, and political party affiliation. The results demonstrate that most of the students have used cannabis and support cannabis legalization. Policy implications for the campus and state are suggested.

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Chapter 1. Introduction

Cannabis (*Cannabis sativa*) is a plant species that originated 28 million years ago in the Tibetan plateau and spread across the Western hemisphere (Lawler, 2019; Patton, 2020). It has been cultivated worldwide, having multiple uses throughout human civilization. Its fiber has been used for rope, cloth, and textiles; its seeds for oil, paint and animal feed; and its resin for medicine, religious ceremonies, and as an intoxicant (Patton, 2020; U.S. Drug Enforcement Administration, "DEA", 2021). In the United States of America (USA), cannabis is mainly associated with its ability to be used as a drug. It is a popular drug of choice and one of the most commonly used federally illegal drugs in the USA (Substance Abuse and Mental Health Services Administration, "SAMHSA", 2020).

Brief History

Although cannabis has been criminalized in the USA, this was not always the case. In the early history of the United States (U.S.), cannabis was legally cultivated and encouraged by the government to play a role in the development of U.S. agriculture (DEA, 2021; Patton, 2020). Cannabis was also perceived as a medicinal plant that could treat pain and other diseases as early as 1850 when cannabis was listed in the U.S. Pharmacopeia (Bridgeman & Abazia, 2017; Crocq, 2020; Mead, 2019; Patton, 2020). However, attitudes towards cannabis and its potential effects started to shift. By the 20th century, a stigma developed around the plant's psychoactive properties and this fear led to many states creating restrictions on the plant and its uses (Mead, 2019; Patton, 2020). Eventually as this fear grew, the federal government responded by enacting strict regulations on the cannabis plant which effectively prevented its production, sale, and possession by passing the Marihuana[sic] Tax Act of 1937 (Campos, 2018; Crocq, 2020; Mead 2019; Musto, 1972; Patton, 2020). The media also perpetuated concerns and fears of cannabis by

spreading the narrative that cannabis was a dangerous drug that could lead people to insanity and violence like in the film "Reefer Madness" in the late 1930s (Patton, 2020; Stringer & Maggard, 2016). However, towards the late 20th century, there was a rise in countercultural movements that embraced cannabis usage and the potential of how it could be used medically and therapeutically (Mead, 2019; Patton, 2020). Even though the Marihuana[sic] Tax Act was ruled unconstitutional in 1969, cannabis was classified as a Schedule I drug in the Controlled Substance Act of 1970 (*Leary v. United States*, 1969; Mead, 2019; Patton, 2020; Sacco, 2022).

The Controlled Substance Act (CSA) is a statute established by the U.S. government to help guide drug policy by creating categories and regulations for specific drugs (Mead, 2019; Patton, 2020; Sacco, 2022). The CSA developed five schedules to categorize substances based on their medical value, potential for abuse, potential for dependency, and safety. Schedule I substances are perceived as the most dangerous and addictive drugs while Schedule V substances are perceived as the least (Mead, 2019; Patton, 2020; Sacco, 2022). Cannabis is classified as a Schedule I drug, which is described as having "a high potential for abuse, no currently accepted medical use in treatment in the United States of America, and a lack of accepted safety for use under medical supervision" (U.S. Department of Justice & Drug Enforcement Administration, 2020, p. 1). Since the birth of the CSA, cannabis has remained a Schedule I drug for over 50 years (Patton, 2020; Sacco, 2022).

Despite the legal framework of the CSA, there is a U.S. federal-state policy gap when it comes to the cultivation, possession, and distribution of cannabis, arising from the reality that many states have legalized cannabis for medicinal use, recreational use, or both (Bridgeman & Abazia, 2017; Hutchison et al., 2019; Mead, 2019; Patton, 2020; Sacco, 2022; Yu et al., 2020). California was the first state to legalize cannabis for medical use in 1996 (Patton, 2020; Sacco,

2020). Then, at the end of 2012, Colorado and Washington became the first states to legalize cannabis for recreational use (Patton, 2020; Sacco, 2020). As of April 24th, 2023, 38 states, three territories, and the District of Columbia have legalized cannabis for medical use, and 23 states, two territories, and the District of Columbia have legalized cannabis for recreational use (National Conference of State Legislatures, "NCSL", 2023). The passage of state laws for the medicinal and recreational use of cannabis directly contrasts with the federal government's policy that continues to maintain that cannabis has no medical value and that the use of cannabis is a federal crime (DEA, 2021; Mead, 2019; Sacco, 2020).

Regardless of federal and state legality, people use cannabis across the U.S. The 2021 National Survey on Drug Use and Health (NSDUH) reported that 45.7 percent of people in the U.S. aged 12 years and older had used federally illegal cannabis at least once in their lifetime (Center for Behavioral Health Statistics and Quality, 2022). Young adults aged 18-25 have the highest past-year usage at 35.4 percent, 11.8 million people, compared to only 18.7 percent of all people aged 12 years and older (SAMHSA, 2022). Thus, half of the U.S. population has committed a federal drug crime, with young adults being the primary agents. In addition to usage, the support for cannabis legalization has significantly increased over the past 20 years, aligning with the fact that more and more U.S. citizens are living in states where cannabis is legal medically, recreationally, or both (NCSL, 2023; Schaeffer, 2023). Additionally, nearly 90 percent of U.S. adults say cannabis should be legal for medical or recreational use, and most U.S. adults support relaxing criminal sanctions for people with cannabis convictions (Schaeffer, 2023).

Redefining Cannabis: The Impact of the 2014 and 2018 Farm Bills

In 2014, the federal government passed the Agriculture Improvement Act of 2014 (e.g., 2014 Farm Bill) (P.L. 113-79), which made the distinction of "industrial hemp", defining it as cannabis plant material that contains less than 0.3% delta-9-tetrahydrocannabinol (delta-9-THC) on a dry weight basis (Johnson, 2021). Delta-9-THC is considered one of the main psychoactive compounds of cannabis, which produces the effect of a "high" (Felder & Glass, 1998). The 2014 Farm Bill created a pilot program that legalized industrial hemp cultivation for research by institutions of higher education or state departments of agriculture (Johnson, 2021). Since industrial hemp was a variety of cannabis, it was still considered a Schedule I substance, illegal under federal law (Johnson, 2021; Sacco, 2020).

At that time, "cannabis" under the CSA meant that all varieties and compounds of the plant, except for stalk/fiber and sterilized seeds, were federally criminalized (Mead, 2019; Sacco, 2020). However, this would change after the enactment of the Agriculture Improvement Act of 2018 (e.g., 2018 Farm Bill) (P.L. 115-334), which amended what the federal government constituted as illegal cannabis in the CSA by excluding "hemp", cannabis plant material that contains less than 0.3% delta-9-THC (Hemp Production and the 2018 Farm Bill, 2019; Sacco, 2020). Hemp is now considered an agricultural crop that can be cultivated for commercial use at a state's discretion under a U.S. Department of Agriculture (USDA) license and USDA regulations (Johnson, 2021). Thus, the criminalization of cannabis is now more specifically focused on cannabis plant material with more than 0.3% delta-9-THC, commonly referred to as "marijuana" (Johnson, 2021; Sacco, 2020; SAMHSA, 2023).

The 2018 Farm Bill legalizes the production of cannabis products that fall within the definition of hemp, like cannabidiol (CBD) which is a cannabinoid (e.g., a compound of

cannabis) that does not produce the “high” of delta-9-THC although it can have an impact on brain activity (Batalla et al., 2021; ElSohly et al., 2017; Pellati et al., 2018). Since 2018, public interest in CBD has increased drastically, primarily due to its potential for medicinal and therapeutic uses (Leas et al., 2019; Narayanan et al., 2020; SAMHSA, 2023). However, the boom in CBD products in dispensaries, retail stores, and online has outpaced clinical research. There are no federal standards to regulate them as many of them are not approved by the U.S. Food and Drug Administration (FDA) (Cooper et al., 2021; Gibson et al., 2021; Hutchison et al., 2019; SAMHSA, 2023). For instance, the FDA has only approved one CBD product as a medicine, the prescription medication Epidiolex (Cooper et al., 2021; Oberbarnscheidt & Miller, 2020; SAMHSA, 2023). Despite non-FDA approval, in 2019, it was documented that over 270,000 U.S. retail stores sold commercial CBD products, with about 33 percent of adults stating that they have used a CBD product at least once in their lifetime (Brenan, 2019; Berger, 2021; SAMHSA, 2023). Additionally, in 2022, CBD products amounted to national sales of close to 5.3 billion U.S. dollars (Conway, 2023). However, due to inadequate quality control measures, the actual CBD concentration in commercial CBD products may be inaccurately stated, and the production process might introduce harmful biological and chemical impurities that have limited evidence to support their safety (Oberbarnscheidt & Miller, 2020; SAMHSA, 2023).

The 2018 Farm Bill has also legalized the production of a multitude of psychoactive cannabis products that are derived and synthesized from hemp like delta-8-THC, delta-10-THC, hexahydrocannabinol (HHC), tetrahydrocannabiphorol (THCP), and tetrahydrocannabivarin (THCV) (Harlow et al., 2022; Rossheim et al., 2023). The most common and popular products are composed of delta-8-THC (Kruger & Kruger, 2022; Livingston et al., 2022; LoParco et al., 2023; Rossheim et al., 2023). Delta-8-THC is a psychoactive compound naturally found in

cannabis plants at very low levels (LoParco et al., 2023; SAMHSA, 2023). Most of the delta-8-THC sold commercially is synthesized from CBD using a series of chemical reactions that could contain harmful byproducts which are understudied (Harlow et al., 2022; LoParco et al., 2023; SAMHSA, 2023). Delta-8-THC products can produce effects like relaxation, pain relief, cognitive distortions, short-term memory loss, and a heightened sense of time similar to but less potent than delta-9-THC (Bergeria et al., 2023; Kruger & Kruger, 2022). Like CBD, the growth in delta-8-THC and other synthesized psychoactive cannabis products has outpaced clinical research's need to document the health impacts of this type of usage (LoParco et al., 2023; SAMHSA, 2023). These products have become especially popular in states where recreational cannabis (e.g., cannabis plant material with a delta-9-THC concentration greater than 0.3%) is illegal (Leas et al., 2022; Livingston et al., 2022).

For example, in Tennessee, the recreational and medicinal use of cannabis with a delta-9-THC concentration greater than 0.3% is illegal (Tennessee Bureau of Investigation, 2019; Tenn. Code Ann. § 39-17-415). Despite this illegal status, 13.3 percent of the population, 754,000 people, and 30.1 percent of young adults aged 18-25 have used illicit cannabis between 2017 and 2019 (SAMHSA, 2020). However, the passage of the 2018 Farm Bill (Senate Bill 357 / House Bill 844) legalized hemp-derived products like CBD, delta-8-THC, delta-10-THC, HHC, THCP, and THCV in the state (Byrd, 2023; Jones, 2023; Smith, 2023). Thus, it is legal to use certain forms of cannabis and even to get "high" as long as the cannabis product falls within the definition of hemp. Recently, the Tennessee government passed House Bill 403 and Senate Bill 378, which became effective July 1st, 2023, increasing regulation of these hemp-derived products by requiring consumers to be at least 21 years old to purchase and enforcing a six percent tax along with other revisions to licensing, testing, labeling, and safety requirements.

Even though this new bill increases regulation, it still allows the production and usage of cannabis-derived products that are lacking in adequate research on consumer health effects (Cooper et al., 2021; LoParco et al., 2023; SAMHSA, 2023).

The Cannabis Research Gap

The gap in research on the health impacts of legalized hemp-derived products is becoming increasingly important to understand (Cooper et al., 2021; Leas et al., 2022; Livingston et al., 2022; LoParco et al., 2023; SAMHSA, 2023). However, research on cannabis in general and its impact on human consumers has been lacking well before the introduction of these products mainly due to the barriers caused by the federal scheduling of cannabis (Cooper et al., 2021; Hutchison et al., 2019; Mead, 2019; NASEM, 2017; Nutt et al., 2013). Schedule I substances are regarded as hazardous drugs, so in order to research them, researchers must often interact with several federal agencies like the National Institute on Drug Abuse (NIDA), the U.S. Food and Drug Administration (FDA), and the U.S. Drug Enforcement Administration along with state departments, local agencies, institutions, or organizations (Cooper et al., 2021; Hutchison et al., 2019; Mead, 2019; NASEM, 2017; Nutt et al., 2013). The process to begin research is entrenched by many legal and regulatory barriers that has and continues to discourage and deter researchers from pursuing cannabis research in the first place (Cooper et al., 2021; NASEM, 2017; Nutt et al., 2013).

Furthermore, from 1970 to 2021, the federal government had only authorized a single supplier of cannabis for research, the National Center for the Development of Natural Products at the University of Mississippi, whose production was exclusively for the NIDA (Cooper et al., 2021; DEA, 2021; Hutchison et al., 2019; NASEM, 2017). Having only one entity authorized to produce cannabis for research has presented barriers for other research entities and a lack of

external validity to produce the variety and potency of products that are widely available throughout the country (Cooper et al., 2021; Hutchison et al., 2019; NASEM, 2017). These barriers have historically made cannabis research challenging to conduct and have stunted the growth of information necessary to inform public health and education (Cooper et al., 2021; Hutchison et al., 2019; Mead, 2019; NASEM, 2017).

However, as mentioned earlier, the federal government has taken steps to increase research on cannabis (e.g., hemp) with the passing of the 2014 and 2018 Farm Bills (Johnson, 2021). Then, in 2019, the DEA acknowledged the need to increase medical and scientific research on cannabis by creating applications for additional bulk manufacturers to grow cannabis with a delta-9-THC concentration greater than 0.3% for research purposes (Cooper et al., 2021; DEA, 2019; DEA, 2021). As of 2023, there are eight entities that the DEA has authorized to do so: (1) Biopharmaceutical Research Company LLC, (2) Bright Green Corporation, (3) Groff NA Hemplex LLC, (4) Irvine Labs, Inc., Maridose, LLC, (5) National Center for Development of Natural Products, (6) Royal Emerald (7) Pharmaceuticals Research and Develop, and (8) Scottsdale Research Institute (U.S. Department of Justice and U.S. Drug Enforcement Administration, 2023). These changes make obtaining cannabis for research more accessible, which will likely increase the knowledge of cannabis with time (DEA, 2021). Nevertheless, the current reality still stands that the production and usage of widely available cannabis products exceed the pace of research and the knowledge about its short- and long-term effects on the human body (Cooper et al., 2021; Hutchison et al., 2019; Oberbarnscheidt & Miller, 2020; SAMHSA, 2023).

Current Study

The current study aims to address this need for continued research by exploring the patterns that emerge from the use and perceptions of cannabis among college students in Tennessee by evaluating associations between their age, gender, race/ethnicity, and class cohort. Tennessee is a state of confusing cannabis laws where cannabis can be legal or illegal depending on the delta-9-THC concentration of the plant material. Regardless of the legality, cannabis is being used mainly by young adults, and there has been an increase in the production of legal cannabis products in the state. Being that cannabis products are lacking in research regarding their health impacts, studying the usage and perceptions of cannabis among a population of primarily young adults (e.g., college students) can help inform clinical research, public policy, education, and harm reduction strategies. This study can provide a foundation of knowledge and data that can guide the design and assessment of clinical trials, treatment programs, and interventions related to substance use, inform evidence-based public policies that align with the needs, attitudes, and beliefs of the population, and promote the development of public education campaigns grounded in recent and relevant data (NASEM, 2017; Research Triangle Institute, 2021).

List of Terms

Cannabis = a flowering plant that is used for medicinal, recreational, and industrial purposes (Patton, 2020)

Cannabinoids = a class of chemical compounds that interact with the endocannabinoid system in the human body. Cannabinoids can be naturally occurring, as found in the cannabis plant, or synthetic, created through chemical processes (Capodice & Kaplan, 2021)

Delta-9-tetrahydrocannabinol (Delta-9-THC) = the main psychoactive cannabinoid of cannabis that produces the effect of a "high" (Felder & Glass, 1998)

Federally Illegal Cannabis = cannabis plant material with more than 0.3% delta-9-THC, commonly referred to as "marijuana" (Sacco, 2020)

Hemp = cannabis plant material that contains less than 0.3% delta-9-tetrahydrocannabinol (delta-9-THC) on a dry weight basis (Johnson, 2021)

Cannabidiol (CBD) = a cannabinoid of the cannabis plant that does not produce the "high" of delta-9-THC although it can have an impact on brain activity (Batalla et al., 2021)

Delta-8-THC, Delta-10-THC, hexahydrocannabinol (HHC), tetrahydrocannabiphorol (THCP), and tetrahydrocannabivarin (THCV) = psychoactive cannabinoids that can be derived and synthesized from hemp (Harlow et al., 2022; Rossheim et al., 2023)

Chapter Summary

The purpose of this chapter was to introduce the significance of cannabis in the USA by providing a brief history that includes the federal scheduling of cannabis, the federal-state policy gap, and the general use and perceptions of cannabis among U.S. adults. In addition, it discussed the redefining of cannabis at the federal level that led to the growth of legal hemp-derived products that continues to contribute to the cannabis research gap about the health costs for consumers. Chapter two will expand on the literature pertaining to cannabis production, potential health effects, cannabis usage and its perceptions in the USA and how they vary based on demographic characteristics. Chapter three will present the methodology of this study by discussing the survey instrumentation, sampling strategy, and the statistical models used to analyze the variables. Chapter four will present the study's findings, and Chapter five will

discuss the implications of these results and offer guidance for future research, public policy, and education.

Chapter 2. Literature Review

Introduction

Since 1996, when California became the first state to legalize cannabis for medical use, there have been drastic changes in the legal availability of cannabis and cannabis products across the United States of America (USA) (Mead, 2019; Patton, 2020; Sacco, 2022; SAMHSA, 2023; Spindle et al., 2019; Yu et al., 2020). As mentioned in the previous chapter, 38 states, three territories, and the District of Columbia have legalized cannabis for medical use, and 23 states, two territories, and the District of Columbia have legalized cannabis for recreational use (NCSL, 2023). Additionally, and because of the 2014 and 2018 farms bills, at least nine states (e.g., Tennessee) have legalized low-THC, high CBD products despite having state laws that continue to criminalize cannabis for recreational and medicinal use (NCSL, 2023; Sacco, 2020).

The continued legalization of cannabis among states across the country has created the reality that much of the USA population lives either in states where cannabis is legal to some degree or in states neighboring these (NCSL, 2023). The cannabis market has grown with the spread of cannabis legalization, reaching 27 billion dollars in sales in 2022, and is expected to be worth $50.7 billion in 2028 (Zehner, 2023). Although there is a gap in the scientific knowledge and public understanding of their health effects, the United States (U.S.) population has access to a variety of cannabis products that can be readily found in dispensaries, retail stores, and online (Cooper et al., 2021; Hutchison et al., 2019; SAMHSA, 2023; Spindle et al., 2019). Therefore, the need to understand cannabis and the relationship between consumers across the country is becoming increasingly apparent. This chapter will provide a literature review of cannabis production, potential health effects, cannabis usage patterns, and the perceptions of cannabis in the USA.

Cannabis Production

Cannabis Botany

Cannabis sativa Linnaeus (*L.*) is an ancient plant species (Abel, 2013; Lawler, 2019; Patton, 2020; Thomas & ElSohly, 2016). Its taxonomic classification has been a subject of debate and revision over the years, especially surrounding whether certain cannabis plants are distinct species or subspecies (Erkelens & Hazekamp, 2014; Hillig & McPartland, 2004; McPartland, 2018; Piomelli, & Russo, 2016; Pollio, 2016; Small & Cronquist, 1976). However, due to the extensive hybridization of cannabis plants, which has produced a wide range of varieties, it has become difficult to separate cannabis into a traditional classification system (McPartland, 2018; Pollio, 2016; Sarma et al., 2020). With the advancement of genetic analysis, some taxonomists and scholars have advocated for a more sophisticated classification system based on genetic markers and chemical profiles rather than traditional morphology (Jin et al., 2021; Sarma et al., 2020; Spindle et al., 2019). For the sake of this chapter, *Cannabis sativa L.* will describe the entire cannabis plant species and will be referred to as "cannabis."

Cannabis is a flowering herb that is mainly dioecious, meaning it has separate male and female plants (Raman et al., 2017; United Nations Office on Drugs and Crime, "UNODC," 2013). Depending on environmental, genetic, and cultivation factors, the cannabis plant often grows between one to three meters in length, where male plants are typically taller than female plants (Ramen et al., 2017; Stefkove et al., 2022; UNODC, 2013). The cannabis plant is notoriously recognized for the structure of its fan leaves (Hesami et al., 2023). Fan leaves are serrated and palmate, which means multiple leaflets radiate from a central point (i.e., the term "palmate" describes how the leaflets are arranged in a palm-like fashion) (Gloss, 2015; Raman et al., 2017). Fan leaves are the plant's larger, more prominent leaves and are predominantly

responsible for photosynthesis (Hesami et al., 2023; McGue et al., 2021; Rodriguez-Morrison et al., 2021). Although the image of the plant's fan leaves is well-known, the cannabis plant's inflorescence, which refers to the flowering or reproductive part of the plant, is the primary focus of the recreational and medicinal cannabis industries (Hesami et al., 2023; Malabadi et al., 2023; Spitzer-Rimon et al., 2019; Thomas & ElSohly, 2016). Both male and female plants produce flowers; however, their floral anatomies differ (Malabadi et al., 2023; Thomas & ElSohly, 2016; Raman et al., 2017). The inflorescence of female cannabis plants has a larger floral biomass compared to male plants and a denser concentration of glandular trichomes (Bernstein et al., 2019; Malabadi et al., 2023; Spitzer-Rimon et al., 2019; Stefkov et al., 2022; Tanney et al., 2021; Thomas & ElSohly, 2016). Glandular trichomes are tiny, hair-like structures that are found on the surface of various parts of the cannabis plant, mainly the flowers and sugar leaves, which are small leaves that grow out of the flower buds (Andre et al., 2016; Bernstein et al., 2019; Lorensen et al., 2023; Spitzer-Rimon et al., 2019; Tanney et al., 2021). They produce a resinous secretion that is rich in more than 600 phytochemicals, such as cannabinoids, terpenes, and phenolic compounds (Spitzer-Rimon et al., 2019; Stefkov et al., 2022; Tanney et al., 2021). Although the exact purpose of the glandular trichomes' resin is still unclear, some research has proposed that it serves as a defensive mechanism for the cannabis plant (Bernstein et al., 2019; Chandra et al., 2017; Hesami et al., 2023; Tanney et al., 2021).

Of the chemical compounds produced by these hair-like structures, there are over 110 cannabinoids, 120 terpenes, and 20 flavonoids (e.g., a phenolic compound) (Tanney et al., 2021). Cannabinoids are the primary active compounds in the cannabis plant, with the two most well-known compounds being delta-9-tetrahydrocannabinol (delta-9-THC) and cannabidiol (CBD) (ElSohly et al., 2016; Tanney et al., 2021; Thomas & ElSohly, 2016). Other cannabinoids

include delta-8-THC, cannabinol (CBN), and cannabigerol (CBG) (Sarma et al., 2020; Stasiłowicz et al., 2021). Cannabinoids have been of interest due to their range of psychoactive and therapeutic effects (Andre et al., 2016; Batalla et al., 2021; NASEM, 2017; Pellati et al., 2018; Thomas & ElSohly, 2016). Terpenes are organic compounds that are responsible for the aroma and flavor of different cannabis strains and can play a role in modifying the effects of cannabinoids (Andre et al., 2016; Isidore et al., 2021; Sommano et al., 2020; Tanney et al., 2021). Some common terpenes found in cannabis include myrcene, limonene, pinene, and linalool (Andre et al., 2016; Sommano et al., 2020; Thomas & ElSohly, 2016). Phenolic compounds are less well-studied than cannabinoids and terpenes (Isidore et al., 2021; Tanney et al., 2021). They are bioactive compounds associated with antioxidant and anti-inflammatory properties (Andre et al., 2016; Isidore et al., 2021; Izzo et al., 2020; Khoddami et al., 2013). Flavonoids are a common phenolic compound found in cannabis plants, which are pigments that contribute to the plant's coloration (Andre et al., 2016; Isidore et al., 2021; Izzo et al., 2020; Khoddami et al., 2013).

Cannabis Cultivation

Due to its larger floral biomass, the cultivation of the female cannabis plant is the exclusive focus for recreational and medicinal cannabis production facilities (Chandra et al., 2017; Malabadi et al., 2023; Spitzer-Rimon et al., 2019; Thomas & ElSohly, 2016; Wizenberg et al., 2020). A popular cultivation technique for cannabis is called sinsemilla (Chandra et al., 2020; Thomas & ElSohly, 2016; UNODC, 2013). The term "sinsemilla" comes from the Spanish words "sin" (without) and "semilla" (seed) (Thomas & ElSohly, 2016; UNODC, 2013). This cultivation technique aims to produce female cannabis plants that are not pollinated and thus do not produce seeds (Feder et al., 2021; Thomas & ElSohly, 2016; UNODC, 2013). When the female cannabis

plant is unfertilized, it will direct more energy toward producing phytochemicals like cannabinoids, terpenes, and phenolic compounds by increasing the plant's surface area (Feder et al., 2021; Malabadi et al., 2023; Wizenberg et al., 2020). Thus, sinsemilla cultivation is highly sought after because of its potential to produce inflorescence with higher concentrations of phytochemicals (Feder et al., 2021; Malabadi et al., 2023; UNODC, 2013). It is the utmost importance during sinsemilla cultivation to protect the female plants from pollination in order to avoid energy being spent on seed production (Malabadi et al., 2023; Thomas & ElSohly, 2016; UNODC, 2013). Given the need to prevent pollination and the fact that cannabis plants are wind-pollinated, male plants are rarely included in cultivation areas as just one male cannabis plant can lead to unwanted pollination and thus alter the entire cannabis crop (Chandra et al., 2017; Malabadi et al., 2023; Thomas & ElSohly, 2016; Wizenberg et al., 2020;).

The cultivation of cannabis can start from seed or the use of cloning (Chandra et al., 2017; Thomas & ElSohly, 2016; UNODC, 2013). The seeds or clones used to grow cannabis often start with the selection of a "mother" plant, which is a mature, healthy female cannabis plant that has been selected for its desirable traits (Chandra et al., 2017; Chandra et al., 2020; Malabadi et al., 2023; Thomas & ElSohly, 2016). When cannabis is grown from seed, the plants are usually 50 percent male and 50 percent female (Chandra et al., 2020; Thomas & ElSohly, 2016). At the early flowering stage, male plants are distinguishable from female plants and can be removed in order to induce sinsemilla cultivation (Chandra et al., 2017; Chandra et al., 2020; Malabadi et al., 2023; Thomas & ElSohly, 2016). However, it must be noted that it is possible to produce seeds that will only yield female offspring and thus eliminate the step of removing male plants (Chandra et al., 2017; Malabadi et al., 2023). Regardless, growing cannabis from seed will most likely produce variety in the chemical makeup of the plants which does not allow for

uniformity in the production of cannabis products (Chandra et al., 2017; Chandra et al., 2020; Thomas & ElSohly, 2016). For cloning, a cutting, typically a small section of a branch containing nodes, leaves, and part of the stem, is taken from the mother plant (Chandra et al., 2017; Chandra et al., 2020; Thomas & ElSohly, 2016; UNODC, 2013). If the cutting is successfully rooted and transplanted, it will create a genetically identical plant (Thomas & ElSohly, 2016; UNODC, 2013;). Clones can also be created through biotechnological techniques called micropropagation, which uses tissue cultures from the mother plant (Chandra et al., 2017; Chandra et al., 2020; Thomas & ElSohly, 2016). Being able to produce cannabis plants with genetic consistency is a benefit of using this technique as it can help preserve certain qualities of the final cannabis product like its potency and aroma (Chandra et al., 2020; Thomas & ElSohly, 2016; UNODC, 2013; Wizenberg et al., 2020). To fulfill the demand for consistent products, recreational and medicinal industries use cloning as an effective tool (Chandra et al., 2020; Thomas & ElSohly, 2016).

Both outdoor and indoor cannabis cultivation is practiced in the recreational and medicinal industries (Chandra et al., 2017; Chandra et al., 2020; Potter et al., 2016; Thomas & ElSohly, 2016; UNODC, 2013; Zheng et al., 2021). Outdoor cultivation is the traditional and original method of growing cannabis, relying on the outdoor environment like natural sunlight and soil to nurture the plants (Chandra et al., 2017; Potter et al., 2016; Thomas & ElSohly, 2016; UNODC, 2013; Zheng et al., 2021). This method is popular for various reasons, including its ability to be economical, the opportunity to produce larger yields, and its reliance on natural resources (Chandra et al., 2017; Thomas & ElSohly, 2016; Zheng et al., 2021). However, outdoor cultivation has its challenges as it is at the mercy of the environment, making it prone to damage from the weather, exposure to disease and pests, and security concerns (Potter et al.,

2016; Thomas & ElSohly, 2016; Zheng et al., 2021). On the other hand, indoor cultivation involves growing cannabis plants in a controlled indoor environment, which can range from a grow room or tent to an extensive greenhouse (Chandra et al., 2017; Potter et al., 2016; Thomas & ElSohly, 2016; UNODC, 2013; Zheng et al., 2021). Growing cannabis indoors gives cannabis cultivators more control over the environment which can help produce consistent quality across the cannabis crops by controlling the lighting, air circulation, temperature, and humidity, while also providing security from others (Chandra et al., 2017; Thomas & ElSohly, 2016; Zheng et al., 2021). However, some pitfalls for indoor cannabis cultivation are energy consumption, the limitations of space, and the potentially large financial investment to purchase the proper equipment and build the infrastructure (Potter et al., 2016; Thomas & ElSohly, 2016; Zheng et al., 2021). It is important to note that as the mass cultivation of cannabis outdoors and indoors increases due to the rise in demand, there is a pressing need to understand the environmental impacts of cannabis cultivation and the development of sustainable practices (Zheng et al., 2021).

Within both outdoor and indoor cultivation, cannabis is harvested, dried, and cured before it is stored for further processing (Addo et al., 2021; Chandra et al., 2017; Chandra et al., 2020; Jin et al., 2019; Thomas & ElSohly, 2016; Ubeed et al., 2022). For the recreational and medicinal cannabis industries, cannabis is harvested for its mature flower buds, where the timing of this harvest can significantly impact the quality of the product (Chandra et al., 2017; Chandra et al., 2020; Jin et al., 2019; Thomas & ElSohly, 2016). The entire plant can be harvested at once, or selected flower buds can be harvested depending on their maturity (Chandra et al., 2017; Thomas & ElSohly, 2016). After harvesting the cannabis plants, proper drying is essential (Addo et al., 2021; Jin et al., 2019; Ubeed et al., 2022). The cannabis plant material can be dried in a

variety of ways: hang drying, oven drying, and forced-air drying (Addo et al., 2021; Chandra et al., 2017; Chandra et al., 2020; Ubeed et al., 2022). Then, the flower buds are separated from the stem, branches, and leaves (Addo et al., 2021; Thomas & ElSohly, 2016; Ubeed et al., 2022). Next, the cannabis buds can be cured by storing them in airtight containers while maintaining a specific temperature and humidity (Addo et al., 2021; Jin et al., 2019; Ubeed et al., 2022). The curing stage can enhance certain qualities of the flower, and the length of this process typically depends on the cultivator's preference (Addo et al., 2021; Ubeed et al., 2022). Lastly, for storage, cannabis buds are placed in airtight containers and stored in a cool, dark room or freezer (Addo et al., 2021; Chandra et al., 2017; Chandra et al., 2020; Jin et al., 2019; Thomas & ElSohly, 2016).

Cannabis Decarboxylation and Extraction

The cannabinoids found in cannabis plants are present in their inactive acidic forms and must go through a process called decarboxylation in order to activate their psychoactive and other effects (Reason et al., 2022; Sarma et al., 2020; Wang et al., 2016). The process of decarboxylation involves applying heat to the cannabis which causes a carboxyl group to be removed from the cannabinoid acids, converting these acidic forms into their active counterparts (Reason et al., 2022; Sarma et al., 2020; Wang et al., 2016). For instance, tetrahydrocannabinolic acid (THCA) and cannabidiolic acid (CBDA) are converted to the well-known THC and CBD (Reason et al., 2022; Sarma et al., 2020; Wang et al., 2016). Smoking, vaporizing, and oven baking are a few popular methods of performing decarboxylation (Reason et al., 2022; Sarma et al., 2020; Wang et al., 2016). This process of activating the cannabinoids present in cannabis can occur before or after the process of cannabis extraction (Lazarjani et al., 2021; Reason et al., 2022).

Cannabis extraction is a widespread practice for recreational and medicinal industries to create concentrated forms of cannabis (Addo et al., 2021; Pattnaik et al., 2022; Sarma et al., 2020). However, cannabis does *not* need to go through an extraction process in order to be used recreationally or medicinally (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019). Cannabis extraction refers to the process of separating phytochemicals like cannabinoids and terpenes from the plant in order to make cannabis concentrates (Addo et al., 2021; Lazarjani et al., 2021; Pattnaik et al., 2022). There are two main categories of cannabis extraction methods: solvent-based and solventless (Blake & Nahtigal, 2019; Lazarjani et al., 2021; Pattnaik et al., 2022). Solvent-based extraction refers to the use of chemical solvents to dissolve and extract the phytochemicals of cannabis, often using solvents like ethanol, butane, propane, and carbon dioxide (Addo et al., 2021; Lazarjani et al., 2021; Pattnaik et al., 2022). Solventless extraction is a technique of cannabis extraction without the use of solvent chemicals and instead relies on different methods like heating and pressure (e.g., rosin pressing) (Blake & Nahtigal, 2019; Lazarjani et al., 2021; Pattnaik et al., 2022). Solventless extraction methods can generally be considered safer than solvent-based extractions because solvent-based extractions may leave residual solvents and impurities in the final extract (Blake & Nahtigal, 2019; King, 2019; Lazarjani et al., 2021; Raber et al., 2015). However, the benefit of using solvent-based extractions is the ability to produce higher quantities of cannabis extracts which is preferable for large companies looking to provide a variety of cannabis products (Blake & Nahtigal, 2019; King, 2019). Due to the possibility of solvent byproducts being left in the final product, post-extraction processing is often employed to minimize these (Citti et al., 2019; King, 2019; Li et al., 2022). Thus, the choice of extraction method can impact the quality of cannabis products and

will contribute to varying levels of safety, efficiency, and costs (Addo et al., 2021; Blake & Nahtigal, 2019; King, 2019; Li et al., 2022).

Cannabis Products and Methods of Consumption

In the U.S., cannabis products are generally divided into two major cannabis groups: hemp (cannabis with less than 0.3% delta-9-THC) and federally illegal cannabis (cannabis with greater than 0.3% delta-9-THC), which is commonly referred to as marijuana (Schwabe & McGlaughlin, 2019; Sacco, 2020; Sarma, 2020). Within the latter group specifically, colloquial terms like “sativa”, “indica”, and “hybrid” have been used to describe different varieties of the cannabis plant, giving rise to hundreds of strain names like "Sour Diesel," "Purple Kush," and "Tahoe O.G." (Jin et al., 2021; Sarma, 2020; Schwabe & McGlaughlin, 2019). However, these so-called strains do not create a reliable foundation by which different types of cannabis can be consistently and accurately categorized and identified (Jin et al., 2021; Sarma, 2020; Schwabe & McGlaughlin, 2019). Thus, the creation of cannabis chemotypes has been used to distinguish distinct chemical profiles of the cannabis plants (Jin et al., 2021; Sarma, 2020; Spindle et al., 2019) Mainly based on the relative concentrations of the most active cannabinoids THC and CBD, three main chemotype categories have emerged (Jin et al., 2021; Sarma, 2020; Spindle et al., 2019). Type I, or THC-dominant, cannabis plants have high levels of THC and low levels of CBD (Jin et al., 2021; Sarma, 2020; Spindle et al., 2019). Type II, or balanced, cannabis plants have relatively equal ratios of THC and CBD (Jin et al., 2021; Sarma, 2020; Spindle et al., 2019). Type III, or CBD-dominant, cannabis plants have high levels of CBD and low levels of THC (Jin et al., 2021; Sarma, 2020; Spindle et al., 2019). Within the recreational and medicinal markets, the chemical profiles of the cannabis plants may be more reliable for predicting the effects cannabis will have on consumers (Jin et al., 2021; Sarma, 2020; Spindle et al., 2019). For

example, high THC cannabis products (Type I) may be more associated with psychoactive effects like euphoria and memory impairment, while high CBD cannabis products (Type III) may be more associated with anti-anxiety, anti-inflammatory, and less intoxicating effects (Batalla et al., 2021; Freeman et al., 2019; Spindle et al., 2019). High CBD products are usually derived from hemp, while high THC products are typically derived from federally illegal cannabis (Johnson & Wallace, 2021; Spindle et al., 2019). However, as mentioned in chapter one, hemp can be used to create products that are high in the cannabinoids delta-8-THC and delta-10-THC instead of delta-9-THC (Harlow et al., 2022; Rossheim et al., 2023).

Within the context of recreational and medicinal markets, cannabis of all three chemotypes can be used to make a variety of cannabis products that have multiple methods of consumption. Four common methods of cannabis administration are (1) smoking, (2) vaporizing, (3) orally ingesting, and (4) topically applying (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019). Smoking dried cannabis flower is the most traditional and widely consumed form of cannabis, often done through joints, blunts, pipes, and water bongs (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019). Dried cannabis flowers and cannabis concentrates can also be consumed through the process of vaping with devices that are similar to e-cigarettes. The process of vaporizing cannabis can also be done through a popular technique called “dabbing” which is used to vaporize concentrates only (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019). Cannabis concentrates can also be used to make products that are ingested orally (e.g., "edibles"). These can come in the form of cannabis-infused foods and liquids and may also come in the form of oils and tinctures (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019). The last common method is a topical application where lotions, balms, creams, and

patches are infused with cannabis concentrates and applied to the skin (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019). Although these are common cannabis products and methods of consumption, the types of cannabis products and methods of consumption continue to grow in diversity and variety (Goodman et al., 2020; Simpson & Barrington-Trimis, 2021; Spindle et al., 2019).

Through every chain of cannabis production, from cultivation to extraction and the creation of a final cannabis product, there is a lack of federal standards for both medicinal and recreational industries throughout the U.S. (Orser, 2022; Sarma et al., 2020). The absence of standardized production procedures can lead to inconsistencies in the quality of cannabis products across the country and increase the risk of contamination with harmful substances like pesticides, residual solvents, heavy metals, and mold (Orser, 2022; Sarma et al., 2020). In order to conduct controlled studies and trials that contribute to a better understanding of cannabis and its applications, standardization will be essential as varying practices fragment the cannabis industry and make it challenging to develop a consistent framework without federal regulations (Orser, 2022; Sarma et al., 2020).

Potential Health Effects

Compared to cannabis' widespread use and growing acceptance legally, the effects of cannabis can be considered understudied (Cooper et al., 2021; Hutchison et al., 2019). Cannabis use has been reported to have both therapeutic effects and health risks; however, these claims vary across research (Cooper et al., 2021; Datta et al., 2021; Hutchison et al., 2019). The difficulty of developing a scientific consensus around both the therapeutic and adverse health effects of cannabis use has been the historical regulatory challenges, the complexity of the cannabis plant, the growing diversity in cannabis products, and individual variability among

users (Cooper et al., 2021; Hutchison et al., 2019). Additionally, the effects of cannabis will vary based on the type of cannabis used, dosage, frequency of use, and other factors (Haney, 2021; Hutchison et al., 2019). These elements and others make it difficult to draw universal conclusions about the effects of cannabis (Cooper et al., 2021; Hutchison et al., 2019). Nevertheless, some potential therapeutic effects and health risks will be described below.

Potential Therapeutic Benefits

The potential therapeutic effects of cannabis have been developed from a growing understanding of the endocannabinoid system in the body (Andre et al., 2016; Capodice & Kaplan, 2021; Finn et al., 2021). The endocannabinoid system is a regulator of various physiological processes, including pain perception, mood, metabolism, appetite, motor function, stress response, and others (Andre et al., 2016; Capodice & Kaplan, 2021; Finn et al., 2021). The endocannabinoid system consists of receptors that are distributed throughout the body and can be found in the central nervous system and the peripheral tissues (Andre et al., 2016; Capodice & Kaplan, 2021; Finn et al., 2021). Delta-9-THC and CBD interact in direct and indirect ways with these receptors (Capodice & Kaplan, 2021; Finn et al., 2021). CBD also interacts with other receptor systems in the body, like the serotonin and opioid systems (Capodice & Kaplan, 2021). In addition to the impact cannabis has on the endocannabinoid system, another developing concept that attempts to explain the therapeutic effects of cannabis is the idea of an entourage effect (Anand et al., 2021; Andre et al., 2016). The entourage effect is a concept that suggests that cannabinoids, terpenes, and other compounds found in the cannabis plant work together synergistically to enhance the therapeutic effects of the plant (Anand et al., 2021; Andre et al., 2016). In other words, the combined action of various cannabis compounds is believed to produce a more significant impact than the effects of each compound alone (Anand et al., 2021;

Andre et al., 2016). While there is some evidence to suggest that the entourage effect exists, more research is needed to fully understand its potential mechanism and benefits (Anand et al., 2021; Andre et al., 2016).

There have been many claims of the benefits of using of cannabis; however, only five popular therapeutic uses will be expanded upon. First, cannabis is frequently used for pain management (Li et al., 2019; NASEM, 2017; Romero-Sandoval et al., 2018). There is some evidence to suggest that it may alleviate chronic pain, neuropathic pain, arthritis, and other pains associated with certain medical treatments (NASEM, 2017; Romero-Sandoval et al., 2018). Second, cannabis, specifically the cannabinoid CBD, has shown success in treating certain forms of epilepsy (Franco & Perucca, 2019; Gray & Whalley, 2020). This has led to the development and approval by the FDA of a pure CBD-based medication call Epidiolex, which can help treat epilepsy syndromes like Dravet and Lennox-Gastaut syndromes (Franco & Perucca, 2019; Gray & Whalley, 2020). Third, cannabis has been used to treat nausea and vomiting, especially in association with individuals undergoing cancer treatments like chemotherapy (Grimison et al., 2020; Haney, 2021; NASEM, 2017). Oral medications of synthetic delta-9-THC, like Dronabinol and nabilone, have been approved for such treatment (Grimison et al., 2020; Haney, 2021). Fourth, some individuals use cannabis to manage their symptoms of anxiety and stress, especially in regards to CBD as it is thought to have anxiety-reducing properties (Sharpe et al., 2020; Spinella et al., 2021). Fifth, certain types of cannabis have been used to manage sleep and have shown some effectiveness in treating sleep disorders and insomnia (Kaul et al., 2021; Maddison et al., 2023; NASEM, 2017). In addition to these five therapeutic uses, cannabis is also being studied to treat inflammatory conditions like irritable bowel syndrome, neurological disorders like multiple sclerosis and Parkinson's disease, and posttraumatic stress disorders

(Bonn-Miller et al., 2022; Chye et al., 2019; Cohen et al., 2019; NASEM, 2017; Perisetti et al., 2020; Urbi et al., 2022). It is important to note that research on the therapeutic benefits of cannabis use is still ongoing, and much of the research is largely in its early stages (Breijyeh et al., 2021; Hutchison et al., 2019).

Potential Health Risks

Some health risks associated with cannabis use are impaired cognitive function, adverse mental health effects, addiction and dependence, respiratory issues, and an increase in car accidents (Datta et al., 2021; Hall & Lynskey, 2020). First, there is the concern that long-term or heavy use may adversely affect the areas of the brain responsible for memory, attention, and learning, especially when cannabis is first used during adolescence or young adulthood (Hall & Lynskey, 2020; Datta et al., 2021; Lovell et al., 2020). Second, cannabis use has been correlated to an increased risk of mental health issues, like anxiety, depression, and an increased risk of psychosis or schizophrenia in susceptible individuals (Chiu et al., 2021; Crocker et al., 2021; Hall & Lynskey, 2020). Although mentioned in the last section that cannabis can be used to reduce symptoms of anxiety and stress in some individuals, it can also have the reverse effect as some users may experience heightened anxiety or an exacerbation of pre-existing mental health conditions (Crocker et al., 2021; Sharpe et al., 2020; Spinella et al., 2021). Third, cannabis use may lead to addiction and dependence, often referred to as cannabis use disorder (CUD) (Connor et al., 2021; Haney, 2021; Hall & Lynskey, 2020). People dealing with CUD are likely to find it difficult to control how often they use cannabis, may continue using despite any negative consequences they experience, and may find it hard to stop because of withdrawal symptoms (Connor et al., 2021; Haney, 2021). Overtime and with frequent use, they may develop a tolerance to cannabis and seek more potent forms of cannabis products to satisfy their needs

(Connor et al., 2021; Haney, 2021). Fourth, smoking cannabis may expose the lungs to harmful substances that may be similar to smoking tobacco (Datta et al., 2021; Hall & Lynskey, 2020; Tashkin et al., 2019). Respiratory issues like chronic bronchitis and an increased risk of respiratory infections have been associated with frequent smoking of cannabis (Datta et al., 2021; Hall & Lynskey, 2020; Tashkin et al., 2019). A healthier alternative to smoking cannabis may be the use of vapes and vaporizers; however, vaping cannabis may be linked with other respiratory and health risks that are still largely unknown in the medical field (Braymiller et al., 2020; Chaiton et al., 2021). The last health risk is the concern that an increase in cannabis use will lead to an increase in car accidents over time, as people intoxicated by cannabis will not be able to operate a vehicle safely (Chiu et al., 2021; Hall & Lynskey, 2020; Preuss et al., 2021).

In addition to these five health risks, a growing public health concern is the increasing potency of delta-9-THC in cannabis products (Chiu et al., 2021; Freeman et al., 2021; Pennypacker et al., 2022). As the cannabis industry continues to advance and the demand for cannabis grows, there has been a trend toward developing products with higher concentrations of delta-9-THC (Chiu et al., 2021; Freeman et al., 2021; Pennypacker et al., 2022). Higher concentrations of delta-9-THC can lead to more intense psychoactive effects and may increase the likelihood of unintentional overconsumption as there is a lack of information on proper dosing (Chiu et al., 2021; Freeman et al., 2021; Pennypacker et al., 2022). Furthermore, frequent use of high potency cannabis products may lead to an increased risk of dependency and addiction and the development of psychiatric issues, especially in vulnerable people who already have a history of mental health problems (Chiu et al., 2021; Freeman et al., 2021; Pennypacker et al., 2022). As the potency of THC continues to increase, it will be necessary for the public to be

informed on best practices for consumption and the creation of regulatory measures for the cannabis industry (Chiu et al., 2021; Freeman et al., 2021; Pennypacker et al., 2022).

Cannabis Use

Demographic Patterns from the 2021 National Survey on Drug Use and Health

According to the 2021 National Survey on Drug Use and Health for U.S. citizens aged 12 and older, 45.7 percent of them have used cannabis at least once in their lifetime (Center for Behavioral Health Statistics and Quality, 2022). Across gender, men are slightly more likely to have used cannabis at least once in their lives at 48.6 percent compared to 43.0 percent of women (SAMHSA, 2022). Across race/ethnicity, people who identify as American Indian/Alaskan Native are the most likely to have used cannabis once in their lifetime, and people who identify as Asian are the least likely (SAMHSA, 2022). In order of greatest usage to least, 60.7 percent of American Indian/Alaskan Native people, 57.4 percent of people who identify with two or more races, 51.3 percent of White (non-Hispanic) people, 44.2 percent of Black or African American people, 34.1 percent of Hispanic or Latino people, and 21.1 percent of Asian people report using cannabis at least once in their lifetime (SAMHSA, 2022). For past-year usage among individuals aged 12 and older, 18.7 percent have used cannabis at least once in the year 2021 (SAMHSA, 2022). Males are slightly more likely to have used cannabis in the past year (20.8 percent) compared to females (16.7 percent) (SAMHSA, 2022). When considering race/ethnicity, American Indian/Alaskan Native individuals are again the most likely to have used cannabis in the past year, while Asians are the least likely (SAMHSA, 2022). The percentages, from greatest to least, are as follows: 35.0 percent for American Indian/Alaskan Native, 30.7 percent for people identifying with two or more races, 21.3 percent for Black or

African American, 19.5 percent for White (non-Hispanic), 15.8 percent for Hispanic or Latino, and 8.6 percent for Asian individuals (SAMHSA, 2022).

Cannabis Use of Young Adults and College Students

Past-year cannabis usage is highest for people between the ages of 18 and 25 (SAMHSA, 2022). Of these young adults, 35.4 percent report using cannabis in the year 2021, compared to only 19.6 percent of all people aged 18 and over (SAMHSA, 2022). Across gender, men are slightly more likely to have used cannabis once in the past year at 20.8 percent compared to 16.7 percent of women (SAMHSA, 2022). Across race/ethnicity, people who identify as two or more races are the most likely to have used cannabis in the past year, and people who identify as Asian are the least likely (SAMHSA, 2022). In order of greatest usage to least, 41.6 percent of people who identify with two or more races, 37.9 percent of White (non-Hispanic) people, 37.0 percent of Black or African American people, 30.7 percent of Hispanic or Latino people, and 21.6 percent of Asian people have used cannabis in the year 2021 (*note: there was not enough data to conclude the percentage of American Indian/Alaskan Native past-year usage for the 18-25 age group) (SAMHSA, 2022).

As mentioned above, the prevalence of cannabis use is highest among young adults (SAMHSA, 2022). Most college students fall within the young adult demographic and have also been found to have high prevalence rates of cannabis usage (Schulenberg et al., 2021). According to the 2020 Monitoring the Future National Survey Results on Drug Use, more than half (55.4 percent) of college students have reported using cannabis at least once in their lifetime (Schulenberg et al., 2021). In 2020, 44 percent of college students reported using cannabis at least once in the past year, which documents a historical high since the 1980s (Schulenberg et al., 2021). A quarter of college students reported using cannabis at least once in the past month, and

8 percent of college students reported using cannabis daily or near daily in 2020 (Schulenberg et al., 2021). Across gender, men are more likely than women to report using cannabis in the past year (45.9% versus 42.5%), past-month (29.9% versus 20.9%), and daily or near daily use (10.7% versus 6.1%) (Schulenberg et al., 2021).

Perceptions of Cannabis

Over the past 20 years, support for cannabis legalization has significantly increased, reflecting a notable shift in public opinion and societal attitudes towards cannabis (Chiu et al., 2021; Daniller, 2019; Schaeffer, 2023). The support for cannabis legalization was documented at 12 percent in 1970, 60 percent in 2016, and 88 percent in 2022 (Chiu et al., 2021; Daniller, 2019; Schaeffer, 2023). Three common reasons for supporting cannabis legalization are that it would be medically beneficial, it would allow law enforcement to focus on other crimes, and cannabis usage is a matter of freedom and choice (Jones, 2019). Three common reasons cited for opposing cannabis legalization are that it would increase car accidents, it would encourage people to use other illicit substances, and it would influence more people to use cannabis (Jones, 2019). Of the 88 percent of U.S. adults documented to support cannabis legalization in 2022, nearly 60 percent of them support cannabis legalization for medical *and* recreational use, while 30 percent support cannabis legalization for medical use *only* (Green, 2022; Schaeffer, 2023). The Pew Research Center found differences in perceptions about the legalization of cannabis for medical and recreational use, especially amongst age, partisan, and racial/ethnic groups (Green, 2022). U.S. adults between the ages of 18-29 are the most supportive of both recreational and medicinal legalization of cannabis while adults 75 years and older are the least (72% versus 30%) (Green, 2022). In regard to partisanship, 73 percent of Democrats were supportive of legalizing cannabis for both medical and recreational use, while only 45 percent of Republicans were (Green, 2022).

Among race and ethnicity, 68 percent of Black adults and 60 percent of White adults were supportive of both medical and recreational legalization, compared to 49 percent of Hispanic and 48 percent of Asian adults (Green, 2022). Perceptions of cannabis legalization may also vary based on those who have used cannabis at least once in their lives compared to those who have never used cannabis (Pearson et al., 2017; Romm et al., 2022). Cannabis users have been found to be more supportive of cannabis legalization, while non-users are less supportive (Palali & Ours, 2017; Trevino & Richard, 2002).

Additionally, the perception of perceived risk and harm of cannabis use has also declined in recent decades, especially among young adults (Levy et al., 2021; Pearson et al., 2017; Schulenberg et al., 2021). Since cannabis has been increasingly legalized for medicinal and recreational use in the USA, cannabis use is becoming normalized rather than stigmatized (Chiu et al., 2021; Romm et al., 2022). Thus, a decline in perceived risk of harm and an increase in cannabis consumption may be associated with the changing landscape legally, socially, and culturally (Pearson et al., 2017; Lachance et al., 2022; Levy et al., 2021). Given that young adults aged 18-25 are the group with the highest prevalence of cannabis use, it may not be surprising that the perceived risk of harm is low as perceptions of risk can shape substance use behavior (Levy et al., 2021; Romm et al., 2022; SAMHSA, 2022). Compared to adolescents or adults over the age of 26, young adults aged 18-25 were the least likely to perceive smoking cannabis weekly as a great risk of harm (SAMHSA, 2022). Only about a quarter of young adults believed that smoking cannabis weekly would pose a great risk (SAMHSA, 2022). Understanding perceptions and usage patterns amongst young adults can provide a glimpse into broader shifts in societal norms and cultural acceptance. Thus, continued research on this age group can better inform public policies, health practices, and education campaigns.

Chapter Summary

This chapter provided a summary of cannabis production, potential health effects, cannabis usage patterns, and the perceptions of cannabis in the USA. It described the complexity of the cannabis plant and the variation in its production, which can create numerous forms of cannabis products. In addition, this chapter provided information on the potential therapeutic and harmful effects of cannabis usage. Then, this chapter presented insight into current patterns of cannabis usage in the USA, focusing on young adults, which encompass college students. The last section of this chapter described prevalent perceptions of cannabis, especially as it relates to cannabis legalization and perceived risk of harm. This chapter sets the stage for the current study, which focuses on a demographic of young adults and their patterns of cannabis usage and perceptions. The next chapter will present the methodology of this study by discussing the survey instrumentation, sampling strategy, and the statistical models used to analyze the variables. Chapter four will present the study's findings, and Chapter five will discuss the implications of these results and offer guidance for future research, public policy, and education.

Chapter 3. Methodology

Introduction

Chapter two established the importance and need for continued research on cannabis by reviewing literature on cannabis production, documented health impacts, cannabis usage patterns, and the perceptions of cannabis in the USA. The discussion of usage patterns and perceptions of cannabis are of particular interest as they create the foundation for the current study. The current study seeks to describe the patterns that emerge from the use and perceptions of cannabis among college students in Tennessee. The first section of this chapter will state the main research questions for this study. The second section will explore the sampling approach, including the survey design, the methods for contacting participants, and the administration of the survey. The third section will describe the independent and dependent measures. The fourth section will lay out the plan for statistical analysis and the analytical tests to be employed. The last section will describe a few limitations of this research design.

Research Questions

RQ1: What are the patterns associated with the use of cannabis among college students in Tennessee?

H1: Young adults are more likely to use cannabis than older adults.

H2: Men are more likely to use cannabis than women.

H3: There is a difference in cannabis usage depending on race/ethnicity.

RQ2: What are the patterns associated with the perception of cannabis among college students in Tennessee?

H4: Individuals who have used cannabis will be more supportive of cannabis legalization than individuals who have not used cannabis.

H5: Younger adults will be more supportive of cannabis legalization than older adults.

H6: There is a difference in cannabis perceptions depending on race/ethnicity.

H7: Individuals who identify with Democrats will be more supportive of cannabis legalization than individuals who identify with Republicans.

Sample and Survey Design

College students were recruited for participation from a university in Eastern Tennessee. This university has a population size of 13,005 undergraduate and graduate students. In order to participate, the students must have been over the age of 18, currently attending the university of interest, and physically present in the United States of America. Due to feasibility, the current study relied upon convenience sampling, specifically self-selection. The student body received an email with a brief statement about the research and requirements for participation, emphasizing that participation was voluntary and anonymous. This statement also informed the students that participation would remain open for a 30-day period from February 8th to March 8th. Two additional emails were sent to remind students of participation during the two-week mark and when there was three days left to participate. Students interested in participating clicked on the survey link at the bottom of the email. This survey link took students to an informed consent that gave a detailed explanation of the research and requirements to participate. The informed consent also emphasized that the study was anonymous and did not collect identifiable data (i.e., name, home address, email, phone number, IP address, etc). In order to consent to participation, students clicked on an "agree" button which then directed them to the online survey. After completing all survey items, the participants clicked a "Finish" button. The survey was estimated to take around five minutes, and the software Qualtrics was used to present the survey and collect the data.

An online survey design was chosen because it allows for standardized questions and responses which provide consistent data collection and simplifies statistical analysis. Additionally, this method is cost-effective, time-efficient, and accessible for many college students who have access to the internet on campus. The survey consisted of 24 questions which were divided into three sections. The first five questions related to the demographics, the next six questions related to cannabis usage, and the last 13 questions relate to perceptions of cannabis (see Appendix 1 for complete document). The purpose of the first section of the survey was to gather data on the demographics of the participants. The participants were asked to identify their age, gender, race/ethnicity, class cohort, and political party affiliation.

The second section of the survey gathered data on cannabis usage and addressed the first research question. In order to provide clarity about the term "cannabis", a brief statement was presented before the survey items in this section. The statement read, "*The term 'cannabis' is referring to ANY derivative and/or compound of the plant. For this survey, the use of cannabis is not exclusively referring to cannabis with the psychoactive property delta-9-tetrahydrocannabinol (THC), which people commonly refer to as "marijuana" or "weed". Cannabis usage, here, will also include hemp-derived products like cannabidiol (CBD), delta-8-THC, delta-10-THC and others which are legal in the state of Tennessee*". Then, participants were asked "Have you used cannabis in any form at any point in your life?". If participants answered "no" to using cannabis in any form, they were not asked to answer the remaining questions in this section and were directed to the third section of the survey about perceptions. If participants answered "yes", they were directed to questions about their past-year usage. The next five questions of this section collected data on the frequency of cannabis usage and the form by which it was consumed in the past year. The 9-item responses for these five questions are

drawn from Simons et al. (1998) and Chabrol et al. (2005). These items ranged from (0) "No use" in the past 12 months to (8) "More than once a day" and considered smoking, vaping, ingesting (e.g., eating and eating), and application on skin. The first question asked "How often have you used cannabis in the past 12 months?". If participants selected "No use", they were not asked to answer the remaining four questions in this section and were directed to the third section of the survey.

The third section of the survey gathered data on perceptions of cannabis. The first question asked participants to select if they believed cannabis should be "Illegal for ANY use", "Legalized for medical use ONLY", or "Legalized for BOTH medical and recreational use". Following this question, 12 statements that utilized a Likert-scale response were presented to the participants, and responses ranged from (1) "Strongly Agree" to (5) "Strongly Disagree". These 12 statements were drawn from a Gallup poll conducted in 2019 and associated with opposing or supporting cannabis legalization (Jones, 2022).

Measures

Demographic Measures

Age was measured as ratio-level data with participants being able to insert a numerical value that reflects their age in years which was then dichotomized into two categories: (1) young adults aged 18-25 and (2) older adults aged 26 and older. *Gender* was measured categorically with participants selecting from the following options: (1) Man, (2) Woman, (3)Transgender/Gender Non-Conforming, and (4) Other identity not listed. Due to the lack of statistically significant participants in categories (3) and (4), this variable was dichotomized into two categories: (1) Man and (2) Woman. *Race/Ethnicity* was measured categorically with participants being able to select one of the options that most applied to them. These options were

(1) Asian or Asian American, (2) Black or African American, (3) Hispanic or Latino, (4) Native American/Alaskan Native, (5) Native Hawaiian/Pacific Islander, (6) White or European, (7) Biracial or Multiracial, and (8) Other Racial/Ethnic Category Not Listed. Since there was not a statistically significant number of respondents in categories (1), (2), (3), (4), (5), (7) and (8), this variable was dichotomized into (1) White and (2) Non-White categories. *Class cohort* was measured categorically with participants selecting from the following options: (1) Freshman, (2) Sophomore, (3) Junior, (4) Senior, (5) Graduate student. *Political party affiliation* was measured categorically with participants selecting from the following options: (1) Democrat, (2) Independent, (3) Republican, (4) Other Preference Not Listed.

Cannabis Usage and Perception Measures

The first measure of cannabis usage was the *lifetime* measure. This measure determined if participants have ever used cannabis in their lifetime. This measure was dichotomous (1=yes, 0=no). The second measure of cannabis usage was the *past-year* measure. This measure had nine options: (1) no use, (2) less than once a month but at least once in the last 12 months, (3) once a month, (4) two to three times per month, (5) once or twice per week, (6) three to four times per week, (7) nearly every day, (8) once a day, (9) more than once a day. The next four measures pertained to the mode of cannabis consumption and are the *smoked*, *vaped*, *ingested*, and *applied* measures. These measures determined the frequency by which an individual smoked, vaped, ingested, or topically applied cannabis in the past year. These measures had the same nine options that were used for the *past-year* measure (e.g., 1=no use, 2=less than once a month but at least once in the last 12 months…8=once a day, and 9=more than once a day).

The first measure of cannabis perception was the *legal* measure. There were three options to select from which were coded as (0) illegal for any use, (1) legalized for medical use only, and

(2) legalized for both recreational and medical use. The second measure was the *support* measure which determined how much the participants supported cannabis legalization. This variable was operationalized by the responses to the first 12 Likert-scale questions in the third section of the survey. Half of these questions were statements related to supporting cannabis legalization while the other half were related to opposing cannabis legalization. For the supporting cannabis legalization statements, the options were coded as (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree. For the opposing cannabis legalization statements, the options were coded inversely as (5) strongly disagree, (4) disagree, (3) neutral, (2) agree, and (1) strongly agree. A standardized score was determined by summing the score of each response.

Data Analysis

The data was analyzed using SPSS (Statistical Package for the Social Sciences) which is a software program used for statistical analysis and data management. First, descriptive statistics of the sample population were calculated among the five demographic variables along with the variables for cannabis usage and perceptions of cannabis to provide an overview of the data distribution. Second, the first research question and three hypotheses were addressed. To determine the relationship of cannabis usage with age, gender, and race/ethnicity, the *lifetime* and *past-year* measures were tested against these demographics. For the *lifetime* measure, chi-square tests were run for *age, gender,* and *race/ethnicity* since all of these variables were dichotomous. The *past-year* measure was coded as a mean value where higher scores equated to more use. To compare the *past-year* usage patterns among *age*, *gender*, and *race/ethnicity*, independent t-test were run to determine if there were any significant differences.

Third, the second research question and last four hypotheses were addressed which focused on how the *support* variable related to *lifetime* usage, *age*, *race/ethnicity,* and *political*

party affiliation. For *lifetime* usage, *age*, and *race/ethnicity*, independent t-tests were ran to determine if there were any significant differences among mean scores of the *support* mean. Since *political party affiliation* is a categorical variable, an ANOVA test was ran to compare the means of each group.

Chapter Summary

This chapter explained the methodological steps used to answer the research questions by describing the sample, variables, and analyses. The research questions sought to assess the patterns that emerged among cannabis usage and perceptions among the participants. Data was gathered via an online survey with participants self-selecting themselves into the study. Statistical analysis will consist of descriptive statistics, multiple independent t-tests, and anova tests. Chapter four will describe the results of the statistical analyses discussed in chapter three. Chapter five will discuss the implication of these results and offer guidance for future research, public policy, and education.

Chapter 4. Results

Introduction

The purpose of the current study was to evaluate the patterns of the use and perceptions of cannabis among college students in Tennessee. The first two chapters discussed the importance of studying cannabis and the high prevalence of use across the nation, while the third chapter explained the methodology and purpose of the current study. This chapter will address and summarize the results of the various statistical analyses conducted to answer the research questions posed in chapter three. First, descriptive statistics are assessed to provide an overall description of the demographic variables and created measures. Next, the first research question is addressed via chi-square and independent t-test analyses. Lastly, the second research question is analyzed using independent t-tests and ANOVA analysis.

Descriptive Statistics

A total of 1542 students completed the survey. However, missing data was prevalent on 12 of the submissions, leaving a final sample of 1530 usable surveys (n=1530). Descriptive statistics were calculated for the five demographic variables of *age*, *gender*, *race/ethnicity*, *class cohort*, and *political party affiliation* (see Table 1). For age, 75.9% (1160) of the respondents fell within the young adult demographic of 18-25 while 24.1% (369) fell within the age range of 26-73. Across gender, there were 997 women (65.2%), 457 men (29.9%), 60 transgender/gender non-conforming people (3.9%), and 16 people who selected “other identity not listed” (1.0%). Due to the small sample of non-cisgender individuals, *gender* was dichotomized into women and men, leaving a total of 1454 students for all gender-related analyses. For race/ethnicity, the variable was also dichotomized with the majority (84.9% or 1299) of the sample identifying as white, and the remaining (15.1% or 231) of the sample identifying with non-white categories.

For class cohort, the sample was 17.5% freshmen (268), 15.7% sophomores (240), 19.2% juniors (294), 20.7% seniors (316), and 26.9% graduate students (412). For political party affiliation, the sample was 26.4% Democrats (404), 36.5% Independent (558), 23.9% Republican (365), and 13.3% preference not listed (203).

Table 1

Descriptive Statistics of Demographics

Variable	Frequency	Percent
Age		
18-25	1160	75.9%
26-73	369	24.1%
Gender		
Man	457	29.9%
Woman	997	65.2%
Transgender/Gender Non-Conforming	60	3.9%
Other Identity Not Listed	16	1.0%
Race/Ethnicity		
Asian or Asian American	20	1.3%
Black or African American	93	6.1%
Hispanic or Latino	47	3.1%
Native American/Alaskan Native	3	0.2%
Native Hawaiian/Pacific Islander	1	0.1%
White	1299	84.9%
Biracial or Multiracial	59	3.9%
Other Race/Ethnicity Not Listed	8	0.5%
Class Cohort		
Freshman	268	17.5%
Sophomore	240	15.7%
Junior	294	19.2%
Senior	316	20.7%
Graduate Student	412	26.9%
Political Party Affiliation		
Democrat	404	26.4%
Independent	558	36.5%
Republican	365	23.9%
Preference Not Listed	203	13.3%

Descriptive statistics were also calculated for the two dependent variables that measured cannabis usage, the *lifetime* and *past-year* variables (see Table 2). Additionally, the corresponding frequencies of lifetime cannabis usage among *age*, *gender*, and *race/ethnicity* can be seen in Table 3. For the *lifetime* variable, 70% (1071) of the participants have used cannabis at least once in their lives while 30.0% (459) have not. Of the 1071 respondents who have used cannabis, 73.3% (785) have used cannabis at least once in the past 12 months which is 51.3% of the entire sample. The 785 students who used cannabis in the past year reported various methods of administration: 79.9% (627) of them have smoked, 72.9% (572) have vaped, 73.6% (578) have ingested, and 19.2% (151) have applied cannabis at least once during the past 12 months.

Table 2

Descriptive Statistics of Cannabis Usage (Lifetime and Past-Year)

Variable	Frequency	Percent
Lifetime		
Yes	1071	70.0%
No	459	30.0%
Past-Year		
No use	286	26.7%
Less than once a month but at least once in the last 12 months	245	22.9%
Once a month	53	4.9%
Two to three times per month	88	8.2%
Once or twice per week	77	7.2%
Three to four times per week	61	5.7%
Nearly every day	93	8.7%
Once a day	39	3.6%
More than once a day	129	12.0%
Total	1071	100.0%
Smoked		
No use	158	20.1%
At least once in the past 12 months	627	79.9%
Total	785	100.0%

(continued)

Vaped		
No use	213	27.1%
At least once in the past 12 months	572	72.9%
Total	785	100.0%
Ingested		
No use	207	26.4%
At least once in the past 12 months	578	73.6%
Total	785	100.0%
Applied		
No use	634	80.8%
At least once in the past 12 months	151	19.2%
Total	785	100.0%

Table 3

Lifetime Cannabis Usage by Age, Gender, and Race/Ethnicity Frequencies

Demographic Variable	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Age						
18-25	797	69.7%	363	31.3%	1160	100.0%
26-73	273	74.0%	96	26.0%	369	100.0%
Total	1070	70.0%	459	30.0%	1529	100.0%
Gender						
Man	323	70.7%	134	29.3%	457	100.0%
Woman	687	68.9%	310	31.3%	997	100.0%
Total	1010	69.5%	444	30.5%	1454	100.0%
Race/Ethnicity						
White	921	70.9%	378	29.1%	1299	100.0%
Non-White	150	64.9%	81	35.1%	231	100.0%
Total	1071	70.0%	459	30.0%	1530	100.0%

Additionally, descriptive statistics were also calculated for the dependent variables that measured perceptions of cannabis, the *legal* and *support* variables. For the *legal* variable, the

majority (73.7% or 1128) of the respondents believed that cannabis should be legal for both medical and recreational use, 22% (337) believed that cannabis should be legal for medical use only, and only 4.2% (65) believed that cannabis should be illegal for any use (see Table 4).

Table 4

Legal Frequency

Items	Frequency	Percent
Illegal for ANY use	65	4.2%
Legal for medical use ONLY	337	22.0%
Legal for BOTH medical and recreational use	1128	73.7%

The *support* variable, as discussed in the previous chapter, was determined by participants' responses to 12 Likert-scale questions. Each question had a range from one to five where values greater than three (e.g., the neutral value) reflect more support for cannabis legalization. For clarity, the six statements related to supporting cannabis legalization were coded as (1) strongly disagree and (5) strongly agree. The remaining six statements related to opposing cannabis legalization were coded as (1) strongly agree and (5) strongly disagree. Thus, values greater than three for the statements that oppose cannabis legalization reflect more disagreement with the statement rather than agreement. Table 5 displays the individual items of the scale and the sample's corresponding means for each statement. In addition to these individual scores, a composite score was calculated to determine the primary dependent measure for analysis (see Table 6). This standardized score ranged from (12) indicating the highest level of opposition to cannabis legalization and (60) indicating the highest level of support for cannabis legalization. The overall mean for the sample was 45.6444. A reliability analysis test also determined that the *support* scale had internal validity (α=.909).

Table 5

Individual Support Scale Scores

Support Items	Mean	Std. Deviation	Minimum	Maximum
Cannabis helps people who use it for medical reasons	4.5176	0.72244	1.00	5.00
Using cannabis is a matter of freedom and personal choice	4.1634	0.97756	1.00	5.00
Legalizing cannabis would free up law enforcement to focus on other types of crime	4.1157	1.01090	1.00	5.00
Legalizing cannabis will provide a good source of tax revenue for state and local governments	4.0333	0.93731	1.00	5.00
I believe the use of drugs, including cannabis, is immoral*	3.9275	1.14511	1.00	5.00
Government regulation of cannabis would make it safer for those who use it	3.8993	1.08817	1.00	5.00
Legalizing cannabis would lead to more people using stronger and more addictive drugs*	3.7314	1.19203	1.00	5.00
Legalizing cannabis would encourage more people to use cannabis which is harmful*	3.5974	1.17806	1.00	5.00
I believe cannabis is harmful to people who use it*	3.5869	1.16717	1.00	5.00
Legalizing cannabis would not benefit society or individuals much*	3.5542	1.12409	1.00	5.00
I do not believe cannabis is harmful to people who use it	3.2987	1.16761	1.00	5.00
Legalizing cannabis would increase the number of car accidents involving drivers who use cannabis*	3.2190	1.17797	1.00	5.00

Note. * = values greater than three (e.g., the neutral value) reflect more disagreement

Table 6

Support Scale Score

	Mean	Variance	Std. Deviance	Minimum	Maximum	Cronbach's Alpha	N of Items
Support Scale	45.6444	84.134	9.17245	12	60	.909	12

Statistical Analysis

Research Question 1

The first research question examined the relationship of cannabis usage with *age*, *gender*, and *race/ethnicity*. Chi-square tests were conducted to determine the relationship between the independent variables and *lifetime* usage while independent t-tests were ran to determine the relationship between *past-year* usage.

For *lifetime* usage, there was no significant difference among *age* (x^2= 3.711; p= .054), *gender* (x^2= .464; p= .496), and *race/ethnicity* (x^2= 3.324, p= .068) (see Table 7). These findings do not support any of the first three hypotheses. For *past-year* usage, there was a statistically significant difference among *age* (t= 9.509; p< .001) and among *gender* (t= 3.885; p< .001) where young adults and men reported consuming cannabis at a higher frequency than older adults and women, respectively (see Table 8). This finding supports hypotheses one and two. However, there was no significant difference among *race/ethnicity* with *past-year* usage (t= .313; p= .754) which runs contrary to hypothesis three.

Table 7

Chi-Square Tests for Age, *Gender*, and *Race/Ethnicity*

Variable	Value (x^2)	Df	Value (p)
Age	3.711	1	.054
Gender	.464	1	.496
Race/Ethnicity	3.324	1	.068

Table 8

Independent T-Tests for Age, Gender, and *Race/Ethnicity*

Variable	Mean	T	Mean Difference	Significance
Age		9.509*	1.695	<.001
18-25	4.32			
26-73	2.63			
Gender		3.885*	.756	<.001
Man	4.37			
Woman	3.61			
Race/Ethnicity		.313	.078	.754
White	3.88			
Non-White	3.95			

Note. *= p<.01

Research Question 2

The second research question looked to determine the relationship between the support for cannabis legalization and participants' *lifetime* cannabis usage, *age*, *race/ethnicity*, and *political party affiliation*. The dependent variable is the *support* measure and independent t-tests were ran for *lifetime* cannabis usage, *age,* and *race/ethnicity* while an ANOVA test was ran for *political party affiliation*.

The results of analysis indicated that there were no statistically significant differences found among *age* (t= 1.042; p= .149) and *race/ethnicity* (t= -1.603; p= .055) which run contrary to hypotheses five and six (see Table 9). However, there were statistically significant differences found for cannabis usage (t= 22.863; p< .001) and political party affiliation (F= 76.77; p< .001) where cannabis users and Democrats had more support for cannabis legalization than non-cannabis users and Republicans, respectively (see Table 10). This finding supports hypotheses four and seven. Additionally, an ANOVA test and a posthoc test were ran for class cohort and found a statistically significant difference (F= 3.774; p= 0.05) where sophomores, juniors and

seniors had higher support for cannabis legalization compared to freshmen and graduate students.

Table 9

Independent T-Tests for Lifetime Cannabis Usage, Age, and Race/Ethnicity

Variable	Mean	T	Mean Difference	Significance
Lifetime Cannabis Usage		22.863*	10.10209	<.001
Yes	48.6751			
No	38.5730			
Age		1.042	.57108	.149
18-25	45.4129			
26-73	46.0840			
Race/Ethnicity		-1.603	-1.04968	.055
White	45.8029			
Non-White	44.8029			

Table 10

ANOVA Tests for Political Party Affiliation and Class Cohort

Variable	Mean	Std. Deviation	F	Significance
Political Party Affiliation			76.774**	<.001
Democrat	49.2054	6.67389		
Independent	46.4785	8.56397		
Republican	40.0849	9.99813		
Preference Not Listed	46.2611	9.06062		
Class Cohort			3.774*	.005
Freshman	44.3470	8.78855		
Sophomore	46.2667	9.09433		
Junior	46.3980	9.23941		
Senior	46.6044	9.09867		
Graduate Student	44.8519	9.34601		

Chapter Summary

This chapter offered an analysis of the results derived from conducting different statistical tests to evaluate the study hypotheses. Descriptive analysis demonstrated that most

participants have used cannabis at least once in their lifetime and nearly the entire sample supported cannabis legalization for either medical use or both medical and recreational use. For the first research question, there was partial support for hypotheses one and two, revealing that young adults and men consumed cannabis at a higher frequency than older adults and women, respectively. For the second research question, there was statistical support for hypotheses four and seven as cannabis users and Democrats had more support for cannabis legalization than non-cannabis users and Republicans, respectively. Chapter five will discuss these findings further.

Chapter 5. Discussion

Introduction

This study sought to examine the patterns that emerged from the use and perception of cannabis among college students in Tennessee. The previous chapter explained the results of the statistical analyses used to test the research hypotheses and address the research questions. This chapter serves to discuss the results of this study in the context of the empirical research on cannabis. Additionally, it will discuss the limitations of this study, its policy implications, and potential directions for future research.

Findings

The first research question looked to determine the patterns that emerged from the sample's cannabis usage. Descriptive statistics found that 70 percent of the participants had used cannabis at least once in their lifetime and that 51.3 percent of the sample had used cannabis within the past year. These findings are higher than the results of the 2021 National Survey on Drug Use and Health (NSDUH) and the 2020 Monitoring the Future National Survey Results on Drug Use (MTF) which found that 45.7 percent of U.S. citizens aged 12 and older and 55.4 percent of college students have reported using cannabis at least once in their lifetime, respectively (Center for Behavioral Health Statistics and Quality, 2022; Schulenberg et al., 2021). For past-year usage, the 2021 NSDUH and 2020 MTF studies found that 18.7 percent of people aged 12 and older and 44 percent of college students used cannabis in the past 12 months (SAMHSA, 2022; Schulenberg et al., 2021).

The first three hypotheses sought to address the first research question by discovering if age, gender, and race/ethnicity were associated with cannabis use. There were no significant differences between any of these demographics and their lifetime usage. However, there were

statistically significant differences among age group and gender for past-year usage which supported hypotheses one and two. For age, young adults aged 18-25 consumed cannabis at a higher frequency than older adults aged 26-73. The young adults had a mean of 4.32 which translates to a frequency of cannabis usage between two to three times per month and once or twice per week while the older adults had a mean of 2.63 which is between less than once a month but at least once in the last 12 months and once a month. This finding is supported by the 2021 NSDUH which found that past-year cannabis usage is highest for people between the ages of 18 and 25 (SAMHSA, 2022). For gender, men reported using cannabis more frequently than women in the past year. Men had a mean of 4.37 which translates to a frequency of cannabis usage between two to three times per month and once or twice per week while women had a mean of 3.61 which is between once a month or two to three times per month. This finding is supported by the 2021 NSDUH and 2020 MTF which found that men were more likely to use cannabis in the past 12 months compared to women (SAMHSA, 2022; Schulenberg et al., 2021).

The second research question looked to determine the patterns that emerged from the sample's perceptions of cannabis. Descriptive statistics found that nearly 96 percent of the participants supported legalization for cannabis, where about 74 percent supported cannabis legalization for *both* medical and recreational cannabis use and 22 percent supported cannabis legalization for medical use *only*. This finding is higher than a national study conducted by the Pew Research Center in 2022 which found that 88 percent of U.S. adults supported legalization where nearly 60 percent of them supported cannabis legalization for medical *and* recreational use, while 30 percent support cannabis legalization for medical use *only* (Green, 2022). Results from the *support* scale indicated that the three top reasons for supporting cannabis legalization

were its medical benefit, that cannabis usage is a matter of freedom and choice, and that it would free up law enforcement to focus on other crimes. These top reasons mirrored those found in the 2019 Gallup poll (Jones, 2019).

The last four hypotheses sought to address the second research question by discovering if cannabis usage, age, race/ethnicity, and political party affiliation were associated with support for cannabis legalization. There were no statistical differences found among age and race/ethnicity which runs contrary to hypotheses five and six. However, there were statistically significant differences among cannabis usage and political party affiliation. For cannabis usage, participants who had used cannabis once in their lifetime had higher means of support than participants who had never used cannabis (48.6751 vs. 38.5730). This finding is reflective of other studies that have found that cannabis users were more supportive of cannabis legalization than non-users (Palali & Ours, 2017; Trevino & Richard, 2002). For political party affiliation, people who identified with Democrats were more supportive of cannabis legalization than Republicans (49.2054 vs. 40.0849). This partisan gap between Democrats and Republicans has also been found in other studies (Chiu et al., 2022; Green, 2022).

Limitations

While this study offers insights into the use and perceptions of cannabis among college students in Tennessee, there are several limitations. First, collecting data through an online survey can produce sampling bias and nonresponse bias as the participants who were self-selected into the study may differ from the individuals who did not choose to participate. For instance, some students may not have felt comfortable voluntarily giving up information of their usage and perception of cannabis given it is criminalized in the state of Tennessee and at the federal level. Secondly, the results of this study are not likely to be generalizable to college

students across Tennessee because the sample was pulled from only one school. For example, the student body population does reflect the sample's demographics which both consist of about 80 percent of students who identify as white and over 60 percent who identify as women. However, this campus lacks a diversity of students who identify with racial/ethnic and gender minorities, so analysis was limited to categorizing race/ethnicity and gender in binary terms. This study may be generalizable for the college of interest but may not be for other schools. A college in a different area of Tennessee may reflect different usage patterns and perceptions of cannabis compared to what was gathered in this study.

Implications

There are a few implications that develop from the findings of this study. The results of this study demonstrate that there is a high prevalence of cannabis use among these college students even though they reside in a state that continues to criminalize cannabis. Although this study did not distinguish between cannabis usage that was legal or illegal in Tennessee, this finding may indicate that many students are still accessing and engaging with cannabis in the state. Since all students over the age of 21 can legally purchase and consume certain varieties of cannabis in Tennessee, there should be accurate knowledge and college campus awareness about these products' usage and its effects. Education about cannabis should not be limited to merely responding to drug abuse and dependency as this is a reactive response. To be proactive, general education about cannabis should be accessible to all students whether or not they have used cannabis in the past and should take into account that most frequent users may likely be young adults and men. It may be beneficial to pair this general education with education about alcohol consumption and safe practices. These resources should address what is known about the health and safety of cannabis, especially in regards to smoking, vaping and ingesting the plant since

these were used by more than 70 percent of past-year users. Topics could include advice on the risks associated with the different methods of consumption, the concentration of THC and CBD within products, awareness of dosages, frequency of usage and associated outcomes, activities consumers should avoid doing after consumption (e.g., driving a motor-vehicle), and risks associated with concurrent usage with other drugs.

Additionally, the campus should make efforts to decrease any stigma associated with having conversations about cannabis use to have a better understanding of what type of resources the students need. Education will allow students to make educated choices about their cannabis consumption and guidance on how to seek help and support if needed. Furthermore, this college desires to have a drug-free campus and attests that it will enact disciplinary action towards any students who violates this desire. However, as this study demonstrates, this campus is being impacted by the use of cannabis as more than 50 percent of students are likely to be current users. The college may want to rethink its drug-free policies since people are using cannabis regardless of these policies and their potential disciplinary consequences. If students are likely to engage in drug usage regardless of the school's policies, creating sufficient resources to educate the student body will help inform their choices and provide measures to combat the potential development of abuse and unsafe practices.

This study also found that there is a high level of support for cannabis legalization among these college students which indicates that the state's law does not reflect their views. This may give a glimpse into the broader public opinion about cannabis legalization in Tennessee and may indicate that Tennessee should consider reforming their laws on cannabis by decriminalizing it or legalizing it. The most popular reason for support was its perceived medical benefits, so medical legalization of cannabis may garner more support rather than opposition which further identifies

a need for knowledge about cannabis' medical value, especially about what is not known. Another implication arises from their third most popular reason for supporting cannabis legalization: it would free up law enforcement to focus on other crimes. According to data available from the FBI's Crime Data Explorer (CDE), about 42 percent of arrests for drug possession offenses and 24 percent of arrests for drug sale offenses are cannabis-related which totals to 14,426 arrests made in 2022 (Federal Bureau of Investigation Crime Reporting Program, 2022). With the context of this data, it seems that if cannabis were legalized, law enforcement would indeed be able to put significantly more resources towards other crimes by eliminating the need to make these arrests in the first place.

Future Research

Although this study provided insight into the patterns of the use and perception of cannabis among college students in Tennessee, future research may want to further explore the individual, social, and environmental factors that influence cannabis use and perceptions among college students and young adults. Further exploration could examine factors such as peer influence, social norms, personality traits, campus culture, academic stress, access to cannabis, and exposure to cannabis-related marketing and media. Additionally, studies can conduct longitudinal analyses to identify patterns of cannabis use and perceptions by tracking when college students and young adults initiate cannabis use, if and when this use escalates, and if and when they stop using, as well as any changes in attitudes and beliefs. Next, future research can also investigate the relationship between cannabis use and the impact on educational attainment by exploring any patterns that emerge with academic performance (e.g., GPA, retention of information, etc.) and graduation rates. Lastly, studies can research the influence of cannabis use on the health and well-being of college students by exploring the impact on physical health (e.g.,

respiratory health, cardiovascular health), mental health (e.g., anxiety, depression, psychosis), cognitive function (e.g., memory, attention, executive function), and overall quality of life.

Conclusion

Although cannabis is commonly used across the USA in a variety of forms, research gaps persist on the effects of these novel products on consumers (Cooper et al., 2021; Hutchison et al., 2019; SAMHSA, 2023; Spindle et al., 2019). These gaps are the result of decades of barriers to research caused by the federal scheduling of cannabis as one of the most dangerous and addictive drugs in the nation (Cooper et al., 2021; NASEM, 2017; Nutt et al., 2013). This scheduling, however, has not stopped cannabis usage or its growth in popularity, but has rather decreased the amount of knowledge the public has access to (Cooper et al., 2021; Hutchison et al., 2019; Mead, 2019). This study sought to fill these gaps in the research by focusing on the patterns of cannabis use and perceptions of college students in Tennessee, which encompass a demographic of mainly young adults who are typically associated with high usage patterns. Although this study may not be generalizable to the state or the nation, it demonstrates the continued need to understand cannabis and the impact it has on people and society as a whole.

References

Abel, E. L. (2013). *Marihuana: The first twelve thousand years*. Springer Science & Business Media.

Addo, P. W., Desaulniers Brousseau, V., Morello, V., MacPherson, S., Paris, M., & Lefsrud, M. (2021). Cannabis Chemistry, post-harvest processing methods and secondary metabolite profiling: A Review. *Industrial Crops and Products*, *170*, 113743. https://doi.org/10.1016/j.indcrop.2021.113743

Anand, U., Pacchetti, B., Anand, P., & Sodergren, M. H. (2021). Cannabis-based medicines and pain: A review of potential synergistic and entourage effects. *Pain Management*, *11*(4), 395–403. https://doi.org/10.2217/pmt-2020-0110

Andre, C. M., Hausman, J.-F., & Guerriero, G. (2016). Cannabis sativa: The plant of the thousand and one molecules. *Frontiers in Plant Science*, *7*. https://doi.org/10.3389/fpls.2016.00019

Batalla, A., Bos, J., Postma, A., & Bossong, M. G. (2021). The impact of Cannabidiol on Human Brain Function: A systematic review. *Frontiers in Pharmacology*, *11*, 1–15. https://doi.org/10.3389/fphar.2020.618184

Berger, K. (2021). *CBD statistics*. https://www.singlecare.com/blog/news/cbd-statistics/

Bergeria, C. L., Strickland, J. C., Spindle, T. R., Kalaba, M., Satyavolu, P. U., Feldner, M., Vandrey, R., Bonn-Miller, M., Peters, E. N., & Weerts, E. (2023). A crowdsourcing survey study on the subjective effects of delta-8-tetrahydrocannabinol relative to delta-9-tetrahydrocannabinol and cannabidiol. *Experimental and Clinical Psychopharmacology*, *31*(2), 312–317. https://doi.org/10.1037/pha0000565

Bernstein, N., Gorelick, J., & Koch, S. (2019). Interplay between chemistry and morphology in medical cannabis (Cannabis Sativa L.). *Industrial Crops and Products*, *129*, 185–194. https://doi.org/10.1016/j.indcrop.2018.11.039

Blake, A., & Nahtigal, I. (2019). The evolving landscape of Cannabis Edibles. *Current Opinion in Food Science*, *28*, 25–31. https://doi.org/10.1016/j.cofs.2019.03.009

Bonn-Miller, M. O., Brunstetter, M., Simonian, A., Loflin, M. J., Vandrey, R., Babson, K. A., & Wortzel, H. (2022). The long-term, prospective, therapeutic impact of cannabis on post-traumatic stress disorder. *Cannabis and Cannabinoid Research*, *7*(2), 214–223. https://doi.org/10.1089/can.2020.0056

Braymiller, J. L., Barrington-Trimis, J. L., Leventhal, A. M., Islam, T., Kechter, A., Krueger, E. A., Cho, J., Lanza, I., Unger, J. B., & McConnell, R. (2020). Assessment of nicotine and cannabis vaping and respiratory symptoms in young adults. *JAMA Network Open*, *3*(12). https://doi.org/10.1001/jamanetworkopen.2020.30189

Breijyeh, Z., Jubeh, B., Bufo, S. A., Karaman, R., & Scrano, L. (2021). Cannabis: A toxin-producing plant with potential therapeutic uses. *Toxins*, *13*(2), 117. https://doi.org/10.3390/toxins13020117

Brenan, M. (2019). *14% of Americans say they use CBD products*. https://news.gallup.com/poll/263147/ americans-say-cbd-products.aspx

Bridgeman, M. B., & Abazia, D. T. (2017). Medicinal cannabis: history, pharmacology, and implications for the acute care setting. *Pharmacy and Therapeutics*, *42*(3), 180–188.

Byrd, E. (2023, June 1). *New law puts first regulations on delta-8 products*. WVLT8. https://www.wvlt.tv/2023/06/01/new-law-puts-first-regulations-delta-8-products/

Campos, I. (2018). Mexicans and the origins of marijuana prohibition in the United States: A reassessment. *The Social History of Alcohol and Drugs*, *32*, 6–37. https://doi.org/10.1086/shad3201006

Capodice, J. L., & Kaplan, S. A. (2021). The endocannabinoid system, cannabis, and Cannabidiol: Implications in urology and Men's Health. *Current Urology*, *15*(2), 95–100. https://doi.org/10.1097/cu9.0000000000000023

Center for Behavioral Health Statistics and Quality. (2022). *Results from the 2021 National Survey on Drug Use and Health: Detailed tables*. Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/report/2021-nsduh-detailed-tables

Chabrol, H., Ducongé, E., Casas, C., Roura, C., & Carey, K. B. (2005). Relations between cannabis use and dependence, motives for cannabis use and anxious, depressive and borderline symptomatology. *Addictive Behaviors*, *30*(4), 829–840. https://doi.org/10.1016/j.addbeh.2004.08.027

Chaiton, M., Kundu, A., Rueda, S., & Di Ciano, P. (2021). Are vaporizers a lower-risk alternative to smoking cannabis? *Canadian Journal of Public Health*, *113*(2), 293–296. https://doi.org/10.17269/s41997-021-00565-w

Chandra, S., Lata, H., & ElSohly, M. A. (2020). Propagation of cannabis for clinical research: An approach towards a modern herbal medicinal products development. *Frontiers in Plant Science*, *11*. https://doi.org/10.3389/fpls.2020.00958

Chandra, S., Lata, H., ElSohly, M. A., Walker, L. A., & Potter, D. (2017). Cannabis cultivation: Methodological issues for obtaining medical-grade product. *Epilepsy & Behavior*, *70*, 302–312. https://doi.org/10.1016/j.yebeh.2016.11.029

Chiu, V., Hall, W., Chan, G., Hides, L., & Leung, J. (2022). A Systematic Review of Trends in US Attitudes toward Cannabis Legalization. Substance Use & Misuse, 57(7), 1052–1061. https://doi.org/10.1080/10826084.2022.2063893

Chiu, V., Leung, J., Hall, W., Stjepanović, D., & Degenhardt, L. (2021). Public health impacts to date of the legalisation of medical and recreational cannabis use in the USA. *Neuropharmacology, 193*, 108610. https://doi.org/10.1016/j.neuropharm.2021.108610

Chye, Y., Christensen, E., Solowij, N., & Yücel, M. (2019). The endocannabinoid system and Cannabidiol's promise for the treatment of substance use disorder. *Frontiers in Psychiatry, 10*. https://doi.org/10.3389/fpsyt.2019.00063

Citti, C., Linciano, P., Forni, F., Vandelli, M. A., Gigli, G., Laganà, A., & Cannazza, G. (2019). Analysis of impurities of cannabidiol from hemp. isolation, characterization and synthesis of cannabidibutol, the novel cannabidiol butyl analog. *Journal of Pharmaceutical and Biomedical Analysis, 175*, 112752. https://doi.org/10.1016/j.jpba.2019.06.049

Cohen, K., Weizman, A., & Weinstein, A. (2019). Positive and negative effects of cannabis and cannabinoids on health. *Clinical Pharmacology & Therapeutics*, *105*(5), 1139–1147. https://doi.org/10.1002/cpt.1381

Connor, J. P., Stjepanović, D., Le Foll, B., Hoch, E., Budney, A. J., & Hall, W. D. (2021). Cannabis use and cannabis use disorder. *Nature Reviews Disease Primers*, *7*(1). https://doi.org/10.1038/s41572-021-00247-4

Cooper, Z. D., Abrams, D. I., Gust, S., Salicrup, A., & Throckmorton, D. C. (2021). Challenges for clinical cannabis and Cannabinoid Research in the United States. *JNCI Monographs, 2021*(58), 114–122. https://doi.org/10.1093/jncimonographs/lgab009

Crocker, C. E., Carter, A. J., Emsley, J. G., Magee, K., Atkinson, P., & Tibbo, P. G. (2021). When cannabis use goes wrong: Mental health side effects of cannabis use that present to emergency services. *Frontiers in Psychiatry*, *12*. https://doi.org/10.3389/fpsyt.2021.640222

Crocq, M.-A. (2020). History of cannabis and the endocannabinoid system. *Dialogues in Clinical Neuroscience*, *22*(3), 223–228. https://doi.org/10.31887/dcns.2020.22.3/mcrocq

Daniller, A. (2019, November 14). *Two-thirds of Americans support marijuana legalization*. Pew Research Center. https://www.pewresearch.org/short-reads/2019/11/14/americans-support-marijuana-legalization/

Datta, S., Ramamurthy, P. C., Anand, U., Singh, S., Singh, A., Dhanjal, D. S., Dhaka, V., Kumar, S., Kapoor, D., Nandy, S., Kumar, M., Koshy, E. P., Dey, A., Proćków, J., & Singh, J. (2021). Wonder or evil?: Multifaceted health hazards and health benefits of Cannabis Sativa and its phytochemicals. *Saudi Journal of Biological Sciences*, *28*(12), 7290–7313. https://doi.org/10.1016/j.sjbs.2021.08.036

ElSohly, M. A., Mehmedic, Z., Foster, S., Gon, C., Chandra, S., & Church, J. C. (2016). Changes in cannabis potency over the last 2 decades (1995–2014): Analysis of current data in the United States. *Biological Psychiatry*, *79*(7), 613–619. https://doi.org/10.1016/j.biopsych.2016.01.004

ElSohly, M. A., Radwan, M. M., Gul, W., Chandra, S., & Galal, A. (2017). Phytochemistry of Cannabis Sativa L. *Progress in the Chemistry of Organic Natural Products*, 1–36. https://doi.org/10.1007/978-3-319-45541-9_1

Erkelens, J. L., & Hazekamp, A. (2014). That which we call Indica, by any other name would smell as sweet. *International Association for Cannabinoid Medicines*, *9*(1), 9–15.

Feder, C. L., Cohen, O., Shapira, A., Katzir, I., Peer, R., Guberman, O., Procaccia, S., Berman, P., Flaishman, M., & Meiri, D. (2021). Fertilization following pollination predominantly decreases phytocannabinoids accumulation and alters the accumulation of terpenoids in cannabis inflorescences. *Frontiers in Plant Science, 12*. https://doi.org/10.3389/fpls.2021.753847

Federal Bureau of Investigation Crime Reporting Program. (2022). *Arrests offense counts in Tennessee*. Federal Bureau of Investigation Crime Data Explorer. https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/arrest

Felder, C. C., & Glass, M. (1998). Cannabinoid receptors and their endogenous agonists. *Annual Review of Pharmacology and Toxicology*, *38*(1), 179–200. https://doi.org/10.1146/annurev.pharmtox.38.1.179

Finn, D. P., Haroutounian, S., Hohmann, A. G., Krane, E., Soliman, N., & Rice, A. S. C. (2021). Cannabinoids, the endocannabinoid system, and pain: A review of preclinical studies. *Pain*, *162*(1). https://doi.org/10.1097/j.pain.0000000000002268

Franco, V., & Perucca, E. (2019). Pharmacological and therapeutic properties of cannabidiol for epilepsy. *Drugs*, *79*(13), 1435–1454. https://doi.org/10.1007/s40265-019-01171-4

Freeman, A. M., Petrilli, K., Lees, R., Hindocha, C., Mokrysz, C., Curran, H. V., Saunders, R., & Freeman, T. P. (2019). How does cannabidiol (CBD) influence the acute effects of delta-9-tetrahydrocannabinol (THC) in humans? A systematic review. *Neuroscience & Biobehavioral Reviews*, *107*, 696–712. https://doi.org/10.1016/j.neubiorev.2019.09.036

Freeman, T. P., Craft, S., Wilson, J., Stylianou, S., ElSohly, M., Di Forti, M., & Lynskey, M. T. (2020). Changes in delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD)

concentrations in cannabis over time: Systematic Review and meta-analysis. *Addiction*, *116*(5), 1000–1010. https://doi.org/10.1111/add.15253

Gibson, L. P., Karoly, H. C., Ellingson, J. M., Klawitter, J., Sempio, C., Squeri, J. E., Bryan, A. D., Bidwell, L. C., & Hutchison, K. E. (2021). Effects of cannabidiol in cannabis flower: Implications for harm reduction. *Addiction Biology*, *27*(1), 1–12. https://doi.org/10.1111/adb.13092

Gloss, D. (2015). An overview of products and bias in research. *Neurotherapeutics*, *12*(4), 731–734. https://doi.org/10.1007/s13311-015-0370-x

Goodman, S., Wadsworth, E., Leos-Toro, C., & Hammond, D. (2020). Prevalence and forms of cannabis use in legal vs. illegal recreational cannabis markets. *International Journal of Drug Policy*, *76*, 102658. https://doi.org/10.1016/j.drugpo.2019.102658

Gray, R. A., & Whalley, B. J. (2020). The proposed mechanisms of action of CBD in epilepsy. *Epileptic Disorders*, *22*(51). https://doi.org/https://doi.org/10.1684/epd.2020.1135

Green, T. V. (2022, November 22). *Americans overwhelmingly say marijuana should be legal for medical or recreational use*. Pew Research Center. https://www.pewresearch.org/short-reads/2022/11/22/americans-overwhelmingly-say-marijuana-should-be-legal-for-medical-or-recreational-use/

Grimison, P., Mersiades, A., Kirby, A., Lintzeris, N., Morton, R., Haber, P., Olver, I., Walsh, A., McGregor, I., Cheung, Y., Tognela, A., Hahn, C., Briscoe, K., Aghmesheh, M., Fox, P., Abdi, E., Clarke, S., Della-Fiorentina, S., Shannon, J., … Stockler, M. (2020). Oral THC:CBD cannabis extract for refractory chemotherapy-induced nausea and vomiting: A randomised, placebo-controlled, phase II crossover trial. *Annals of Oncology*, *31*(11), 1553–1560. https://doi.org/10.1016/j.annonc.2020.07.020

Hall, W., & Lynskey, M. (2020). Assessing the public health impacts of legalizing recreational cannabis use: The US experience. *World Psychiatry, 19*(2), 179–186. https://doi.org/10.1002/wps.20735

Haney, M. (2022). Cannabis use and the endocannabinoid system: A clinical perspective. *American Journal of Psychiatry*, *179*(1), 21–25. https://doi.org/10.1176/appi.ajp.2021.21111138

Harlow, A. F., Leventhal, A. M., & Barrington-Trimis, J. L. (2022). Closing the loophole on hemp-derived cannabis products. *JAMA*, *328*(20), 2007–2008. https://doi.org/10.1001/jama.2022.20620

Hemp Production and the 2018 Farm Bill. (2019). (testimony of Amy Abernethy). https://www.fda.gov/news-events/congressional-testimony/hemp-production-and-2018-farm-bill-07252019

Hesami, M., Pepe, M., & Jones, A. M. (2023). Morphological characterization of Cannabis Sativa L. throughout its complete life cycle. *Plants*, *12*(20), 1–21. https://doi.org/10.3390/plants12203646

Hillig, K. W., & Mahlberg, P. G. (2004). A chemotaxonomic analysis of cannabinoid variation in Cannabis (Cannabaceae). *American Journal of Botany*, *91*(6), 966–975. https://doi.org/10.3732/ajb.91.6.966

Hutchison, K. E., Bidwell, L. C., Ellingson, J. M., & Bryan, A. D. (2019). Cannabis and health research: Rapid progress requires innovative research designs. *Value in Health*, *22*(11), 1289–1294. https://doi.org/10.1016/j.jval.2019.05.005

Isidore, E., Karim, H., & Ioannou, I. (2021). Extraction of phenolic compounds and terpenes from cannabis sativa L. by-products: From conventional to intensified processes. *Antioxidants*, *10*(6), 942. https://doi.org/10.3390/antiox10060942

Izzo, L., Castaldo, L., Narváez, A., Graziani, G., Gaspari, A., Rodríguez-Carrasco, Y., & Ritieni, A. (2020). Analysis of phenolic compounds in commercial cannabis sativa L. inflorescences using UHPLC-Q-orbitrap hrms. *Molecules*, *25*(3), 631. https://doi.org/10.3390/molecules25030631

Jin, D., Henry, P., Shan, J., & Chen, J. (2021). Identification of chemotypic markers in three chemotype categories of cannabis using secondary metabolites profiled in inflorescences, leaves, stem bark, and roots. *Frontiers in Plant Science*, *12*. https://doi.org/10.3389/fpls.2021.699530

Jin, D., Jin, S., & Chen, J. (2019). Cannabis indoor growing conditions, management practices, and Post-Harvest Treatment: A Review. *American Journal of Plant Sciences*, *10*(06), 925–946. https://doi.org/10.4236/ajps.2019.106067

Johnson, R. (2021, Dec. 2). Comparing hemp provisions in the 2014 and 2018 Farm Bills. (CRS IF11984). https://crsreports.congress.gov/product/pdf/IF/IF11984

Johnson, M. S., & Wallace, J. G. (2021). Genomic and chemical diversity of commercially available high-CBD industrial hemp accessions. *Frontiers in Genetics*, *12*. https://doi.org/10.3389/fgene.2021.682475

Jones, J. M. (2019, June 12). *In U.S., Medical Aid Top Reason Why Legal Marijuana Favored*. Gallup.com. https://news.gallup.com/poll/258149/medical-aid-top-reason-why-legal-marijuana-favored.aspx

Jones, V. (2023, May 23). *Tennessee gov. Bill Lee signs new law on delta-8 products. here's what it does.* The Tennessean. https://www.tennessean.com/story/news/politics/2023/05/23/delta-8-hemp-cannabinoid-marijuana-tennessee-law-regulation/70245331007/

Kaul, M., Zee, P. C., & Sahni, A. S. (2021). Effects of cannabinoids on sleep and their therapeutic potential for sleep disorders. *Neurotherapeutics*, *18*(1), 217–227. https://doi.org/10.1007/s13311-021-01013-w

King, J. W. (2019). The relationship between cannabis/hemp use in foods and processing methodology. *Current Opinion in Food Science*, *28*, 32–40. https://doi.org/10.1016/j.cofs.2019.04.007

Khoddami, A., Wilkes, M., & Roberts, T. (2013). Techniques for analysis of plant phenolic compounds. *Molecules*, *18*(2), 2328–2375. https://doi.org/10.3390/molecules18022328

Lachance, A., Bélanger, R. E., Riva, M., & Ross, N. A. (2022). A systematic review and narrative synthesis of the evolution of adolescent and young adult cannabis consumption before and after legalization. *Journal of Adolescent Health*, *70*(6), 848–863. https://doi.org/10.1016/j.jadohealth.2021.11.034

Lawler, A. (2019). *Oldest evidence of marijuana use discovered in 2500-year-old cemetery*. Science. https://www.science.org/content/article/oldest-evidence-marijuana-use-discovered-2500-year-old-cemetery-peaks-western-china

Lazarjani, M. P., Young, O., Kebede, L., & Seyfoddin, A. (2021). Processing and extraction methods of medicinal cannabis: A narrative review. *Journal of Cannabis Research*, *3*(1). https://doi.org/10.1186/s42238-021-00087-9

Leary v. United States, 395 U.S. 6. 1969. https://supreme.justia.com/cases/federal/us/395/6/

Leas, E. C., Nobles, A. L., Caputi, T. L., Dredze, M., Smith, D. M., & Ayers, J. W. (2019). Trends in internet searches for cannabidiol (CBD) in the United States. *JAMA Network Open, 2*(10). https://doi.org/10.1001/jamanetworkopen.2019.13853

Leas, E. C., Nobles, A. L., Shi, Y., & Hendrickson, E. (2022). Public interest in Δ8-tetrahydrocannabinol (delta-8-THC) increased in US states that restricted Δ9-tetrahydrocannabinol (delta-9-THC) use. *International Journal of Drug Policy, 101*, 1–4. https://doi.org/10.1016/j.drugpo.2021.103557

Levy, N. S., Mauro, P. M., Mauro, C. M., Segura, L. E., & Martins, S. S. (2021). Joint perceptions of the risk and availability of cannabis in the United States, 2002-2018. *Drug and Alcohol Dependence, 226*, 108873. https://doi.org/10.1016/j.drugalcdep.2021.108873

Li, W., Lu, H. T., Doblin, M. S., Bacic, A., Stevens, G. W., & Mumford, K. A. (2022). A solvent loss study for the application of solvent extraction processes in the pharmaceutical industry. *Chemical Engineering Science, 250*, 117400. https://doi.org/10.1016/j.ces.2021.117400

Li, X., Vigil, J. M., Stith, S. S., Brockelman, F., Keeling, K., & Hall, B. (2019). The effectiveness of self-directed medical cannabis treatment for pain. *Complementary Therapies in Medicine, 46*, 123–130. https://doi.org/10.1016/j.ctim.2019.07.022

Livingston, M. D., Walker, A., Cannell, M. B., & Rossheim, M. E. (2022). Popularity of delta-8 THC on the internet across US states, 2021. *American Journal of Public Health, 112*(2), 296–299. https://doi.org/10.2105/ajph.2021.306586

LoParco, C. R., Rossheim, M. E., Walters, S. T., Zhou, Z., Olsson, S., & Sussman, S. Y. (2023). Delta-8 tetrahydrocannabinol: A scoping review and commentary. *Addiction, 118*(6), 1011–1028. https://doi.org/10.1111/add.16142

Lorensen, M. D., Hayat, S. Y., Wellner, N., Bjarnholt, N., & Janfelt, C. (2023). Leaves of cannabis sativa and their trichomes studied by DESI and MALDI mass spectrometry imaging for their contents of cannabinoids and flavonoids. *Phytochemical Analysis*, *34*(3), 269–279. https://doi.org/10.1002/pca.3202

Lovell, M. E., Akhurst, J., Padgett, C., Garry, M. I., & Matthews, A. (2020). Cognitive outcomes associated with long-term, regular, recreational cannabis use in adults: A meta-analysis. Experimental and Clinical Psychopharmacology, *28*(4), 471–494. https://doi.org/10.1037/pha0000326

Maddison, K. J., Kosky, C., & Walsh, J. H. (2022). Is there a place for medicinal cannabis in treating patients with sleep disorders? what we know so far. *Nature and Science of Sleep*, *Volume 14*, 957–968. https://doi.org/10.2147/nss.s340949

Malabadi, R. B., Kolkar, K. P., Chalannavar, R. K., Munhoz, A. N., Abdi, G., & Baijnath, H. (2023). Cannabis sativa: Dioecious into monoecious plants influencing sex determination. *International Journal of Research and Innovation in Applied Science*, *VIII*(VII), 82–91. https://doi.org/10.51584/ijrias.2023.8709

McGue, L., Morawska, M., Robinson, M.L. and O'Callaghan, A.O. (2021). Hemp Basics: Anatomy of a Female Hemp Plant, Extension, University of Nevada, Reno, FS-21-97 https://extension.unr.edu/publication.aspx?PubID=4479#:~:text=They%20are%20necessary%20for%20photosynthesis,)%20with%20long%2C%20serrated%20leaflets.

McPartland, J. M. (2018). Cannabis systematics at the levels of family, genus, and species. *Cannabis and Cannabinoid Research*, *3*(1), 203–212. https://doi.org/10.1089/can.2018.0039

Mead, A. (2019). Legal and regulatory issues governing cannabis and cannabis-derived products in the United States. *Frontiers in Plant Science*, *10*. https://doi.org/10.3389/fpls.2019.00697

Musto, D. F. (1972). The Marihuana Tax Act of 1937. *Archives of General Psychiatry*, *26*(2), 101. https://doi.org/10.1001/archpsyc.1972.01750200005002

Narayanan, S., Lazar Neto, F., Tanco, K., Lopez, G., Liu, W., Bruera, E., & Subbiah, V. (2020). Cannabidiol (CBD) oil, cancer, and symptom management: A google trends analysis of public interest. *The Journal of Alternative and Complementary Medicine*, *26*(4), 346–348. https://doi.org/10.1089/acm.2019.0428

National Academies of Sciences, Engineering, and Medicine. 2017. *The health effects of cannabis and cannabinoids: The current state of evidence and recommendations for research.* Washington, DC: The National Academies Press. doi: 10.17226/24625. Available from: https://www.ncbi.nlm.nih.gov/books/NBK423845/

National Conference of State Legislatures. (2023, June 22). *Report state medical cannabis laws*. https://www.ncsl.org/health/state-medical-cannabis-laws

Nutt, D. J., King, L. A., & Nichols, D. E. (2013). Effects of schedule I drug laws on neuroscience research and treatment innovation. *Nature Reviews Neuroscience*, *14*(8), 577–585. https://doi.org/10.1038/nrn3530

Oberbarnscheidt, T., & Miller, N. S. (2020). The impact of cannabidiol on psychiatric and medical conditions. *Journal of Clinical Medicine Research, 12*(7), 393–403. https://doi.org/10.14740/jocmr4159

Orser, C. S. (2022). Pre- and post-harvest processing and Quality Standardization. *Revolutionizing the Potential of Hemp and Its Products in Changing the Global Economy*, 197–219. https://doi.org/10.1007/978-3-031-05144-9_11

Palali, A., & Ours, J. (2017). Cannabis use and support for cannabis legalization. Empirical Economics, 53(4), 1747–1770. https://doi.org/https://doi.org/10.1007/s00181-016-1172-7

Pattnaik, F., Nanda, S., Mohanty, S., Dalai, A. K., Kumar, V., Ponnusamy, S. K., & Naik, S. (2022). Cannabis: Chemistry, extraction and therapeutic applications. *Chemosphere*, *289*, 133012. https://doi.org/10.1016/j.chemosphere.2021.133012

Patton, D. V. (2020). History of United States Cannabis Law. *Journal of Law and Health, 34(1),* 1-30.

Pearson, M. R., Liese, B. S., & Dvorak, R. D. (2017). College student marijuana involvement: Perceptions, use, and consequences across 11 college campuses. *Addictive Behaviors*, *66*, 83–89. https://doi.org/10.1016/j.addbeh.2016.10.019

Pellati, F., Borgonetti, V., Brighenti, V., Biagi, M., Benvenuti, S., & Corsi, L. (2018). *cannabis sativa* L. and nonpsychoactive cannabinoids: Their chemistry and role against oxidative stress, inflammation, and cancer. *BioMed Research International*, *2018*, 1–15. https://doi.org/10.1155/2018/1691428

Pennypacker, S. D., Cunnane, K., Cash, M. C., & Romero-Sandoval, E. A. (2022). Potency and therapeutic THC and CBD ratios: U.S. cannabis markets overshoot. *Frontiers in Pharmacology*, *13*. https://doi.org/10.3389/fphar.2022.921493

Perisetti, A. (2020). Role of cannabis in inflammatory bowel diseases. *Annals of Gastroenterology*. https://doi.org/10.20524/aog.2020.0452

Piomelli, D., & Russo, E. B. (2016). The Cannabis sativa versus Cannabis indica debate: An interview with Ethan Russo, MD. *Cannabis and Cannabinoid Research*, *1*(1), 44–46. https://doi.org/10.1089/can.2015.29003.ebr

Pollio, A. (2016). The name of Cannabis: A short guide for nonbotanists. *Cannabis and Cannabinoid Research*, *1*(1), 234–238. https://doi.org/10.1089/can.2016.0027

Potter, G. R., Bouchard, M., & Decorte, T. (2016). The globalization of cannabis cultivation. In World wide weed (pp. 21-40). Routledge.

Preuss, U. W., Huestis, M. A., Schneider, M., Hermann, D., Lutz, B., Hasan, A., Kambeitz, J., Wong, J. W., & Hoch, E. (2021). Cannabis use and car crashes: A Review. *Frontiers in Psychiatry*, *12*. https://doi.org/10.3389/fpsyt.2021.643315

Raber, J. C., Elzinga, S., & Kaplan, C. (2015). Understanding dabs: Contamination concerns of cannabis concentrates and cannabinoid transfer during the act of dabbing. *The Journal of Toxicological Sciences*, *40*(6), 797–803. https://doi.org/10.2131/jts.40.797

Raman, V., Lata, H., Chandra, S., Khan, I. A., & ElSohly, M. A. (2017). Morpho-anatomy of marijuana (cannabis sativa L.). *Cannabis Sativa L. - Botany and Biotechnology*, 123–136. https://doi.org/10.1007/978-3-319-54564-6_5

Reason, D. A., Grainger, M. N., & Lane, J. R. (2022). Optimization of the decarboxylation of cannabis for commercial applications. *Industrial & Engineering Chemistry Research*, *61*(23), 7823–7832. https://doi.org/10.1021/acs.iecr.2c00826

Research Triangle Institute. (2021). *Cannabis research*. RTI. https://www.rti.org/emerging-issue/cannabis-

research#:~:text=Research%20to%20Support%20Policy%20and%20Regulation&text=product%20packaging%2C%20including%20consumer%20awareness,under%20the%20influence%20of%20cannabis

Rodriguez-Morrison, V., Llewellyn, D., & Zheng, Y. (2021). Cannabis yield, potency, and leaf photosynthesis respond differently to increasing light levels in an indoor environment. *Frontiers in Plant Science, 12*. https://doi.org/10.3389/fpls.2021.646020

Romero-Sandoval, E. A., Fincham, J. E., Kolano, A. L., Sharpe, B. N., & Alvarado-Vázquez, P. A. (2018). Cannabis for chronic pain: Challenges and considerations. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *38*(6), 651–662. https://doi.org/10.1002/phar.2115

Romm, K. F., Wang, Y., Ma, Y., Wysota, C. N., Blank, M. D., Huebner, D. M., Roche, K. M., & Berg, C. J. (2022). The reciprocal relationships of social norms and risk perceptions to cigarette, e-cigarette, and cannabis use: Cross-lagged panel analyses among us young adults in a longitudinal study. *Drug and Alcohol Dependence*, *238*, 109570. https://doi.org/10.1016/j.drugalcdep.2022.109570

Rossheim, M. E., Loparco, C. R., Henry, D., Trangenstein, P. J., & Walters, S. T. (2023). Delta-8, delta-10, HHC, THC-O, THCP, and THCV: What should we call these products? *Journal of Studies on Alcohol and Drugs*, *84*(3), 357–360. https://doi.org/10.15288/jsad.23-00008

Sacco, L. (2022, April 7). *The evolution of marijuana as a controlled substance and the federal-state policy gap*. (CRS Report No. R44782). https://crsreports.congress.gov/product/pdf/R/R44782

Sarma, N. D., Waye, A., ElSohly, M. A., Brown, P. N., Elzinga, S., Johnson, H. E., Marles, R. J., Melanson, J. E., Russo, E., Deyton, L., Hudalla, C., Vrdoljak, G. A., Wurzer, J. H., Khan, I. A., Kim, N.-C., & Giancaspro, G. I. (2020). Cannabis inflorescence for medical purposes: USP Considerations for Quality attributes. *Journal of Natural Products*, *83*(4), 1334–1351. https://doi.org/10.1021/acs.jnatprod.9b01200

Schaeffer, K. (2023, April 13). *7 facts about Americans and marijuana*. Pew Research Center. https://www.pewresearch.org/short-reads/2023/04/13/facts-about-marijuana/

Schulenberg, J. E., Patrick, M. E., Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Miech, R. A. (2021). Monitoring the Future national survey results on drug use, 1975–2020: Volume II, College students and adults ages 19–60. Ann Arbor: Institute for Social Research, The University of Michigan. Available at http://monitoringthefuture.org/pubs.html#monographs

Schwabe, A. L., & McGlaughlin, M. E. (2019). Genetic tools weed out misconceptions of strain reliability in Cannabis Sativa: Implications for a budding industry. *Journal of Cannabis Research*, *1*(1). https://doi.org/10.1186/s42238-019-0001-1

Sharpe, L., Sinclair, J., Kramer, A., de Manincor, M., & Sarris, J. (2020). Cannabis, a cause for anxiety? A critical appraisal of the anxiogenic and anxiolytic properties. *Journal of Translational Medicine*, *18*(1). https://doi.org/10.1186/s12967-020-02518-2

Simons, J., Correia, C. J., Carey, K. B., & Borsari, B. E. (1998). Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *Journal of Counseling Psychology*, *45*(3), 265–273. https://doi.org/10.1037/0022-0167.45.3.265

Simpson, K. A., Cho, J., & Barrington-Trimis, J. L. (2021). The association of type of cannabis product used and frequency of use with problematic cannabis use in a sample of young

adult cannabis users. *Drug and Alcohol Dependence*, *226*, 108865. https://doi.org/10.1016/j.drugalcdep.2021.108865

Small, E., & Cronquist, A. (1976). A practical and natural taxonomy for cannabis. *TAXON*, *25*(4), 405–435. https://doi.org/10.2307/1220524

Smith , F. (2023, October 7). *Is CBD legal in Tennessee?*. CBD Clinicals. https://cbdclinicals.com/is-cbd-legal-in-tennessee/

Sommano, S. R., Chittasupho, C., Ruksiriwanich, W., & Jantrawut, P. (2020). The cannabis terpenes. *Molecules*, *25*(24), 5792. https://doi.org/10.3390/molecules25245792

Spindle, T. R., Bonn-Miller, M. O., & Vandrey, R. (2019). Changing landscape of cannabis: Novel products, formulations, and methods of administration. *Current Opinion in Psychology*, *30*, 98–102. https://doi.org/10.1016/j.copsyc.2019.04.002

Spinella, T. C., Stewart, S. H., Naugler, J., Yakovenko, I., & Barrett, S. P. (2021). Evaluating cannabidiol (CBD) expectancy effects on acute stress and anxiety in healthy adults: A randomized crossover study. *Psychopharmacology*, *238*(7), 1965–1977. https://doi.org/10.1007/s00213-021-05823-w

Spitzer-Rimon, B., Duchin, S., Bernstein, N., & Kamenetsky, R. (2019). Architecture and Florogenesis in female cannabis sativa plants. *Frontiers in Plant Science*, *10*. https://doi.org/10.3389/fpls.2019.00350

Stasiłowicz, A., Tomala, A., Podolak, I., & Cielecka-Piontek, J. (2021). Cannabis sativa L. as a natural drug meeting the criteria of a multitarget approach to treatment. *International Journal of Molecular Sciences*, *22*(2), 778. https://doi.org/10.3390/ijms22020778

Stefkov, G., Cvetkovikj Karanfilova, I., Stoilkovska Gjorgievska, V., Trajkovska, A., Geskovski, N., Karapandzova, M., & Kulevanova, S. (2022). Analytical techniques for

phytocannabinoid profiling of cannabis and cannabis-based products—a comprehensive review. *Molecules, 27*(3), 975. https://doi.org/10.3390/molecules27030975

Stringer, R. J., & Maggard, S. R. (2016). Reefer madness to marijuana legalization. *Journal of Drug Issues, 46*(4), 428–445. https://doi.org/10.1177/0022042616659762

Substance Abuse and Mental Health Services Administration. Behavioral Health Barometer: Tennessee, Volume 6: Indicators as measured through the 2019 National Survey on Drug Use and Health and the National Survey of Substance Abuse Treatment Services. HHS Publication No. SMA–20–Baro–19–TN. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2020.

Substance Abuse and Mental Health Services Administration: *Cannabidiol (CBD) – Potential Harms, Side Effects, and Unknowns*. Publication No. PEP22- 06-04-003. Rockville, MD: National Mental Health and Substance Use Policy Laboratory. Substance Abuse and Mental Health Services Administration, 2023.

Substance Abuse and Mental Health Services Administration. (2020). *Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on Drug Use and Health* (HHS Publication No. PEP20-07-01-001, NSDUH Series H-55). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. Retrieved from https://www.samhsa.gov/data/

Substance Abuse and Mental Health Services Administration. (2022). Key substance use and mental health indicators in the United States: Results from the 2021 National Survey on Drug Use and Health (HHS Publication No. PEP22-07-01-005, NSDUH Series H-57). Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health

Services Administration. https://www.samhsa.gov/data/report/2021-nsduh-annual-national-report

Tanney, C. A., Backer, R., Geitmann, A., & Smith, D. L. (2021). Cannabis glandular trichomes: A cellular metabolite factory. *Frontiers in Plant Science*, *12*. https://doi.org/10.3389/fpls.2021.721986

Tashkin, D. P., & Roth, M. D. (2019). Pulmonary effects of inhaled cannabis smoke. *The American Journal of Drug and Alcohol Abuse*, *45*(6), 596–609. https://doi.org/10.1080/00952990.2019.1627366

Tennessee Code Title 39. Criminal Offenses § 39-17-415.

Tennessee Bureau of Investigation. (2019). *Hemp & Marijuana*. Tennessee State Government. https://www.tn.gov/tbi/crime-issues/crime-issues/hemp---marijuana.html

Thomas, B. F., & ElSohly, M. A. (2016). *The Analytical Chemistry of Cannabis: Quality Assessment, assurance, and regulation of medicinal marijuana and cannabinoid preparations*. Elsevier.

Trevino, R. A., & Richard, A. J. (2002). Attitudes towards drug legalization among drug users. The American Journal of Drug and Alcohol Abuse, 28(1), 91–108. https://doi.org/10.1081/ADA-120001283

Ubeed, H. S. M. A., Wills, R. B., & Chandrapala, J. (2022). Post-harvest operations to generate high-quality medicinal cannabis products: A systemic review. *Molecules*, *27*(5), 1719. https://doi.org/10.3390/molecules27051719

United Nations Office on Drugs and Crime. (2013). *Recommended methods for the identification and analysis of cannabis and cannabis products*. United Nations. https://doi.org/10.18356/1e8e4f16-en

Urbi, B., Corbett, J., Hughes, I., Owusu, M. A., Thorning, S., Broadley, S. A., Sabet, A., & Heshmat, S. (2022). Effects of cannabis in parkinson's disease: A systematic review and meta-analysis. *Journal of Parkinson's Disease*, *12*(2), 495–508. https://doi.org/10.3233/jpd-212923

U.S. Drug Enforcement Administration. (2019). Bulk manufacturer of controlled substances applications: Bulk manufacturers of marihuana. *Federal Register* , *84*(166), 44920–44923. https://www.federalregister.gov/documents/2019/08/27/2019-18456/bulk-manufacturer-of-controlled-substances-applications-bulk-manufacturers-of-marihuana

U.S. Drug Enforcement Administration. (2021, May 14). *DEA continues to prioritize efforts to expand access to marijuana for research in the United States*. DEA. https://www.dea.gov/stories/2021/2021-05/2021-05-14/dea-continues-prioritize-efforts-expand-access-marijuana-research

U.S. Drug Enforcement Administration. (2021). *Cannabis*. DEA Museum. https://museum.dea.gov/exhibits/online-exhibits/cannabis-coca-and-poppy-natures-addictive-plants/cannabis

U.S. Department of Justice and Drug Enforcement Administration. (2020, April). Drug fact sheet: marijuana/cannabis https://www.dea.gov/sites/default/files/2020-06/Marijuana-Cannabis-2020_0.pdf

U.S. Department of Justice and U.S. Drug Enforcement Administration. (2023). *Marihuana Growers Information*. Marihuana growers information. https://www.deadiversion.usdoj.gov/drugreg/marihuana.htm

U.S. Food and Drug Administration. (2023, February 24). *FDA and cannabis: Research and Drug Approval Process*. https://www.fda.gov/news-events/public-health-focus/fda-and-cannabis-research-and-drug-approval-process

Wang, M., Wang, Y.-H., Avula, B., Radwan, M. M., Wanas, A. S., van Antwerp, J., Parcher, J. F., ElSohly, M. A., & Khan, I. A. (2016). Decarboxylation study of acidic cannabinoids: A novel approach using ultra-high-performance supercritical fluid chromatography/photodiode array-mass spectrometry. *Cannabis and Cannabinoid Research*, *1*(1), 262–271. https://doi.org/10.1089/can.2016.0020

Wizenberg, S. B., Weis, A. E., & Campbell, L. G. (2020). Comparing methods for controlled capture and quantification of pollen in *cannabis sativa*. *Applications in Plant Sciences*, *8*(9). https://doi.org/10.1002/aps3.11389

Yu, B., Chen, X., Chen, X., & Yan, H. (2020). Marijuana Legalization and historical trends in marijuana use among US residents aged 12–25: Results from the 1979–2016 national survey on drug use and health. *BMC Public Health*, *20*(1), 1–10. https://doi.org/10.1186/s12889-020-8253-4

Zehner, M. (2023, February 21). *Brightfield's 2023 US cannabis market forecast*. Tips and Insights on Emerging Trends. https://blog.brightfieldgroup.com/brightfields-2023-us-cannabis-market-forecast

Zheng, Z., Fiddes, K., & Yang, L. (2021). A narrative review on environmental impacts of cannabis cultivation. *Journal of Cannabis Research*, *3*(1). https://doi.org/10.1186/s42238-021-00090-0

APPENDIX: Survey Guide

SECTION 1: DEMOGRAPHICS

1. What is your age?

- (type in response)

2. What describes your gender identity? (select one)

- Man
- Woman
- Transgender/Gender Non-Conforming
- Other Identity Not Listed

3. What describes your race/ethnicity? (select one)

- Asian or Asian American
- Black or African American
- Hispanic or Latino
- Native American/Alaska Native
- Native Hawaiian/Pacific Islander
- White
- Biracial or Multiracial
- Other Racial/Ethnicity Not Listed

4. What is your class cohort at ETSU? (select one)

- Freshmen
- Sophomore
- Junior
- Senior
- Graduate Student

5. How would you describe yourself? (select one)

- Democrat
- Independent
- Republican
- Preference Not Listed

SECTION 2: CANNABIS USAGE

**Note to Participant:* The term "cannabis" is referring to ANY derivative and/or compound of the plant. For this section, the use of cannabis is not exclusively referring to cannabis with the psychoactive property delta-9-tetrahydrocannabinol (THC), which people commonly refer to as "marijuana" or "weed". Cannabis usage, here, will also include hemp-derived products like cannabidiol (CBD), delta-8-THC, delta-10-THC and others which are legal in the state of Tennessee.

1. Have you used cannabis in any form at any point in your life?

- Yes
- No

2. How often have you used cannabis in the past 12 months? (select one)

- No use (0)
- Less than once a month but at least once in the last 12 months (1)
- Once a month (2)
- Two to three times per month (3)

- Once or twice per week (4)
- Three to four times per week (5)
- Nearly every day (6)
- Once a day (7)
- More than once a day (8)

3. How often have you <u>smoked</u> cannabis in the past 12 months? (select one)

- No use (0)
- Less than once a month but at least once in the last 12 months (1)
- Once a month (2)
- Two to three times per month (3)
- Once or twice per week (4)
- Three to four times per week (5)
- Nearly every day (6)
- Once a day (7)
- More than once a day (8)

4. How often have you <u>vaped</u> cannabis in the past 12 months? (select one)

- No use (0)
- Less than once a month but at least once in the last 12 months (1)
- Once a month (2)
- Two to three times per month (3)
- Once or twice per week (4)
- Three to four times per week (5)
- Nearly every day (6)
- Once a day (7)
- More than once a day (8)

5. How often have you <u>ingested</u> cannabis (through solid form like edibles and/or infused liquids or oils) in the past 12 months? (select one)

- No use (0)
- Less than once a month but at least once in the last 12 months (1)
- Once a month (2)
- Two to three times per month (3)
- Once or twice per week (4)
- Three to four times per week (5)
- Nearly every day (6)
- Once a day (7)
- More than once a day (8)

6. How often have you <u>applied</u> cannabis (like in the form of an oil or lotion) on skin in the past 12 months? (select one)

- No use (0)
- Less than once a month but at least once in the last 12 months (1)
- Once a month (2)
- Two to three times per month (3)
- Once or twice per week (4)
- Three to four times per week (5)
- Nearly every day (6)
- Once a day (7)

- More than once a day (8)

SECTION 3: PERCEPTIONS OF CANNABIS

**Note to Participant:* For this last section, the term "cannabis" is more specifically referring to cannabis that contains THC and can produce a "high" or mind-altering state when consumed.

1. In your opinion, cannabis should be… (select one)

- Illegal for ANY use
- Legalized for medical use ONLY
- Legalized for BOTH medical and recreational use

2. *Using the scale to the right of the page, please indicate how much you agree with the following statements.*

SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree

Legalizing cannabis would increase the number of car accidents involving drivers who use cannabis	SD	D	N	A	SA
Cannabis helps people who use it for medical reasons	SD	D	N	A	SA
Legalizing cannabis would lead to more people using stronger and more addictive drugs	SD	D	N	A	SA
Legalizing cannabis would free up law enforcement to focus on other types of crime	SD	D	N	A	SA
Legalizing cannabis would encourage more people to use cannabis which is harmful	SD	D	N	A	SA
Using cannabis is a matter of freedom and personal choice	SD	D	N	A	SA
Legalizing cannabis would not benefit society or individuals much	SD	D	N	A	SA
Legalizing cannabis will provide a good source of tax revenue for state and local governments	SD	D	N	A	SA
I believe cannabis is harmful to people who use it	SD	D	N	A	SA
Government regulation of cannabis would make it safer for those who use it	SD	D	N	A	SA
I believe the use of drugs, including cannabis, is immoral	SD	D	N	A	SA
I do not believe cannabis is harmful to people who use it	SD	D	N	A	SA

VITA

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