CANADIAN CANCER SURVIVORS' USE OF CANNABIS AS A SLEEP AID

by

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Abstract

This project is a cross-sectional exploration of cannabis as a sleep aid among Canadian cancer survivors. Participants were recruited via the Angus Reid Forum and completed a survey including the Insomnia Severity Index and questions about their sociodemographic information, medical history, and cannabis use for sleep.

The first study explored the prevalence and patterns of cannabis use for sleep. Of participants ($N=1464$), 23.5% reported currently using cannabis for sleep. Current consumers ($M_{age}=61.1$, 50% women) received their cancer diagnosis 12.5 years prior. Benefits to sleep included relaxation, falling asleep faster, fewer nocturnal awakenings, and improved sleep quality.

The second study examined factors associated with cannabis use as a sleep aid. Participants ($N=940$) were more likely to use cannabis for sleep if they identified as a gender other than men or women, were diagnosed with multiple medical conditions or sleep disorders, two psychological conditions, insomnia, bone, gastrointestinal, genitourinary, hematological, or an unlisted cancer, received hormone therapy only, partake in heavy drinking, or scored in the mild insomnia range.

Given the prevalence and potential impact of cannabis on sleep, more research is needed to examine its efficacy and safety. The present findings will inform future trials by generating patient-oriented hypotheses and methodologies.

General Summary

This project explored Canadian cancer survivors' use of cannabis for sleep. Participants were recruited from the Angus Reid Forum and completed a survey about their cannabis use for sleep. The first study explored the percentage of participants using cannabis for sleep and how they used it. Of participants, 23.5% reported currently using cannabis for sleep and believed it helps them relax, fall asleep faster, sleep through the night, and have better sleep quality. The second study explored factors related to using cannabis for sleep. Participants were more likely to use cannabis for sleep if they identified as a gender other than man or woman, had multiple medical conditions or sleep disorders, two psychological conditions, insomnia, bone, gastrointestinal, genitourinary, hematological, or an unlisted cancer, had hormone therapy only, are heavy drinkers, or scored in the mild insomnia range. More research is needed. These findings will be used to design future studies.

Finally, I would like to express my heartfelt gratitude to my family and friends who have been with me every step of the way, through every achievement and setback. Your unwavering support, encouragement, and love have been instrumental in helping me get to this point. Thank you for having confidence in me, encouraging me to celebrate my successes, and reminding me that this is a big deal!

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Chapter 1:

Cannabis use for Sleep Among Canadian Cancer Survivors: An Overview

Overview

This thesis explored the use of cannabis as a sleep aid among Canadian cancer survivors. The first chapter provides an overview of the literature that illustrates the theoretical motivation for these studies. This chapter begins with an explanation of the relationship between sleep and cancer, evidence-based sleep aids that exist, cannabis, and cannabis as a sleep aid. The first chapter concludes with the research objectives. Chapter two is a manuscript exploring the prevalence and patterns of cannabis use as a sleep aid, including frequency, duration, time before bed, method of ingestion, cannabinoid content, healthcare provider awareness, reasons for use, perceived effects, and perceived side effects. Chapter three is a manuscript examining the personal qualities, lifestyle factors, and disease characteristics associated with cannabis use for sleep among Canadian cancer survivors. The final chapter will contextualize these findings within the existing literature and explore implications for clinical practice to better meet the needs of Canadian cancer survivors struggling with their sleep. Directions for future research are also outlined that emphasize the need for rigorously controlled experimental trials to better understand the efficacy and safety of using cannabis as a sleep aid.

Sleep and Cancer

Cancer is a debilitating disease that can cause patients to experience a variety of difficult symptoms, including pain (Jones et al., 2023), nausea (Tipton, 2023), cognitive impairment (Janelsins et al., 2014), fatigue (Bower, 2014), and insomnia (Harrold et al., 2020). In the 1940s, receiving a cancer diagnosis was analogous to receiving a death sentence; the five-year net survival for all cancers was about 25% (Society, 2022). However, with extensive research and clinical efforts such as increased screening, earlier detection, and advances in treatment (Bluethmann et al., 2016), survivorship for Canadians diagnosed with cancer is continuing to

increase (Canadian Cancer Statistics Advisory Comittee in collaboration with the Canadian Cancer Society, 2021) with the five-year net survival rate for all cancers as of 2017 being 64% (Society, 2022). This leap in cancer care means that more people will live longer as cancer survivors — defined as individuals from the time of cancer diagnosis until the end of their life (Mullan, 1985). Increased survival also presents new challenges and opportunities for further research to better understand and address the long-lasting impacts of cancer and cancer treatment.

Insomnia and poor sleep are among the most common challenges of cancer survivorship. A meta-analysis of 160 studies published between 1998 and 2021 found that poor sleep was experienced by 61% of cancer survivors (Al Maqbali et al., 2022), making it one of the most common side effects of cancer and its treatment (Palesh et al., 2012). Further, these disturbances can persist for years after completing treatment (Lowery-Allison et al., 2018; Reynolds-Cowie & Fleming, 2021; Savard & Morin, 2001; Strollo et al., 2020). A nationwide study of 1903 cancer survivors in the US found that 51% still experienced high sleep disturbance nine years after diagnosis (Strollo et al., 2020). Insomnia disorder is characterized in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) as difficulty initiating, maintaining, or returning to sleep occurring at least 3 nights a week for at least 3 months despite adequate opportunity to sleep (APA, 2013). Insomnia can be acute or chronic, resulting from maladaptive psychobiological factors that inhibit optimal sleep conditions (Espie, 2023). For cancer survivors, these sleep-interfering factors may include symptoms such as pain, nausea, or fatigue (Hinds et al., 2007; Walker et al., 2010), as well as frequent napping and more time spent in bed (Alexander et al., 2009; Davidson et al., 2002; Savard & Morin, 2001). Insomnia can also be precipitated in cancer-specific anxiety among cancer survivors by death anxiety or fear of cancer

recurrence (Trill, 2013). Insomnia leads to significant distress and daytime impairment in functioning across various domains such as social, occupational, and behavioural (APA, 2013). In a qualitative exploration of the experience of 27 mixed-diagnosis cancer survivors with insomnia, insomnia was found to negatively impact many important domains: cancer survivors reported temperament changes that caused them to no longer feel like themselves; a need to plan their life around their sleep problem, interfering with their social life and work; changes in physical and psychological well-being; and that their insomnia hindered their relationships long into survivorship (Reynolds-Cowie & Fleming, 2021). Insomnia is experienced by cancer survivors at rates ranging from two to three times higher than the general population (Davidson et al., 2002; Palesh et al., 2010; Savard et al., 2001).

Consequences of Poor Sleep

Poor sleep and insomnia can be harmful to mental and physical health (Colten et al., 2006; Strollo et al., 2020). A meta-analysis of 21 longitudinal studies published from 1980 to 2010 demonstrated that insomnia was a significant predictor of subsequent depression (Baglioni et al., 2011). In a case-control study in Taiwan, a cohort of 51,734 patients with insomnia had a higher prevalence of diabetes, hypertension, coronary heart disease, and chronic liver and kidney disease than a reference group of adults without insomnia. (Hung et al., 2018) In this sample, insomnia was also found to be a significant predisposing factor for developing dementia. Poor sleep can also have consequences on quality of life (Byar et al., 2006; Lis et al., 2008). In a case series of 954 cancer patients, insomnia was negatively associated with overall quality of life (Lis et al., 2008). Despite its negative consequences, poor sleep and insomnia often go unreported and/or untreated by cancer survivors as they are believed to be normal consequences of cancer by both cancer survivors themselves and healthcare providers (Engstrom et al., 1999; Stone et

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al., 2000). In a qualitative investigation of insomnia among mixed-diagnosis cancer survivors, some reported that when seeking help for their poor sleep from their healthcare provider, they were either dismissed or offered only a short-term prescription that left them feeling hopeless about the lack of treatment options and about the reluctance from clinicians to discuss poor sleep (Reynolds-Cowie & Fleming, 2021). However, as sleep problems are persistent beyond cancer treatment (Al Maqbali et al., 2022), it is important to prioritize poor sleep and insomnia in survivorship care (Zhou & Recklitis, 2014) beginning at the time of diagnosis (Zhou et al., 2021).

Evidence-Based Sleep-Aids

Cognitive behavioural therapy for insomnia (CBT-I) is considered the gold-standard treatment in both cancer survivors and the general population (Arnedt et al., 2023; Jacobs et al., 2004; Morin et al., 2009; Rosenberg et al., 2021; Smith & Neubauer, 2003; Trauer et al., 2015). CBT-I is a type of psychotherapy typically conducted over several weeks through regular sessions with a therapist that aims to address the perpetuating underlying thoughts, emotions, and behaviours that contribute to insomnia (Williams et al., 2013). It includes five key components: stimulus control, strengthening the association between the bed with sleeping by limiting potentially stimulating behaviours in bed; sleep restriction, limiting time-in-bed to the amount of time actually spent sleeping; relaxation training, practices that help people relax throughout the day and at bedtime; sleep hygiene, controlling the environment to promote a context conducive to sleep; and cognitive restructuring, sleep education to reduce dysfunctional beliefs or attitudes about sleep (Trauer et al., 2015). CBT-I has both immediate and long-term benefits in reducing insomnia severity in cancer patients (Ma et al., 2021). However, CBT-I requires significant time, effort, and money that all cancer survivors may not be able to commit (Cheung et al., 2018) and

is inaccessible due to a shortage of practitioners and a lack of geographical spread (Thomas et al., 2016).

There are pharmacological interventions that exist for sleep, such as benzodiazepines (e.g., lorazepam, temazepam), "Z-drugs" (e.g., zopiclone, eszopiclone, zaleplon) and over-the-counter drugs (Brandt & Leong, 2017; Rosenberg et al., 2021). Although these can be effective for short-term use, they are generally not intended for long-term use and thus are not ideal for long-lasting sleep difficulties or chronic insomnia (Jacobs et al., 2004) that cancer survivors often experience. Further, sleep medications often produce persistent, undesirable side effects such as memory loss, cognitive impairment, and/or morning hangover that cancer survivors have reported finding especially challenging on top of their cancer and treatment-related side effects (Jacobs et al., 2004; A. Suraev et al., 2020). Sleep medications could also interact with other medications cancer survivors may be taking for cancer treatment or other medical or psychological conditions or may foster dependency (Schutte-Rodin et al., 2008).

Cannabis

The cannabis plant contains more than 538 chemicals (Andre et al., 2016), over 100 of which are phytocannabinoids (Choi et al., 2020; Pertwee, 2006). The two most abundant phytocannabinoids are Δ9-tetrahydrocannabinol (THC)—the main psychoactive compound— and cannabidiol (CBD) (Choi et al., 2020; Pertwee, 2006). Both THC and CBD have therapeutic potential as a sleep aid due to their involvement in the endogenous cannabinoid system (ECS) that is involved with the regulation of the circadian sleep-wake cycle (Hill, 2015; Kesner & Lovinger, 2020; Prospero-Garcia et al., 2016; Sanford et al., 2008; Vaughn et al., 2010). Exogenous THC acts as an agonist activating the CB-1 receptor and can have a sedative effect (Kaul et al., 2021; Murillo-Rodriguez, 2008; Pacher et al., 2006). CBD is an antagonist of the

CB-1 receptor and can counter intoxicating effects of THC (Kaul et al., 2021). CBD has been used for pain, anxiety, inflammation, and seizures (Babson & Bonn-Miller, 2014; Whiting et al., 2015), but its role in the ECS in regards to sleep is still being investigated (Bhagavan et al., 2020; Moltke & Hindocha, 2021). Current research supports that CBD is not intoxicating (Pertwee, 2008), it is safe for short-term use (Canada, 2022), and it does not foster abuse or dependency (Bergamaschi et al., 2011). Each cannabis product has different amounts and balances of THC and CBD, meaning each product likely has different effects on sleep depending on its cannabinoid content (Kuhathasan et al., 2021). There are also different methods of ingesting cannabis that likely impact its effects on sleep, such as inhalation (e.g., smoking and vaporization), oral consumption (e.g., oils, sprays, capsules, and edibles), and topical application. Many people use multiple ingestion methods with varying cannabinoid contents (Hawley et al., 2020; Macari et al., 2020; Webster et al., 2020).

Prevalence of Cannabis Use

Prior to legalization, a 2016 national survey reported that 34.4% of Canadian adults with cancer were current cannabis consumers (Abdel-Rahman, 2021), and 43% of Canadian cancer patients reported cannabis use at some point (Martell et al., 2018). Shortly after Canada passed the Cannabis Act to legalize cannabis in 2018, cannabis use among cancer patients increased by 26% in British Columbia (Hawley et al., 2020) and its prevalence across Canada continues to expand. Many believe due to legalization, there are safer cannabis products available and that it is more natural than their other medication with a more desirable side-effect profile (Abdel-Rahman, 2021; Martell et al., 2018; McTaggart-Cowan et al., 2021; Webster et al., 2020). In a survey of 31 women with gynecologic malignancies who were prescribed cannabis, 80% reported that cannabis helped manage cancer-related symptoms as well as or better than

traditional medications, and 83% reported using cannabis because they believed the side effect profile was the same as or better than their other medications (Webster et al., 2020). A series of telephone interviews with 33 cancer survivors in Canada conducted post-legalization sought to examine factors that influenced cancer survivors' decisions to use cannabis for their cancer-related symptoms. A prominent influence was the belief that cannabis was a more natural alternative that allowed them to reduce their overall number of prescription drugs (McTaggart-Cowan et al., 2021). Survey-based research with sample sizes ranging from 188 to 1987, found that the most common reasons for cannabis use among cancer populations include non-medical use or to manage decreased appetite, sleep, anxiety, nausea, and pain (Donovan et al., 2022; Hawley et al., 2020; Macari et al., 2020; Martell et al., 2018). This is also consistent in the general population from chart-review of 299 patients in palliative care (Wilson et al., 2019), medical dispensary data of 217 adults with a physical or mental health condition (Haug et al., 2017), and data collected through a tracking app used by 991 Canadian consumers (Kuhathasan et al., 2021). Estimates suggest that 41-43% of cannabis consumers (both cancer survivors and the general population) list sleep disturbances as a reason for use (Hawley et al., 2020; Moltke & Hindocha, 2021; Webster et al., 2020); however, not much else is known about its effect on sleep, the way it is used for sleep, and the types of cannabis products used when consumed for sleep among Canadian cancer survivors. While there is some research coming out of the United States and Europe, there are significant differences in healthcare (Davis et al., 2014) and cannabis legislation (Addiction, 2017; Canada, 2018; Patton, 2020) that make generalization between these countries and Canada difficult and leaves a need for Canadian-specific research.

Effectiveness of Cannabis for Sleep

Despite the use of cannabis as an herbal remedy to enhance sleep for over 5000 years (Bonini et al., 2018; Bridgeman & Abazia, 2017; Choi et al., 2020; Daris et al., 2019) and its continuing prevalent use for sleep, the use of cannabis for sleep remains controversial and its efficacy and safety for cancer survivors are not yet fully understood (Choi et al., 2020; Edwards & Filbey, 2021; McLennan et al., 2020; Mondino et al., 2021). A literature review conducted in 2021 concluded that 5/15 randomized-controlled trials (RCTs) suggested potential benefits of cannabis for sleep among cancer survivors such as improving sleep quality, relaxation, and subjective ratings of sleep, however, none of these studies assessed the efficacy of cannabis for sleep as a primary outcome (De Feo et al., 2023). The remaining 10 studies found no effect of cannabis on sleep. Nabiximol (a pharmaceutically manufactured spray consisting of both THC and CBD) in low-medium doses (1-10 sprays per day) has been found to improve numerical ratings of sleep compared to placebos in two RCTs with 397 and 263 cancer patients over the course of 5 weeks (Lichtman et al., 2018; Portenoy et al., 2012). Sleep also improved in a study of 88 cancer patients with high-grade gliomas consuming THC and CBD in combination over 12 weeks (Schloss et al., 2021) and in a study of 46 cancer patients ingesting oral THC twice daily for 18 days (Brisbois et al., 2011). A survey of 476 young adult cancer patients who use cannabis rated cannabis a mean of 8.3 of 10 on effectiveness for improving sleep (Donovan et al., 2022). Cancer patients have also reported that cannabis contributes staying asleep throughout the night and improves the amount of time it takes to fall asleep (Zhou et al., 2021).

Improved time to fall asleep has also been reported in the general population among those using mainly sublingual CBD (Moltke & Hindocha, 2021) and in those smoking THC regularly (Chait, 1990). Cannabis has also been reported to improve sleep quality in the general population (AminiLari et al., 2022; Shannon et al., 2019). In one of the most rigorous, double-blind,

placebo-controlled studies to date with sleep as the primary outcome, 23 participants with self-reported chronic insomnia self-administered ZTL-101 (a pharmaceutically manufactured cannabinoid formulation containing THC, CBD, and cannabinol) sublingually every night for two weeks (Walsh et al., 2021). Participants ingesting cannabis experienced decreased scores on the Insomnia Severity Index (ISI), decreased self-reported time to fall asleep, increased self-reported total sleep time, improved subjective sleep quality, and improved feeling of being rested upon waking. Actigraphy-based sleep assessment also showed decreased nocturnal awakenings, increased total sleep time, and increased sleep efficiency. Improvements on the ISI have been found in other studies of the general population when using cannabis (Kuhathasan et al., 2021; Ware et al., 2010). Bhagavan et al. (2020) attempted a meta-analysis of studies primarily looking at cannabis's effect on sleep, but of the 213 full-text articles screened, only 5 studies met the criteria of analyzing cannabis-based products for the treatment of insomnia disorder in adults and none of these focused on a cancer sample. Of these, 3 were non-randomized studies that showed a favourable effect of cannabinoids on sleep both at 4 and 8 weeks follow up, and 2 RCTs that showed that THC led to more restful sleep and improved time to fall asleep.

In contrast to the above findings, other research found that cannabis negatively impacts sleep in the general population by influencing the amount of time spent in certain sleep stages (Pivik et al., 1972) and altering circadian rhythms (Edwards & Filbey, 2021). A study by A. S. Suraev et al. (2020) found potential wakefulness-promoting properties of CBD in their review of the current literature. Similarly, survey results showed that those using higher concentrations of CBD reported higher rates of insomnia and poorer time to fall asleep than those using cannabis with lower concentrations of CBD (Belendiuk et al., 2015). THC may also negatively impact sleep; THC may have a stimulating effect that can lead to poor sleep and increase time to fall

asleep, especially in new consumers (Babson & Bonn-Miller, 2014). There is a body of research suggesting that acute THC administration may have short-term benefits, but worsens sleep over time (Babson et al., 2017; Kesner & Lovinger, 2020; Schierenbeck et al., 2008). Barratt et al. (1974) found in their study with 12 participants smoking THC, slow-wave sleep increased during the first 4 consecutive days before progressively worsening until it was significantly below baseline levels by the 8th day and did not recover. When examining the polysomnography measured sleep of 31 people overnight for two nights, chronic THC cannabis smokers showed lower total sleep time, less slow wave sleep, poorer sleep efficiency, longer time to fall asleep, and more nocturnal awakenings than control group (Bolla et al., 2008). Gorelick et al. (2013) also found that THC may be associated with improved time to fall asleep in the short-term but a decrease in total sleep time with long-term use due to tolerance. In several studies using cancer samples, cannabis has been found to have no effect on sleep relative to placebo when measured as a secondary outcome (Cote et al., 2016; Fallon et al., 2017; Zylla et al., 2021).

The interaction between cannabis and sleep appears to depend on dosage, cannabinoid content, method of ingestion, previous cannabis use, and time-of-day (Babson et al., 2017; Barratt et al., 1974; Edwards & Filbey, 2021; Mondino et al., 2021; Zhou et al., 2021). While current literature is highly mixed, there is a consensus that there is a need for more rigorous, experimental research that investigates the efficacy and safety of using cannabis sleep as the primary outcome. Further, many studies that have been conducted are of poor quality due to small sample sizes, short treatment periods, and high risk of bias, reducing confidence in the results observed. There is also much inconsistency in product type and cannabinoid content across studies. Additionally, no study has examined the impact of cannabis on sleep as a primary aim in a Canadian cancer sample nor the factors associated with cannabis use for sleep.

Primary Research Objectives

As there is no existing research examining Canadian cancer survivors' cannabis use for sleep, we first need to hear from cancer survivors' themselves about their experiences to generate patient-oriented hypotheses and methods for our future research trials. The primary research objectives of this thesis are as follows:

Chapter 2 objectives:

1) Primary: To establish the prevalence of cannabis use as a sleep aid among Canadian cancer survivors.

2) Secondary: To examine the patterns of use among Canadian cancer survivors currently using cannabis for sleep.

3) Exploratory: To examine the perceived effects and side effects of cannabis use for sleep.

Chapter 3 objectives:

1) To examine the personal qualities, lifestyle factors, and disease characteristics associated with cannabis use for sleep among Canadian cancer survivors.

Chapter 4 objectives:

1) To contextualize the study findings within the existing literature and provide recommendations for future research and knowledge generation.

Chapter 2:

A Cross-Sectional Survey of the Prevalence and Patterns of Cannabis as a Sleep Aid in

Canadian Cancer Survivors

Abstract

OBJECTIVE: Poor sleep is one of the most common side effects of cancer. It can persist for years beyond treatment, negatively impact quality of life, and can initiate or worsen physical and psychological health. Cannabis is increasingly used to manage cancer treatment-related symptoms, including sleep. This study investigated the prevalence and patterns of cannabis use as a sleep aid in Canadian cancer survivors.

METHODS: Adult Canadian cancer survivors (N=1464) were recruited via the Angus Reid Institute and completed an online, cross-sectional survey including the Insomnia Severity Index and questions about cannabis use as a sleep aid. Standard descriptive statistics, such as means, standard deviations, and ranges were produced for measured variables to assess the ways cancer survivors use cannabis for sleep. Frequencies were tabulated for categorical and ordinal variables.

RESULTS: On average, current consumers (Mage =61.1yrs; Women=50%: Men=48.8%) received their cancer diagnosis an average of 12.5 years prior to study participation. Of participants, 23.5% (n=344) currently use cannabis as a sleep aid, with reported benefits including relaxation, reduced time to fall asleep, fewer nocturnal awakenings and improved sleep quality. Two thirds (68.3%) began using cannabis for sleep after their cancer diagnosis. Over a third of participants (36.3%) use cannabis as a sleep aid daily. The most common other reasons for using cannabis were pain (31.4%), non-medical use (24.4%), and anxiety (12.5%).

CONCLUSION: Cannabis use as a sleep aid is prevalent among Canadian cancer survivors. Due to its potential impact, research is needed to examine the actual efficacy of cannabis as a sleep aid.

Keywords: cancer; cannabis; sleep; insomnia; Canada

Introduction

Sufficient sleep quality and quantity is one of the most important contributors to a person's overall health (Nunn et al., 2016), being critical for hormonal and emotional regulation, memory consolidation, physical repair and restoration, and neural growth (Nunn et al., 2016). Impaired sleep has been linked to health risks such as dementia (Hung et al., 2018), cardiovascular disease (Bertisch et al., 2018), and depression (Baglioni et al., 2011), as well as contributing to increased healthcare costs (Bin et al., 2012) and rates of absenteeism (Lallukka et al., 2013). Insomnia is a common sleep disorder that is characterized by difficulty initiating, maintaining, or returning to sleep occurring at least 3 nights a week for at least 3 months (APA, 2013). Insomnia leads to significant distress and daytime impairment in functioning across social, occupational, and behavioural domains (APA, 2013).

Cancer survivors—defined as individuals from the time of diagnosis until the end of their life (Mullan, 1985)—are particularly prone to insomnia. Poor sleep and insomnia symptoms are reported by 61% (Al Maqbali et al., 2022) and 44% (Harrold et al., 2020) of cancer patients, respectively, making sleep issues one of the most common side effects of cancer and its treatment (Palesh et al., 2012). Cancer-related sleep difficulties often persist for years after completing treatment (Lowery-Allison et al., 2018; Reynolds-Cowie & Fleming, 2021; Savard & Morin, 2001; Strollo et al., 2020). This is problematic as chronic insomnia can negatively impact quality of life (Alexander et al., 2009; Lis et al., 2008) and can initiate or worsen physical and psychological health challenges (Colten et al., 2006; Henneghan et al., 2018; Strollo et al., 2020). Thus, interventions are imperative to effectively manage poor sleep and insomnia from the time of diagnosis (Zhou et al., 2021) and thereafter. In cancer survivors and the general population, the gold-standard treatment is cognitive behavioural therapy for insomnia (CBT-I; (Arnedt et al.,

2023; Jacobs et al., 2004; Morin et al., 2009; Rosenberg et al., 2021; Smith & Neubauer, 2003)).

However, CBT-I often requires significant time, effort, and money that cancer survivors may not

be able to commit (Cheung et al., 2018). There are also pharmacological interventions for sleep

(Brandt & Leong, 2017; Rosenberg et al., 2021), such as benzodiazepines (e.g., lorazepam,

temazepam), "Z-drugs" (e.g., zopiclone, eszopiclone, zaleplon) and over-the-counter drugs

(Brandt & Leong, 2017; Rosenberg et al., 2021), but these are not preferred by cancer survivors

either, however, as they often produce persistent, undesirable side effects such as cognitive

impairment that cancer survivors would find especially challenging on top of their cancer and

treatment-related side effects (A. Suraev et al., 2020). Thus, many cancer survivors have turned

cannabis to treat their sleep difficulties and insomnia.

The cannabis plant has been used as an herbal remedy to enhance sleep for over 5000

years (Bonini et al., 2018; Bridgeman & Abazia, 2017; Choi et al., 2020; Daris et al., 2019). It

contains more than 538 chemicals (Andre et al., 2016), over 100 of which are phytocannabinoids

(Choi et al., 2020; Pertwee, 2006). The two most abundant phytocannabinoids are Δ9-

tetrahydrocannabinol (THC)—the main psychoactive compound—and cannabidiol (CBD) (Choi

et al., 2020; Pertwee, 2006). Both THC and CBD have therapeutic potential as a sleep aid due to

their involvement in the endogenous cannabinoid system (ECS) that regulates the circadian

sleep-wake cycle (Hill, 2015; Kesner & Lovinger, 2020; Prospero-Garcia et al., 2016; Sanford et

al., 2008; Vaughn et al., 2010). Different methods of consumption of cannabis include inhalation

(e.g., smoking and vaporization), oral (e.g., oils, sprays, capsules, and edibles), and topical

application; many people use multiple forms (Hawley et al., 2020; Macari et al., 2020; Webster

et al., 2020).

Prior to legalization, a 2016 national survey reported that 34.4% of Canadian adults with cancer used cannabis (Abdel-Rahman, 2021), and 43% of Canadian cancer patients reported any lifetime cannabis use (Martell et al., 2018). Since then, its prevalence has continued to expand (Hawley et al., 2020). Estimates suggest that 41-43% of cannabis consumers (both cancer survivors and the general population) list sleep disturbances as a reason for use (Hawley et al., 2020; Moltke & Hindocha, 2021; Webster et al., 2020); however, not much else is known about the reasons for use, the effect on sleep, and the types of cannabis products used.

Effectiveness of Cannabis as a Sleep Aid

The widespread prevalence of cannabis use for sleep suggests cannabis' possible potential as an adjunct therapy for cancer-related insomnia, however, research on cannabis as a sleep aid is preliminary and mixed (Babson et al., 2017; Choi et al., 2020; De Feo et al., 2023; Edwards & Filbey, 2021; McLennan et al., 2020; Mondino et al., 2021). A literature review conducted in 2021 concluded that 5/15 randomized-controlled trials (RCTs) suggested potential benefits of cannabis for sleep among cancer survivors such as improving sleep quality, relaxation, and subjective ratings of sleep, however, none of these studies assessed the efficacy of cannabis for sleep as a primary outcome (De Feo et al., 2023). A combination of THC and CBD has been found to improve sleep in cancer patients when used for 5-12 weeks (Lichtman et al., 2018; Portenoy et al., 2012; Schloss et al., 2021) and oral THC showed benefits when used for 18 days (Brisbois et al., 2011). Cancer survivors have also anecdotally reported benefits to sleep by using cannabis, including helping reduce nocturnal awakenings and the time it takes to fall asleep (Donovan et al., 2022; Zhou et al., 2021). Cannabis has shown potential sleep benefits in the general population, including falling asleep faster (Bhagavan et al., 2020; Chagas et al., 2013; Chait, 1990; Moltke & Hindocha, 2021; Walsh et al., 2021), improved sleep quality

(AminiLari et al., 2022; Shannon et al., 2019; Walsh et al., 2021), increased total sleep time (Walsh et al., 2021), and less insomnia symptoms (Kuhathasan et al., 2021; Walsh et al., 2021; Ware et al., 2010). In contrast to the above findings, other research found that cannabis can negatively impact sleep in the general population by influencing sleep stage concentration (Pivik et al., 1972), altering circadian rhythms (Edwards & Filbey, 2021), and having stimulating or wakefulness-promoting effects (Babson & Bonn-Miller, 2014; A. S. Suraev et al., 2020). Cannabis use has been associated with higher rates of insomnia (Belendiuk et al., 2015), lower total sleep time, and poorer sleep efficiency, more nocturnal awakenings (Barratt et al., 1974), and longer time to fall asleep (Barratt et al., 1974; Belendiuk et al., 2015; Gorelick et al., 2013). There is a body of research suggesting that acute THC may have short-term benefits but worsens sleep over time with chronic use (Babson et al., 2017; Barratt et al., 1974; Gorelick et al., 2013; Kesner & Lovinger, 2020; Schierenbeck et al., 2008). In several studies using cancer samples, cannabis was found to have no effect on sleep relative to placebo when measured as a secondary outcome (Cote et al., 2016; Fallon et al., 2017; Zylla et al., 2021). Many studies that have been conducted are of poor quality due to small sample sizes, short treatment periods, and high risk of bias, reducing confidence in the results observed.

The Present Study

The interaction between cannabis and sleep may depend on dosage, cannabinoids, method of ingestion, previous cannabis use, and time-of-day (Babson et al., 2017; Barratt et al., 1974; Edwards & Filbey, 2021; Mondino et al., 2021; Zhou et al., 2021). Considering that current literature is highly mixed, there is a need for more rigorous research that investigates the efficacy and safety of using cannabis for sleep. Further, the effects of cannabis may be different for

cancer survivors and perhaps cannot be generalized from a healthy, nonclinical population. The objectives of the present study were:

1) Primary: To establish the prevalence of cannabis use as a sleep aid among Canadian cancer survivors.

2) Secondary: To examine the patterns of use among Canadian cancer survivors currently using cannabis for sleep.

3) Exploratory: To examine the perceived effects and side effects of cannabis use for sleep.

Methods

Participants

Participants were recruited through the Angus Reid Forum—an online market research company—that recruits panel participants through targeted banner ad placements. Participants were eligible if they were over 18 years of age, had ever received a cancer diagnosis, and currently lived in Canada with no restriction on time since diagnosis, cancer type, or stage. Participants were excluded if they did not consent, failed two attention check questions, or exited the survey before completing the Insomnia Severity Index. Respondents received incentives through Angus Reid in the form of points that can be traded in for gift cards and occasional prize draws.

Procedure

First, we established a sub-panel of Canadian cancer survivors among Angus Reid's panel. Then, our survey was released to all members of the cancer sub-panel. Potential participants were told that our study was about the use of cannabis for sleep among cancer survivors but that they did not have to have ever used cannabis to participate as we wanted a representative sample and an estimate of prevalence. Recruitment continued until we reached a

desired sample size. Based on the estimated insomnia prevalence of at least 44% among cancer survivors (Harrold et al., 2020), we determined that the number of individuals required to determine the prevalence of insomnia with a 95% confidence interval with 5%, 4% and 3% margin of error were 379, 592, and 1052, respectively. Power calculations were conducted with Epitools (http://epitools.ausvet.com.au). Eligible members clicked a link to complete the survey on the secure online platform, Qualtrics. The survey could be completed in English or French. Response collection took place in September of 2022. If participants clicked "Yes, I do consent" after reading the informed consent form, they began the survey. If at any point the participant wanted to withdraw from the study, they were told that they could do so by clicking on the exit button present on every survey page and their data would be deleted, but that they would not be able to retract their responses if the survey was submitted due to their anonymity. This study was approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University of Newfoundland (20222467-SC, March 16, 2022).

Measures

Medical history and demographics Sociodemographic information (e.g., gender identity, age, ethnicity, education, employment, location) were self-reported. Participants also self-reported cancer-related information such as primary site, year of diagnosis, stage, current cancer status, and types of cancer treatment received.

Cannabis Use Questionnaire Questions regarding participants' use of cannabis for sleep (e.g., frequency, duration, time, ingestion method, cannabinoid content, perceived sleep effects and side effects, method of obtainment, cost) were developed by the researchers as there was no formally validated comprehensive measure available (Webster et al., 2020). See appendix B for full survey.

Insomnia Severity Index (ISI) The ISI is a seven-item self-report measure that assesses insomnia symptoms over the prior two weeks (Morin, 1993). It is one of the few well-validated patient-reported outcome measures designed to specifically assess the severity of insomnia symptoms, the impact on daytime functioning, and the amount of associated distress (Bastien et al., 2001). Each item is scored on a five-point sale from 0-4 with higher scores representing more severe insomnia symptoms. Total scores are summed and can be categorized into absence of (0-7), mild (8-14), moderate (15-21), or severe insomnia (22-28) (Morin et al., 2011).The ISI has been widely used clinically and in treatment studies of cancer survivors (Savard et al., 2005; Zhou et al., 2021) and has demonstrated internal consistency, reliability, construct validity, specificity, and sensitivity.

Statistical Analysis

Standard descriptive statistics, such as means, standard deviations, and ranges were produced for measured variables to assess the ways cancer survivors use cannabis for sleep. Frequencies were tabulated for categorical and ordinal variables. A series of chi-squared analyses were performed to explore whether reported sleep benefits differed between methods of ingestion and cannabinoid content.

<div align="center">

Results

</div>

Of the 2003 people who started the survey, 239 did not provide consent and 299 were excluded (89 reported they did not receive a cancer diagnosis, 109 failed both attention checks, 101 did not finish the survey) (Figure 1). The remaining 1464 participants were included in the analysis. We found that 64.3% reported any lifetime cannabis use for any reason whereas 35.7% of the sample had never tried using cannabis. Table 1 shows the sociodemographic characteristics and cancer information of the final sample and the sample of those who were

currently using cannabis as a sleep aid. Of participants, 37.9% (*n=555*) have tried using cannabis as a sleep aid at any time: 14.4% (*n=211*) had previously used cannabis to help with sleep, but only 23.5% (*n=344*) were currently using cannabis for sleep. The following reports on those individuals who were currently using cannabis as a sleep aid.

Figure 1. Recruitment
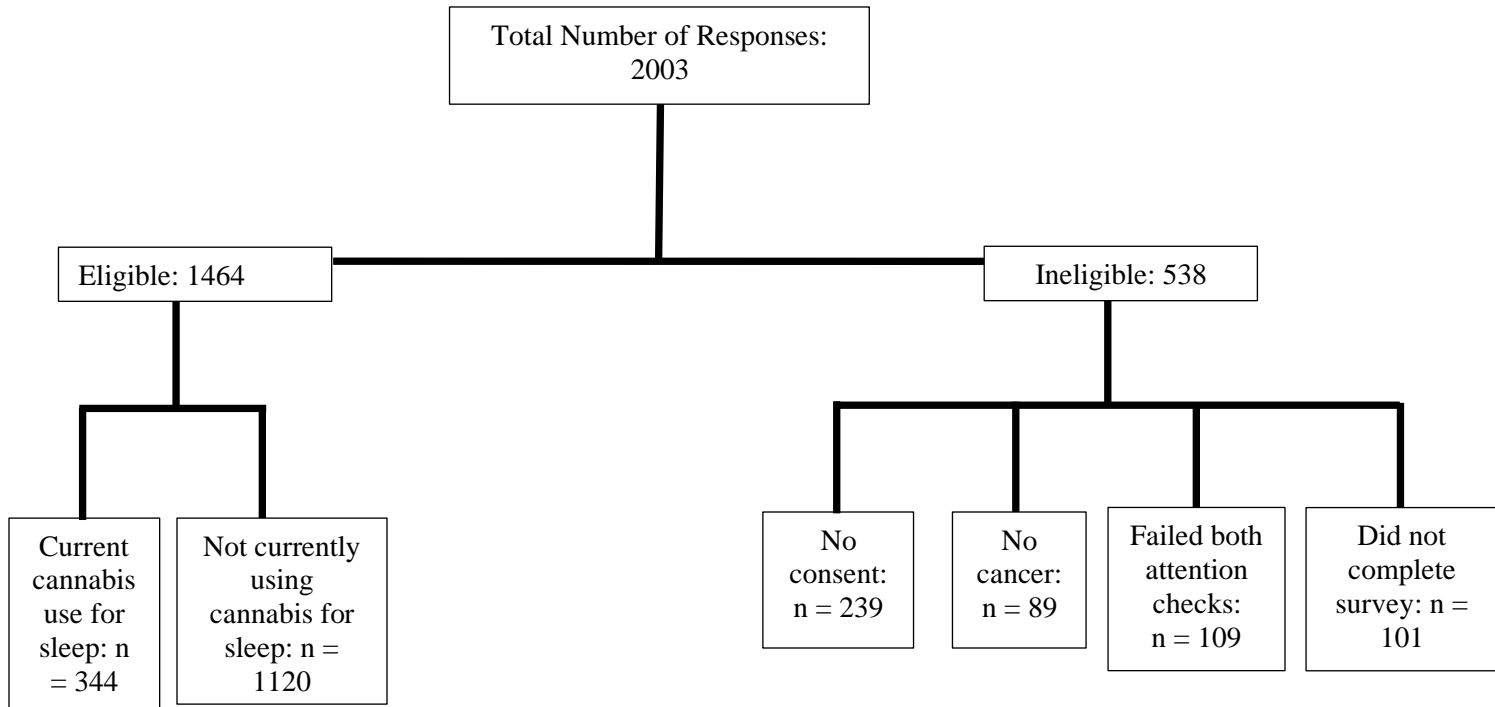
The mean age was 61.1 years (*SD=12.2*, range 24-87) and most identified as White (90.7%). There was a balance of participants who identified as women (50.0%, *n=172*) and men (48.8%, *n=168*). Participants received their cancer diagnosis a mean of 12.5 years ago (*SD=10.9*). The most common forms of cancer were genitourinary (22.4%, *n=77*), skin (16.3%, *n=56*), and breast cancer (11.3%, *n=39*). As cancer treatments, 31.7% received radiotherapy (*n=109*) and 31.1% (*n=107*) received chemotherapy. Most participants (78.2%) were in remission, having completed treatment with no evidence of disease.

Close to one-quarter (24.4%, *n*=84) reported having been diagnosed with insomnia by a medical professional at any point in the past and 22.1% (*n*=76) reported clinically significant insomnia symptom in the previous two weeks; however, 69.8% (*n*=240) met the criteria for having at least mild insomnia symptoms. Two thirds (67.2%, *n*=231) reported that they began struggling with sleep at the same time as, or after, their cancer diagnosis. Current cannabis consumers reported having struggled with sleep for an average of 9.8 years.

Patterns of Cannabis Use as a Sleep Aid

Two thirds (68.3%) began using cannabis for sleep after their cancer diagnosis (*n*=235). Most (70.9%, *n*=244) had been using cannabis for sleep for over a year, and a third (31.1%, *n*=107) had been using cannabis for sleep for over five years. Over a third of participants (36.3%, *n*=125) used cannabis as a sleep aid every day and half of participants (*n*=168) used cannabis at least 4 times a week. Participants used cannabis a mean of 65 minutes before bed (*SD*=62.3). A fifth of those who were currently consuming cannabis for sleep (20.6%, *n*=71) reported cannabis consumption only for sleep. Others used cannabis for other reasons in addition to sleep; the most common other reasons for using cannabis were pain (31.4%, *n*=108), non-medical use (24.4%; *n*=84), and anxiety (12.5%; *n*=43).

Perceived Effects

When asked how cannabis affects sleep, 59.3% (*n*=204) reported that it helped them relax, 48.3% (*n*=166) said it helped them fall asleep faster, 40.1% (*n*=138) reported an improvement in overall sleep quality, and 36% (*n*=124) noted an improvement in sleep continuity. In those who reported that cannabis helped them relax, more reported smoking cannabis (79%) compared to other forms [χ^2 (5, *N*=306) = 14.12, *p*=.015, φ_c=.215], and less reported using cannabis with mostly CBD (44%) [χ^2 (2, *N*=314) = 9.68, *p*=.008, φ_c=.176]. In

those who reported that cannabis helps them sleep throughout the night, fewer smoked cannabis (21%) compared to other forms [χ^2 (5, *N*=306) = 11.61, *p*=.04, φ_c=.195]. In those who reported that cannabis helps them fall asleep faster, more smoked (64%) or used multiple methods of ingestion (58%) [χ^2 (5, *N*=306) = 17.20, *p*=.004, φ_c=.237], and used cannabis containing balanced CBD/THC (57%) [χ^2 (2, *N*=314) = 8.01, *p*=.02, φ_c=.160]; significantly less used capsules (27%), edibles (37%) [χ^2 (5, *N*=306)=17.20, *p*=.004, φ_c=.237] and cannabis containing mostly CBD (36%) [χ^2 (2, *N*=314)=8.01, *p*=.02, φ_c=.160].

Over a third of respondents reported experiencing no side effects when consuming cannabis for sleep (38.7%, *n*=133). The most common side effects reported were drowsiness (21.2%, *n*=74) and dry mouth (19.8%, *n*=68). The majority reported no next-day effects (73.7%, *n*=250), but of next-day effects reported, the most common was feeling groggy (15.7%, *n*=54).

Acquiring Cannabis

Three quarters of participants (75.9%, *n*=261) purchased cannabis from the regulated market, including 56.7% (*n*=195) from the non-medical market, and 19.2% (*n*=66) from a licensed producer with authorization from a healthcare provider. A smaller portion obtained cannabis from an unregulated source (12.5%, *n*=43) or grew it themselves (11.3%, *n*=39). Some people sourced their cannabis from multiple places. Two thirds reported that their health care provider was aware of their cannabis use (*n*=225). Half of participants spent less than $50 CAD per month on cannabis. Only 8.7% (*n*=30) spent over $151 on cannabis every month. The most common reason participants started using cannabis for sleep was a recommendation from a friend/family member (43.3%, *n*=149). Only 16.3% (n=56) first considered using cannabis for sleep through a recommendation from a doctor. See Table 2.

Method of Ingestion

About a third of participants (*n*=100) reported that when using cannabis for sleep, they used multiple methods in similar frequencies. The most common methods of ingestion among those who used mainly one method (i.e., one method is used more than half the time or every time and others were used less than half the time or never) were edibles (18.3%, *n*=63), smoking (15.4%, *n*=53), and oils/sprays (14.5%, *n*=50). The most common methods of ingestion that people used for sleep to any degree of frequency were edibles (59%, *n*=203), oils/sprays (45.9%, *n*=158), and smoking (41.9%, *n*=144).

Cannabinoid Content

A third of the sample used cannabis that contains mostly THC (35.8%, *n*=123), and another third used cannabis that contains a balanced amount of CBD and THC (32.8%, *n*=113). Only 22.7% (*n*=78) used cannabis containing mostly CBD, and 8.4% (*n*=29) did not know the formulation of the cannabis they use for sleep. For each ingestion method, between 23.5% and 42.8% did not know the proportion of THC or CBD. Cannabis knowledge was higher for THC than CBD, and those who used cannabis in the form of oils and sprays had the highest literacy for the proportion of THC and CBD.

Table 1.
Participant Demographic, Cancer, and Sleep Characteristics

	Full Sample		Current Use	
	Mean (SD)	Frequency (%) *n* = 1464	Mean (SD)	Frequency (%) *n* = 344
Age (years)	65.1 (11.3)		61.1 (12.2)	
Gender Identity				
Woman		780 (53.3%)		172 (50.0%)
Man		677 (46.2%)		168 (48.8%)
Other		7 (0.5%)		4 (1.2%)
Employment Status †				
Employed		468 (32.0%)		131 (38.1%)
Not employed		1035 (70.7%)		222 (64.5%)
Education				
High school or less		162 (11.1%)		30 (8.7%)

College or Trade School	490 (33.5%)	129 (37.5%)
Undergraduate University	574 (30.2%	146 (42.4%)
Graduate University	237 (16.2%)	39 (11.3%)
Missing	1 (0.07%)	0 (0.0%)
Language of Communication		
English	1362 (93.0%)	337 (98.0%)
French	102 (7.0%)	7 (2.0%)
Race and Ethnicity †		
Black	9 (0.6%)	2 (0.6%)
Chinese	11 (0.8%)	4 (1.2%)
Filipino	2 (0.1%)	1 (0.3%)
Indigenous Canadian	52 (3.6%)	24 (7.0%)
Latin American	6 (0.4%)	1 (0.3%)
Middle Eastern	5 (0.3%)	2 (0.6%)
Other East Asian	8 (0.5%)	1 (0.3%)
South Asian	12 (0.8%)	6 (1.7%)
White	1356 (92.6%)	312 (90.7%)
Other*	37 (2.5%)	4 (1.2%)
Prefer not to say	28 (1.9%)	7 (2.0%)
Geographical Region		
Atlantic	133 (9.1%)	32 (9.3%)
Quebec	143 (9.8%)	17 (4.9%)
Ontario	577 (39.4%)	139 (40.4%)
Prairies	305 (20.8%)	77 (22.4%)
British Columbia	299 (20.4%)	78 (22.7%)
Territories	5 (0.3%)	0 (0.0%)
Missing	2 (0.1%)	1 (0.3%)
Location		
Rural	415 (28.3%)	97 (28.2%)
Urban	104 (71.5%)	245 (71.2%)
Missing	2 (0.1%)	2 (0.3%)
Years Since Diagnosis	12.4 (11.6)	12.5 (10.9)
Cancer Type†		
Bone	13 (0.9%)	4 (1.2%)
Brain	10 (0.7%)	3 (0.9%)
Breast	235 (16.1%)	39 (11.3%)
Colorectal	96 (6.6%)	19 (5.5%)
Gastrointestinal	71 (4.8%)	24 (7.0%)
Genital-Urinary	251 (17.1%)	77 (22.4%)
Hematological	75 (5.1%)	25 (7.3%)
Head and Neck	61 (4.2%)	14 (4.1%)
Lung	49 (3.3%)	11 (3.2%)
Prostate	181 (12.4%)	31 (9.0%)
Skin	265 (18.1%)	56 (16.3%)
Thyroid	55 (3.8%)	10 (2.9%)

Multiple Types		58 (4.0%)	16 (4.7%)
Missing		44 (3.0%)	15 (4.4%)
Type of Treatment †			
Hormonal therapy		212 (14.5%)	52 (15.1%)
Radiotherapy		500 (34.2%)	109 (31.7%)
Chemotherapy		433 (29.6%)	107 (31.1%)
Surgery		1205 (82.3%)	273 (79.4%)
Other		292 (19.9%)	83 (24.1%)
Cancer Status			
No evidence of disease		1195 (81.6%)	269 (78.2%)
Metastatic disease		89 (6.1%)	26 (7.6%)
Still in treatment		125 (8.5%)	33 (9.6%)
Other		55 (3.8%)	16 (4.7%)
Other Cannabis Use			
Pain		213 (14.5%)	108 (31.4%)
Recreational use		458 (31.3%)	84 (24.4%)
Anxiety		73 (5.0%)	43 (12.5%)
Other (e.g., nausea, appetite, depression)		84 (5.7%)	42 (12.2%)
ISI Total Score	8.3 (5.7)	10.7 (5.4)	
Insomnia Symptom Severity			
No insomnia		710 (48.5%)	104 (30.2%)
Mild		535 (36.5%)	164 (47.7%)
Moderate		198 (13.5%)	66 (19.2%)
Severe		21 (1.4%)	10 (2.9%)
Duration of Sleep Problems		—	
Less than 1 year			54 (15.7%)
1 to less than 5 years			98 (28.5%)
5 to less than 10 years			70 (20.3%)
More than 10 years			100 (29.1%)
Missing			22 (6.4%)
Sleep Problem Occurrence		—	
Before cancer diagnosis			88 (25.6%)
Same year as cancer diagnosis			46 (13.4%)
After cancer diagnosis			185 (53.8%)
Missing			25 (7.3%)

* Answers reported for other race/ethnicity include Canadian, Portuguese, Jewish, Metis, Scottish, Hungarian, Guyanese, and Mixed Heritage

† Respondents could select multiple options

Table 2.

Access, Reasons, Frequency, and Duration of Current Cannabis Use for Sleep

	Mean (SD)	Frequency (%) n = 344
Age when first used cannabis for sleep	51.2 (17.7)	
Where do they obtain Cannabis?		
Government regulated dispensaries		195 (56.7%)
Medical authorization from health care provider		66 (19.2%)
Unauthorized source		43 (12.5%)
Grow their own		39 (11.3%)
Missing		1 (0.3%)
Are health care provider's aware of cannabis use		
Yes		225 (65.4%)
No		115 (33.4%)
Missing		4 (1.2%)
Reasons for starting use of Cannabis †		
Recommendation from family/friend		149 (43.4%)
Other medications had bad side effects		120 (34.9%)
More natural		108 (31.4%)
To try something different		81 (23.5%)
Recommendation from doctor		56 (16.3%)
Personal research		34 (9.9%)
Other		30 (8.7%)
Cost of Cannabis Each Month		
Less than $50		172 (50%)
$50-$100		103 (29.9%)
$101-$150		37 (10.8%)
More than $150		30 (8.7%)
Missing		2 (0.6%)
Start using cannabis for sleep before or after cancer diagnosis		
Before		107 (31.1%)
After		235 (68.3%)
Missing		2 (0.6%)
Frequency of Cannabis use for Sleep		
Once a month or less		45 (13.1%)
2-4 times a month		80 (23.3%)
2-3 times a week		48 (14.0%)
4-6 times a week		43 (12.5%)
Every day		125 (36.3%)
Missing		3 (0.9%)
How long before bed cannabis is taken (Minutes)	65.0 (62.3)	
Duration of Cannabis use for Sleep		
Less than 1 month		23 (6.7%)
1-12 months		75 (21.8%)
1-5 years		137 (39.8%)

| | More than 5 years | 107 (31.1%) |
| | Missing | 2 (0.6%) |

† Respondents could select multiple options

Table 3.

Sleep Effects, Side Effects, Methods of Ingestion, and Cannabinoid Content of Current Cannabis Use for Sleep

	Frequency (%) $n = 344$
How Cannabis Affects Sleep†	
Fall asleep faster	166 (48.2%)
Improves overall sleep quality	137 (39.8%)
Helps them relax	204 (59.3%)
Helps them sleep through the night	124 (36.0%)
Minimizes bad dreams	27 (7.8%)
Other (e.g., alleviates pain, distraction)	20 (5.8%)
Side Effects from Cannabis	
No side effects	133 (38.7%)
Drowsiness	74 (21.5%)
Dry mouth	68 (19.8%)
Increased appetite	39 (11.3%)
Other (e.g., memory issues, sweating, nausea)	30 (8.7%)
Next Day Effects from Cannabis	
No next-day effects	250 (72.7%)
Feeling groggy	54 (15.7%)
Other (e.g., dry mouth, daytime sleepiness, hangover)	39 (11.3%)
Missing	1 (0.3%)
Ingestion Method†	
Multiple Methods	100 (29.1%)
Edibles	63 (18.3%)
Smoke	53 (15.4%)
Oils or Sprays	50 (14.5%)
Vaporize	24 (7.0%)
Capsules	22 (6.4%)
Topical Application	4 (1.2%)
Missing	28 (8.1%)
Cannabinoid Content Typically Used	
Mostly CBD	78 (22.7%)
Mostly THC	123 (35.8%)
Balanced Amounts of THC and CBD	113 (32.8%)
Unknown Formulation	29 (8.4%)
Missing	1 (0.3%)

† Respondents could select multiple options

Discussion

The present study was the first to examine the prevalence, preferences, and perceived effects of cannabis as a sleep aid in Canadian cancer survivors. These results suggest that roughly one in four cancer survivors were currently consuming cannabis to improve their sleep, and over a third had tried using cannabis for sleep. The most similar estimate to date is from 2016, where it was reported that 34.4% of Canadian cancer patients currently use cannabis for any reason, but this study differs from the present study in that it did not look at use for sleep specifically or include cancer survivors in remission (Abdel-Rahman, 2021). The prevalence of insomnia symptoms in cancer survivors is high, with up to 61% reporting insomnia symptoms (Al Maqbali et al., 2022). Clearly, trouble sleeping is an unmet need for a significant number of cancer survivors and people are turning to cannabis to manage this.

Perceived Effects of Cannabis

When asked how cannabis helps sleep, half of participants reported cannabis improves time to fall asleep. The same proportion was found by Moltke and Hindocha (2021) in a general population, cross-sectional survey in the UK using CBD. Improved time to fall asleep is one of the most consistently reported benefits of cannabis in the existing literature (Bhagavan et al., 2020; Chagas et al., 2013; Chait, 1990; Walsh et al., 2021; Zhou et al., 2021) in addition to improved sleep quality (AminiLari et al., 2022; Brisbois et al., 2011; Shannon et al., 2019; Walsh et al., 2021). In the present study, 40.1% reported an improvement in overall sleep quality. Participants also reported that cannabis helps reduce nocturnal awakenings (36%) as previous research has shown (Walsh et al., 2021; Zhou et al., 2021). Another commonly reported benefit was that cannabis helps to relax (59.3%), which was also found in prior research among patients who specifically ingest THC orally (Brisbois et al., 2011). As there is high comorbidity

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between sleep disturbances and anxiety (Breslau et al., 1996; Ford & Kamerow, 1989), it is possible that cannabis' relaxing effects lead to a better sleep by mitigating anxiety. Anxiety reduction is a frequently reported use for cannabis (Haug et al., 2017; Hawley et al., 2020; Kuhathasan et al., 2021; Moltke & Hindocha, 2021; Sarris et al., 2020; A. S. Suraev et al., 2020; Wilson et al., 2019), and cancer patients reported a reduction in anxiety symptoms when using cannabis (Donovan et al., 2022; Macari et al., 2020; Webster et al., 2020). The ECS has been proposed to modulate anxiety by interacting with cannabinoid receptors (De Feo et al., 2023), so this could be co-occurring with cannabis' benefits to sleep through the same pathways. The effects of cannabis on anxiety are mixed, however, so more research is needed to reconcile inconsistencies in findings (Liechtenstein, 2022).

Methods of Ingestion and Cannabinoid Content

The impact of cannabis on sleep may depend on the interaction of many factors, such as the method of consumption and timing. Cannabis consumers in the present study reported taking cannabis a mean of 65 minutes before bedtime. As drowsiness was the most common side effect of cannabis use in the present study (similarly reported by young-adults with cancer; (Donovan et al., 2022)), it may explain why taking cannabis an hour before bedtime, or the "resting" phase of the day is preferred (Mondino et al., 2021; Zhou et al., 2021). Similarly, ingestion methods have different onset times and durations, influencing its impact on time to fall asleep and nocturnal awakenings. The effects of cannabis occur sooner when inhaled by smoking or vaporizing (15-30 mins) but have a shorter duration (2-5 hours; (Grotenhermen, 2003; McCartney et al., 2021)). In contrast, cannabis ingested orally (i.e., capsules, edibles) may take longer to kick in (30-90 mins), but their effects last from 4-12 hours (Grotenhermen, 2003;

McCartney et al., 2021). Effects from cannabis taken sublingually though oils or sprays can be felt within 15 minutes and last up to 8 hours (Eadie et al., 2021).

Cannabinoid content, and quantity of each, also likely impacts sleep (Velzeboer et al., 2022). While research is mixed with both positive and negative sleep effects being seen through CBD and THC on their own, most literature on CBD and THC in combination shows positive impacts on sleep (Lichtman et al., 2018; Portenoy et al., 2012; Schloss et al., 2021; Walsh et al., 2021). Previous cannabis use also seems to impact its effects on sleep. Much research suggests that THC, when used long-term, may negatively impact sleep (Babson & Bonn-Miller, 2014; Barratt et al., 1974; Gorelick et al., 2013; Kesner & Lovinger, 2020; Schierenbeck et al., 2008). Of current cannabis consumers who consumed mostly THC, 82% had been using cannabis for more than a year. These individuals may have experienced benefits to sleep initially, but these may have weakened (due to a potential tolerance) or even hindered sleep with prolonged use. Without this knowledge and its mobilization, cannabis consumers may not be able to make informed decisions about the cannabis they consume for sleep and may be unknowingly making their sleep worse.

In the present study, 8% of cancer survivors did not know the cannabinoid content of the cannabis they consumed. This is similar to the rate among American young-adult cancer patients (7%)(Donovan et al., 2022). Current consumers who purchased cannabis from the unregulated market or grew their own cannabis were less knowledgeable about the cannabinoid content of products (18.3%) compared to those who purchased from the regulated medical or non-medical markets (5.7%). Purchasing cannabis from an unregulated source raises safety concerns, due to lack of regulation with respect to contents and labelling, the potential for contamination, and a lack of information or guidance on safe and recommended use (Donovan et al., 2022).

Health Care Provider Awareness

Despite the usefulness of health care provider guidance, there are significant barriers to accessing it (Webster et al., 2020). Although two thirds reported their health care provider was aware of their cannabis use, only 19.2% had medical authorization. This is lower than the 27% of cancer survivors with authorization using cannabis not specifically for sleep (Hawley et al., 2020). This may be due to health care providers' lack of knowledge and significant gaps in medical education (Arboleda et al., 2020). As of 2020, although 53% of oncology health care providers were interested in receiving training about cannabis use (McLennan et al., 2020), only 10% of physicians in Canada were authorized to prescribe it (Arboleda et al., 2020). Further, up to 84% of health care providers believed they did not have sufficient knowledge about cannabis to make evidence-based recommendations (Arboleda et al., 2020; McLennan et al., 2020; Ng et al., 2022). Some health care providers may be against any discussion of cannabis with their patients, perhaps due to being trained during the pre-legalization era; this stigmatizing disapproval is a notable barrier (Arboleda et al., 2020; McLennan et al., 2020; McTaggart-Cowan et al., 2021). As there are now other legal means of obtaining cannabis, health care providers reluctance to give cancer survivors medical authorization for medicinal cannabis leads to more patients using cannabis without any guidance or monitoring from their health care team (81% in the present study; (Arboleda et al., 2020; McLennan et al., 2020)).

Study Limitations

Although this study is the first large-scale and comprehensive assessment of the use of cannabis as a sleep aid in cancer survivors, there were some limitations of this study that should be acknowledged. The assessment of sleep and cannabis use was completed at only one point in time. Thus, although current cannabis consumers had higher levels of insomnia severity, we

cannot know the relationship between insomnia symptoms and cannabis use over time to understand how current insomnia severity might differ before ingesting cannabis. Although this study is an important step in understanding the impact of cannabis on sleep in Canadian cancer survivors, it cannot be interpreted causally. Further study is needed to clarify the factors that underlie the perceived benefits associated with cannabis use for sleep. Further, there are several questions we did not ask that may have given us more insight into the decisions people make regarding cannabis use for sleep: we did not ask past consumers why they stopped using cannabis for sleep, we did not ask those who had never used cannabis for sleep why not, we did not ask current consumers where they get information on cannabis, and we did not ask current consumers whether they ingest cannabis sativa or indica. Another limitation is that upon seeing the topic of the survey, cancer survivors who do not use cannabis may have chosen not to participate and thus, the proportion of Canadian cancer survivors who use cannabis for sleep may be overrepresented in our sample. Further, despite being demographically representative, the sample was limited to participants who have registered on the Angus Reid platform. Finally, the measures were self-report, which are vulnerable to response bias, recall bias, and socially desirable responding. However, we chose this design as we wanted to hear from cancer survivors themselves about their preferences, perceptions, and patterns of cannabis use. These findings will inform future research and trials of cannabis for the purpose of treating insomnia in cancer survivors.

Conclusion

The current study demonstrates that 23.5% of Canadian cancer survivors reported that they currently used cannabis to improve sleep, with reported benefits including relaxation, reduced time to fall asleep, fewer nocturnal awakenings, and improved sleep quality. Two thirds

(68.3%) began using cannabis for sleep after their cancer diagnosis. Over a third of participants (36.3%) used cannabis as a sleep aid daily. Previous research on cannabis has largely focused on medicinal or non-medical use in the general population. Very few studies have focused on a cancer sample or have used sleep as a primary outcome—even fewer combine the two, especially in Canada. There is a profound need for robust, experimental research in this area. Since poor sleep is a long-lasting effect of cancer treatment that can be detrimental to quality of life and health, it is important that cancer survivors have information on methods to help them improve their sleep. Future experimental research should study the effects of cannabis as a sleep aid in cancer survivors.

Chapter 3:

Personal Qualities, Lifestyle Factors, and Disease Characteristics Related to Cannabis Use as a Sleep Aid Among Canadian Cancer Survivors: A Cross-Sectional Survey

Abstract

OBJECTIVE: Poor sleep is one of the most common consequences of cancer. It can persist for years beyond treatment and negatively impact quality of life and health. Cannabis is increasingly used to manage cancer treatment-related symptoms, including sleep. This study investigated the factors related to cannabis use as a sleep aid among Canadian cancer survivors.

METHODS: Adult Canadian cancer survivors (N=940) were recruited via the Angus Reid Institute and completed an online, cross-sectional survey including the Insomnia Severity Index and questions about cannabis use as a sleep aid. Univariate and multiple binomial logistic regression models identified factors associated with cannabis use as a sleep aid.

RESULTS: On average, participants (M_{age}=64.5yrs; Women=51.1%; White=92.9%) received their cancer diagnosis 12.3 years prior. Of participants, 25.1% (n=236) currently use cannabis as a sleep aid. Participants were at greater odds of using cannabis for sleep if they identified as a gender other than man or woman (AOR=11.132); were diagnosed with multiple medical conditions (2: AOR=1.988; 3+: AOR=1.902), two psychological conditions (AOR=2.171), multiple sleep disorders (AOR=2.338), insomnia (AOR=1.942), bone (AOR=6.535), gastrointestinal (AOR=4.307), genitourinary (AOR=2.586), hematological (AOR=4.739), or an unlisted cancer (AOR=3.470); received hormone therapy as their sole adjuvant therapy (AOR=3.054); partake in heavy drinking (AOR=2.748); or had mild insomnia severity (AOR=1.828). Older participants (AOR=.972) and those with sleep apnea were less likely to use cannabis for sleep (AOR=.560).

CONCLUSION: Given the prevalence and potential impact, research is needed to understand how the factors associated with cannabis use as a sleep aid among Canadian cancer survivor may influence its use and effectiveness.

Introduction

Sufficient sleep quality and quantity is one of the most important contributors to a person's overall health (Nunn et al., 2016). Impaired sleep has been linked to health risks such as dementia (Hung et al., 2018), cardiovascular disease (Bertisch et al., 2018), and depression (Baglioni et al., 2011), and contributes to increased healthcare costs (Bin et al., 2012) and rates of absenteeism (Lallukka et al., 2013). Insomnia is a common sleep disorder where one experiences difficulty initiating, maintaining, or returning to sleep at least 3 nights a week for at least 3 months, leading to significant distress and daytime impairment (APA, 2013). Insomnia can negatively impact quality of life (Byar et al., 2006; Lis et al., 2008) and can initiate or worsen physical and psychological health challenges (Colten et al., 2006; Henneghan et al., 2018; Strollo et al., 2020).

The term cancer survivor refers to an individual from the time of diagnosis until the end of their life (Mullan, 1985). Cancer survivors experience higher rates of insomnia than the general population. Poor sleep is experienced by 61% of cancer patients (Al Maqbali et al., 2022) and 44% of cancer survivors experience insomnia symptoms (Harrold et al., 2020), making sleep difficulties one of the most common consequences of cancer and its treatment (Palesh et al., 2012). Cancer-related sleep difficulties often persist for years after completing treatment (Lowery-Allison et al., 2018; Reynolds-Cowie & Fleming, 2021; Savard & Morin, 2001; Strollo et al., 2020). Thus, early interventions are needed to effectively manage poor sleep and insomnia (Zhou et al., 2021). Existing evidence-based sleep aids include cognitive behavioural therapy for insomnia (CBT-I), a type of psychotherapy (Arnedt et al., 2023; Jacobs et al., 2004; Morin et al., 2009; Rosenberg et al., 2021; Smith & Neubauer, 2003), and pharmacological interventions (Brandt & Leong, 2017; Rosenberg et al., 2021). While CBT-I has both immediate and long-term

benefits in reducing insomnia severity in cancer patients (Ma et al., 2021), it is inaccessible to many cancer survivors because of the cost, time, effort, and access to a psychologist due to a shortage of practitioners and a lack of geographical spread (Cheung et al., 2018; Thomas et al., 2016). Pharmacological interventions can be effective for short-term use, but are generally not intended for long-term use (Jacobs et al., 2004) and they often produce persistent, undesirable side effects that cancer survivors find especially challenging on top of their cancer and treatment-related side effects (A. Suraev et al., 2020). This is why a large portion of cancer survivors have turned to cannabis to treat their sleep difficulties and insomnia.

Before Canada passed the Cannabis Act to legalize cannabis in 2018, a national survey reported that 34.4% of Canadian adults with cancer used cannabis (Abdel-Rahman, 2021), and 43% of Canadian cancer patients reported any lifetime cannabis use (Martell et al., 2018). Since then, its prevalence is believed to have increased (Hawley et al., 2020). It is estimated that 41-43% of cannabis consumers (both cancer survivors and the general population) report using cannabis for sleep disturbances (Hawley et al., 2020; Moltke & Hindocha, 2021; Webster et al., 2020); however, there is little research examining the personal qualities, lifestyle factors, and disease characteristics that are associated with cannabis use specifically for sleep.

Who Uses Cannabis

While limited, studies in the general population examining factors associated with cannabis use found that individuals with medical conditions (Dai & Richter, 2019), younger age, or unemployed/not in school (Dokkedal-Silva et al., 2021) were at higher odds of current cannabis use. Associations with age are mixed, as both younger age (Dokkedal-Silva et al., 2021) and middle age (50-64 vs younger (Choi et al., 2017); and 31-50 vs younger and older (Haug et al., 2017)) have been found to be associated with higher rates of cannabis use. Other factors

found to be associated with higher cannabis consumption include being married/cohabitating (vs nonmarried) (Choi et al., 2017), having some college (compared to both those with less than high school education (Choi et al., 2017) and those who are college graduates (Parekh et al., 2020)), smoking tobacco, e-cigarettes, and heavy drinking, being more physically active, and being male (Parekh et al., 2020).

In a national survey of 4667 Canadian adults with cancer conducted in the pre-legalization era between 2007 and 2016, a logistic regression demonstrated that younger age, male sex, White race, single status, and higher income were associated with cannabis use (Abdel-Rahman, 2021). Conversely, a cross-sectional survey examining cannabis use in 1987 cancer patients attending cancer centres in Alberta, Canada found no significant predictors for lifetime cannabis including age, education level, sex, or type of cancer diagnosis (Martell et al., 2018). Among 476 young adult (YA) cancer patients in the United States who completed a survey at a cancer centre in Florida, recent cannabis consumers were less likely to have a college degree or be working full- or part-time, but were more likely to have a history of smoking, to have undergone surgery for their cancer, and to have undergone cancer treatment within the last 3 months (Donovan et al., 2022).

No studies, in either the general population or a cancer sample, have examined factors associated with current cannabis use for sleep specifically as the primary outcome. The only factor associated with cannabis use for sleep from the existing literature was found in a cross-sectional survey of current and past cannabis consumers in the general population where females were more likely to use cannabis specifically for self-perceived insomnia (Moltke & Hindocha, 2021).

The Present Study

There is a need for more research that investigates what factors may make someone more likely to turn to cannabis to try to improve their sleep. Further, the factors associated with cannabis use generally may be different than the factors associated with cannabis use specifically for sleep, and these may be different again for cancer survivors than a healthy, nonclinical population using cannabis for sleep. The objective of the present study was to investigate the personal qualities, lifestyle factors, and disease characteristics related to cannabis use as a sleep aid among Canadian cancer survivors.

Methods

Participants

Participants were recruited through the Angus Reid Forum—an online market research company—that recruits panel participants through targeted banner ad placements. Respondents received incentives through Angus Reid in the form of points that can be traded in for gift cards and occasional prize draws. Participants were eligible if they were over 18 years of age, currently lived in Canada, and had ever received a cancer diagnosis with no restriction on time since diagnosis, cancer type, or stage. Participants were excluded if they did not consent, failed two attention check questions, or did not complete the survey.

Procedure

We first established a sub-panel of Canadian cancer survivors among Angus Reid's existing panel. Then, our survey was released to all members of the cancer sub-panel until we reached a desired sample size. Based on the estimated insomnia prevalence of at least 44% among cancer survivors (Harrold et al., 2020), we determined that the number of individuals required to determine the prevalence of insomnia with a 95% confidence interval with 5%, 4% and 3% margin of error were 379, 592, and 1052, respectively. Power calculations were

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conducted with Epitools (http://epitools.ausvet.com.au). Eligible members clicked a link to complete the survey on the secure online platform, Qualtrics. The survey could be completed in English or French. If participants clicked "Yes, I do consent" after reading the informed consent form, they began the survey. If at any point the participant wanted to withdraw from the study, they were told that they could do so by clicking on the exit button present on every survey page and their data would be deleted, but that they would not be able to retract their responses if the survey was submitted due to their anonymity. Two attention check questions were included to help ensure participants were engaged and that the data was reliable and high-quality.

Measures

Medical history and demographics Sociodemographic information (e.g., gender identity, age, ethnicity, education, employment, household income, location, children, relationship status) were self-reported. Participants also self-reported medical information such as other diagnosed medical, sleep, and psychological conditions, caffeine intake, alcohol consumption, and physical activity. Finally, cancer-related information was self-reported, including primary site, year of diagnosis, stage, current status, and types of treatment.

Cannabis Use Questionnaire Questions regarding participants' use of cannabis for sleep (e.g., frequency, duration, time, ingestion method, cannabinoid content, perceived sleep effects and side effects, mode of obtainment, cost) were developed by the researchers as there was no formally validated, comprehensive measure available (Webster et al., 2020). See appendix B for full survey.

Insomnia Severity Index (ISI) The ISI is a seven-item self-report measure that assesses insomnia symptoms over the prior two weeks (Morin, 1993). It is one of the few well-validated patient-reported outcome measures designed to specifically assess the severity of insomnia

symptoms, the impact on daytime functioning, and the amount of associated distress (Bastien et al., 2001). Each item is scored from 0-4 with higher scores representing more severe insomnia symptoms. Total scores are summed and can be categorized into absence of (0-7), mild (8-14), moderate (15-21), or severe insomnia (22-28) (Morin et al., 2011).The ISI has been widely used clinically and in treatment studies of cancer survivors (Savard et al., 2005; Zhou et al., 2021) and has demonstrated internal consistency, reliability, construct validity, specificity, and sensitivity.

Statistical Analysis

Standard descriptive statistics, such as means, standard deviations, and ranges were produced for measured variables to assess the ways cancer survivors use cannabis for sleep. Frequencies were tabulated for categorical and ordinal variables. Logistic regression uses complete case analysis and can provide asymptotically unbiased estimates under a wide range of missing-data assumptions (Bartlett et al., 2015). Separate univariate binomial logistic regression models identified significant independent factors associated with cannabis use as a sleep aid. Covariates with p values <.10 were then simultaneously entered into a multiple binomial logistic regression model (Bursac et al., 2008). Nagelkerke R^2 was used to measure the amount of variance in cannabis use for sleep accounted for by the multivariable model. Variables in the multivariable model were assessed for multicollinearity using linear regression. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated to evaluate the effectiveness of the predicted classification against the actual classification of current cannabis use for sleep in the multivariable model. Analyses were conducted using SPSS Version 28.

Results

Participants

Of the 2003 people who started the survey, 239 did not provide consent and 299 were excluded (89 reported they did not receive a cancer diagnosis, 109 failed both attention checks, 101 did not finish the survey) (Figure 1). The remaining 1464 participants were eligible for analysis, but only 940 with complete data were included as we used a complete case analysis method (Bartlett et al., 2015). Table 1 shows the sociodemographic characteristics and cancer information of the final sample and the sample of those currently using cannabis as a sleep aid. The mean age was 64.5 (SD = 11.5), 51.1% identified as women, 67.2% (n=632) were not employed, and 92.9% (n=873) were White. Participants were diagnosed an average of 12.3 years prior to this study, 81.9% (n=770) were in remission, and the most common cancer types were skin (17.8%, n=167), genitourinary (17.8%, n=167), and breast (16.4%, n=154). Of participants, 25.1% (n=236) currently used cannabis for sleep.

Figure 1. Recruitment
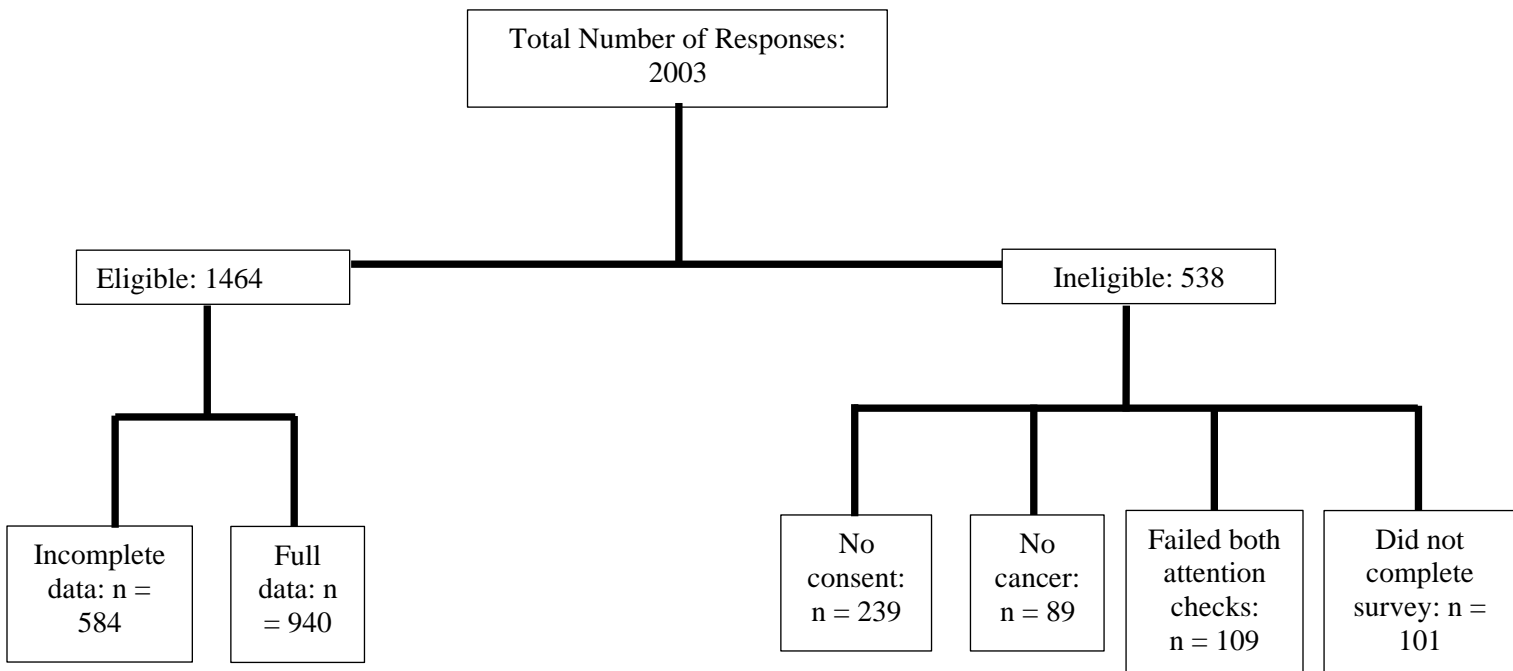
Table 1.

Participant Demographic, Cancer, and Sleep Characteristics

	Full Sample		Current Use	
	Mean (SD)	Frequency (%) *n* = 940	Mean (SD)	Frequency (%) *n* = 236
Age (years)	64.5 (11.5)		60.8 (12.6)	
Gender Identity				
Woman		480 (51.1%)		116 (49.2%)
Man		456 (48.5%)		117 (49.6%)
Other		4 (0.4%)		3 (1.3%)
Employment Status †				
Employed		308 (32.8%)		91 (38.6%)
Not employed		632 (67.2%)		145 (61.4%)
Relationship Status				
In a relationship		631 (67.71%)		147 (62.3%)
Single		309 (32.9%)		89 (37.7%)
Education				
High school or less		97 (10.3%)		20 (8.5%)
College or Trade School		305 (32.4%)		84 (35.6%)
Undergraduate University		390 (41.5%		109 (46.2%)
Graduate University		148 (15.7%)		23 (9.7%)
Annual Household Income				
Under $25 000 CAD		65 (6.9%)		24 (10.2%)
$25 000 to < $50 000		171 (18.2%)		40 (16.9%)
$50 000 to < $100 000		347 (36.9%)		78 (33.1%)
$100 000 to < $150 000		212 (22.6%)		65 (27.5%)
$150 000 to < $200 000		88 (9.4%)		17 (7.2%)
More than $200 000		57 (6.1%)		12 (5.1%)
Race and Ethnicity †				
Black		9 (0.6%)		2 (0.8%)
Chinese		5 (0.5%)		3 (1.3%)
Filipino		2 (0.2%)		1 (0.4%)
Indigenous Canadian		34 (3.6%)		18 (7.6%)
Latin American		6 (0.6%)		1 (0.4%)
Middle Eastern		5 (0.3%)		2 (0.8%)
Other East Asian		5 (0.5%)		0 (0.0%)
South Asian		3 (0.3%)		6 (2.5%)
White		873 (92.9%)		214 (90.7%)
Other*		32 (3.4%)		3 (1.3%)
Prefer not to say		9 (1.0%)		1 (0.4%)
Number of Comorbid Medical Conditions				
0		265 (28.2%)		50 (21.2%)
1		277 (29.5%)		70 (29.7%)
2		212 (22.6%)		57 (24.2%)

3+	186 (19.8%)	59 (25.0%)
Number of Comorbid Psychological Conditions		
0	638 (67.9%)	127 (53.8%)
1	164 (17.4%)	49 (20.8%)
2	83 (8.8%)	36 (15.3%)
3+	55 (5.9%)	24 (10.2%)
Sleep Disorders†		
None	650 (69.1%)	143 (60.6%)
Insomnia	80 (8.5%)	34 (14.4%)
Sleep Apnea	122 (13.0%)	24 (10.2%)
Restless Legs	18 (1.9%)	2 (0.8%)
Shift Work Disorder	8 (0.9%)	3 (1.3%)
Multiple Sleep Disorders	62 (6.6%)	30 (12.7%)
Years Since Diagnosis	12.3 (11.7)	12.8 (11.2)
Cancer Type		
Breast	154 (16.4%)	24 (10.2%)
Brain	7 (0.7%)	3 (1.3%)
Bone	8 (0.9%)	3 (1.3%)
Colorectal	67 (7.1%)	16 (6.8%)
Gastrointestinal	41 (4.4%)	20 (8.5%)
Genitourinary	167 (17.8%)	55 (23.3%)
Hematological	41 (4.4%)	16 (6.8%)
Head and Neck	44 (4.7%)	10 (4.2%)
Lung	29 (3.1%)	7 (3.0%)
Prostate	121 (12.9%)	19 (8.1%)
Skin	167 (17.8%)	35 (14.8%)
Thyroid	40 (4.3%)	8 (3.4%)
Multiple Types	33 (3.5%)	8 (3.4%)
Other	21 (2.2%)	12 (5.1%)
Cancer Stage		
Stage 0	218 (23.2%)	54 (22.9%)
Stage 1	214 (22.8%)	49 (20.8%)
Stage 2	115 (12.2%)	35 (14.8%)
Stage 3	98 (10.4%)	27 (11.4%)
Stage 4	68 (7.2%)	21 (8.9%)
Unknown	227 (24.1%)	50 (21.2%)
Cancer Status		
No evidence of disease	770 (81.9%)	181 (76.7%)
Metastatic disease	62 (6.6%)	20 (8.5%)
Still in treatment	84 (8.9%)	25 (10.6%)
Other	24 (2.6%)	10 (4.2%)
Surgery		
Yes	788 (83.8%)	189 (80.1%)
No	147 (15.6%)	43 (18.2%)

Missing		5 (0.5%)		4 (1.7%)
Type of Adjuvant Therapy †				
No Adjuvant Therapy		467 (49.7%)		120 (50.8%)
Chemotherapy		118 (12.6%)		31 (13.1%)
Radiotherapy		108 (11.5%)		22 (9.3%)
Hormone Therapy		25 (2.7%)		10 (4.2%)
Multiple		222 (23.6%)		53 (22.5%)
Coffee Cups Per Day				
0		167 (17.8%)		35 (14.8%)
1		230 (24.5%)		60 (25.4%)
2		328 (34.9%)		86 (36.4%)
3		145 (15.5%)		40 (16.9%)
4+		69 (7.3%)		14 (5.9%)
Missing		1 (0.1%)		1 (0.4%)
Typical Number of Alcoholic Drinks at one time				
1-2		713 (75.9%)		156 (66.1%)
3-4		165 (17.6%)		46 (19.5%)
5+		62 (6.6%)		34 (14.4%)
ISI Total Score	8.4		10.4	
	(5.7)		(5.3)	
Insomnia Severity				
No insomnia		457 (48.6%)		79 (33.5%)
Mild		329 (35.0%)		104 (44.1%)
Moderate		141 (15.0%)		48 (20.3%)
Severe		13 (1.4%)		5 (2.1%)

* Answers reported for other race/ethnicity include Canadian, Portuguese, Jewish, Metis, Scottish, Hungarian, Guyanese, and Mixed Heritage
† Respondents could select multiple options

Univariable Regression

Separate univariable binomial logistic regression models identified significant independent factors associated with current cannabis use as a sleep aid (see Table 2 for complete univariable analysis). At the univariable level, odds of current cannabis use for sleep were associated with age, gender, employment status, education, household income, number of medical conditions, number of psychological conditions, sleep disorders, cancer type, typical number of alcoholic drinks, and ISI score. Factors that did not meet the .05 significance

threshold but were included in the multivariable analysis for being significant at the .1 level included relationship status, cancer stage, and adjuvant therapy.

Multivariable Regression

Significant factors at the univariable level meeting the threshold of p=.1 were entered into a multivariable regression model. The logistic regression model was significant ($\chi2$ (51) = 176.183, p<.001), with the included predictors explaining 25.3% of the variance in cannabis use for sleep (Nagelkerke R^2 =.253). The Hosmer-Lemeshow test was not significant ($\chi2$ (8) =2.026, p=.980), suggesting the model was a good fit. The multivariable model had an accuracy rate of 78.3%; sensitivity was 65.4% and specificity was 79.9%, while the positive and negative predictive values were 28.8% and 94.9% respectively.

When holding all other predictor variables constant, participants who were older were at lesser odds of using cannabis for sleep (adjusted odds ratio [AOR]= .972[.954, .992], p=.005). Conversely, participants who identified as a gender other than a man or a woman (AOR= 11.132[1.306, 119.656], p=.047) were 11 times more likely to use cannabis for sleep. Those who had two (AOR= 1.988[1.195, 3.307], p=.008) or three or more medical conditions (AOR= 1.902[1.119, 3.234], p=.018) were at greater odds of using cannabis for sleep compared to those with no diagnosed medical conditions. Likewise, odds of current cannabis use for sleep were two times higher in participants diagnosed with two psychological conditions than those with none (AOR= 2.171[1.229 3.835], p=.008). Participants diagnosed with insomnia (AOR= 1.942[1.083, 3.481], p=.026) or with multiple sleep disorders (AOR = 2.338[1.211, 4.706], p=.012) were at greater odds of currently using cannabis for sleep than those who had not been diagnosed with any sleep disorders, whereas those diagnosed with sleep apnea were less likely to use cannabis for sleep (AOR = .560[.318, .985], p=.044). Participants diagnosed with bone (AOR=

6.535[1.257, 33.966], *p*=.026), gastrointestinal (AOR= 4.307[1.645, 11.274], *p*=.003),

genitourinary (AOR= 2.586[1.304, 5.128], *p*=.007), hematological (AOR= 4.739[1.836, 12.229],

p=.001) cancers, or reported an unlisted type of cancer (AOR= 3.470[1.022, 11.778], *p*=.046)

were at greater odds of using cannabis for sleep than those with breast cancer. Participants who

received hormone therapy as their sole adjuvant therapy had 3 times greater odds of currently

using cannabis for sleep than those who received no adjuvant therapy (AOR = 3.054[1.160,

8.041], *p*=.024. Odds of current cannabis use for sleep were almost 3 times higher in participants

who typically drink 5 or more drinks on one occasion (AOR= 2.748[1.453, 5.199] *p*=.002)

compared to those who typically consume 1-2 drinks on one occasion. Finally, odds of current

cannabis use for sleep in participants with mild insomnia scores on the ISI were 1.8 times higher

than those with no insomnia (AOR= 1.828[1.242, 2.690], *p*=.002). At the multivariable level,

employment status, relationship status, education, household income, and cancer stage were no

longer significantly associated with cannabis use for sleep.

Table 2

Factors Associated with Cannabis Use as a Sleep Aid in Canadian Cancer Survivors

		Univariable Logistic Regression		Multivariable Logistic Regression	
		Odds-Ratio [95% CI]	*p*	Adjusted Odds-Ratio [95% CI]	*p*
Age		0.961[.951, .971]	**<.001*****	.972[.954, .992]	**.005****
Gender	Women (ref)	1	-	1	-
	Men	1.167[.915, 1.488]	.214	1.354[.870, 2.108]	.179
	Other	4.713[1.045, 21.26]	**.044****	11.132[1.306, 119.656]	**.047****
Employment Status	Not employed (ref)	1	-	1	-
	Employed	1.478[1.145,1.909]	**.003****	.903[.588, 1.387]	.641
Relationship Status	In a relationship (ref)	1	-	1	-
	Single	1.262[.982, 1.621]	**.068***	1.383[.930, 2.059]	.110
Education	High school or less (ref)	1	-	1	-
	College/Trade School	1.572[1.008, 2.452]	**.046****	1.548[.810, 2.961]	.186
	Undergraduate University	1.501[.968, 2.327]	**.070***	1.690[.897, 3.184]	.104
	Graduate University	.867 [.513, 1.464]	.593	.862[.395, 1.880]	.708

Annual Household Income	<$25 000 CAD (ref)	1	-	1	-
	$25 000 to <$50 000	.572[.346, .945]	**.029****	.773[.375, 1.596]	.487
	$50 000 to <$100 000	.535[.336, .851]	**.008****	.863[.432, 1.725]	.676
	$100 000 to <$150 000	.714[.437, 1.167]	.179	1.485[.698, 3.160]	.305
	$150 000 to <$200 000	.435[.230, .824]	**.011****	.751[.307, 1.836]	.530
	> $200 000 CAD	.574[.286, 1.151]	.118	.754[.280, 2.030]	.576
Number of Comorbid Medical Conditions	0 (ref)	1		1	
	1	1.237[.889, 1.721]	.208	1.262[.789, 2.018]	.332
	2	1.260[.884, 1.795]	.201	1.988[1.195, 3.307]	**.008****
	3+	1.555[1.096, 2.207]	**.013****	1.902[1.119, 3.234]	**.018****
Number of Comorbid Psychological Conditions	0 (ref)	1	-	1	-
	1	1.725[1.261, 2.359]	**<.001*****	1.233[.785, 1.938]	.364
	2	2.877[1.971, 4.199]	**<.001*****	2.171[1.229, 3.835]	**.008****
	3+	3.850[2.410, 6.151]	**<.001*****	1.211[.596, 2.462]	.596
Sleep Disorders	None (ref)	1	-	1	-
	Insomnia	2.787[1.889, 4.112]	**<.001*****	1.942[1.083, 3.481]	**.026****
	Sleep Apnea	1.111[.771, 1.601]	.572	.560[.318, .985]	**.044****
	Restless Legs	.788[.299, 2.079]	.630	.523[.113, 2.420]	.407
	Shift Work Disorder	2.342[.679, 8.081]	.178	1.853[.323, 10.616]	.489
	Multiple	3.547[2.310, 5.447]	**<.001*****	2.338[1.211, 4.706]	**.012****
Years Since Diagnosis		1.001[.990, 1.011]	.867	-	-
Cancer Type	Breast (ref)	1	-	1	-
	Brain	2.154[.534, 8.695]	.281	2.208[.335, 14.557]	.411
	Bone	2.234[.655, 7.618]	.199	6.535[1.257, 33.966]	**.026****
	Colorectal	1.240[.675, 2.279]	.488	1.661[.679, 4.063]	.267
	Gastrointestinal	2.566[1.409, 4.676]	**.002****	4.307[1.645, 11.274]	**.003****
	Genitourinary	2.224[1.438, 3.439]	**<.001*****	2.586[1.304, 5.128]	**.007****
	Hematological	2.513[1.392, 4.535]	**.002****	4.739[1.836, 12.229]	**.001****
	Head and Neck	1.497[.752, 2.981]	.251	1.092[.410, 2.908]	.861
	Lung	1.455[.684, 3.092]	.330	1.749[.607, 5.042]	.301
	Prostate	1.039[.619, 1.742]	.886	1.034[.443, 2.416]	.938
	Skin	1.347[.856, 2.118]	.198	1.398[.643, 3.039]	.398
	Thyroid	1.117[.519, 2.404]	.778	1.141[.412, 3.158]	.799
	Multiple Types	1.915[.979, 3.744]	**.058***	1.686[.596, 4.766]	.325
	Other	2.599[1.276, 5.297]	**.009****	3.470[1.022, 11.778]	**.046****
Cancer Stage	Stage 0 (ref)	1	-	1	-
	Stage 1	1.085[.732, 1.609]	.684	.618[.367, 1.042]	.071
	Stage 2	1.504[.972, 2.328]	**.067***	.850[.455, 1.588]	.611
	Stage 3	1.148[.697, 1.891]	.587	.886[.454, 1.726]	.721
	Stage 4	1.663[.992, 2.787]	**.054***	1.055[.512, 2.174]	.885
	Unknown	1.170[.800, 1.711]	.419	.685[.418, 1.123]	.134
Cancer Status	No evidence of disease (ref)	1	-	-	-
	Metastatic disease	1.421[.882, 2.288]	.149	-	-
	Still in treatment	1.235[.811, 1.880]	.325	-	-

	Other	1.412[.777, 2.567]	.258		
Surgery	Yes (ref)	1	-	-	-
	No	1.264[.926, 1.725]	.140	-	-
Adjuvant Therapy	None (ref)	1	-	1	-
	Chemotherapy	1.117[.770, 1.622]	.560	.794[.440, 1.432]	.443
	Radiotherapy	.903[.607, 1.345]	.617	1.112[.602, 2.057]	.734
	Hormone Therapy	1.939[.956, 3.930]	**.066***	3.054[1.160, 8.041]	**.024****
	Multiple	.943[.692, 1.284]	.708	1.155[.659, 2.025]	.614
Coffee cups per day	0 (ref)	1	-	-	-
	1	1.089[.754, 1.572]	.651	-	-
	2	1.192[.841, 1.691]	.324	-	-
	3	1.138[.751, 1.727]	.542	-	-
	4+	.938[.548, 1.605]	.814	-	-
Number of Drinks	1-2 (ref)	1	-	1	-
	3-4	1.332[.943, 1.882]	.104	1.403[.906, 2.171]	.129
	5+	3.629[2.234, 5.895]	**<.001****	2.748[1.453, 5.199]	**.002****
ISI Score	No insomnia (ref)	1		1	
	Mild	2.576[1.961, 3.400]	**<.001****	1.828[1.242, 2.690]	**.002****
	Moderate	2.913[2.030, 4.182]	**<.001****	1.336[.790, 2.259]	.280
	Severe	5.297[2.194, 12.787]	**<.001****	.688[.172, 2.756]	.598

*significant at .1 level (univariate regressions only)
**significant at .05 level
***significant at .001 level

Discussion

The present study was the first to examine personal qualities, lifestyle factors, and disease characteristics related to cannabis use as a sleep aid among Canadian cancer survivors. We found that as participants aged, their likelihood to use cannabis for sleep marginally decreased. The literature is mixed regarding age associations with cannabis use. Younger age in cancer survivors (Abdel-Rahman, 2021; Dokkedal-Silva et al., 2021) has been associated with higher rates of cannabis use, whereas higher rates of cannabis use was associated with middle age in the general population (50-64 vs younger (Choi et al., 2017); and 31-50 vs younger and older (Haug et al., 2017)). Another study on cancer survivors found no significant association between age and cannabis use, although an association between younger age and lifetime cannabis use was trending

(*p*=.07)(Martell et al., 2018). Further research is needed to clarify the nature of this relationship and determine what age-related factors may contribute to cannabis use for sleep. Participants diagnosed with sleep apnea were also less likely to use cannabis for sleep. This could be age-related as well, as older individuals are more at risk for sleep apnea (Aviv et al., 1994), or, perhaps those with sleep apnea are already engaging in an effective treatment for their sleep concern, such as a CPAP machine, and thus are less likely to be in search of alternative or additional sleep-aids.

Cancer survivors with multiple medical conditions or two psychological conditions were twice as likely to use cannabis for sleep than those with no diagnosed conditions. While no previous research has found associations between psychological conditions and cannabis use, this is consistent with a study in the general population finding that individuals with medical conditions were more likely to use cannabis (Dai & Richter, 2019). Individuals with certain conditions are more likely to struggle with sleep, such as anxiety (Breslau et al., 1996; Ford & Kamerow, 1989), depression (Lustberg & Reynolds, 2000; Nutt et al., 2008), bipolar disorder (Bertrand et al., 2020; Kaplan & Harvey, 2013), post-traumatic stress disorder (Slavish et al., 2023; Woodward et al., 2019) chronic pain (Finan et al., 2013; Pigeon et al., 2012), diabetes (Johnson et al., 2021; Ogilvie & Patel, 2018), hypertension (Johnson et al., 2021; Li & Shang, 2021). Similarly, individuals with diagnosed medical and psychological conditions may be on one or more medications that interfere with their sleep (Do, 2020). Furthermore, individuals who are already taking medications for multiple conditions may be more likely to turn to cannabis for sleep instead of adding another pharmacological intervention on top of their existing medicines or in replacement of their medications as many believe it is a more natural alternative with a more desirable side-effect profile (Abdel-Rahman, 2021; Martell et al., 2018; McTaggart-Cowan et al., 2021; Webster et al., 2020). Finally, there may be a bidirectional relationship between

cannabis use for anxiety or pain and cannabis use for sleep. Individuals may be using cannabis as a sleep aid by means of alleviating other symptoms of their existing conditions, such as pain (Velzeboer et al., 2022) or anxiety (Zhou et al., 2021). Anxiety and pain are frequently reported uses for cannabis (Haug et al., 2017; Hawley et al., 2020; Kuhathasan et al., 2021; Moltke & Hindocha, 2021; Sarris et al., 2020; A. S. Suraev et al., 2020; Wilson et al., 2019), and cancer patients report a reduction in these symptoms when using cannabis (Donovan et al., 2022; Macari et al., 2020; Webster et al., 2020), thus, individuals using cannabis to improve anxiety or pain may consequentially see an improvement in sleep as well. Conversely, since sleep is crucial for physical and psychological restoration, if people are using cannabis primarily to improve sleep, it may also improve anxiety, pain, or other physical or mental ailments and the desirable ability to reduce medications previously treating these symptoms (AminiLari et al., 2022; Bachhuber et al., 2019; Donovan et al., 2022; Zhou et al., 2021).

Individuals with poor sleep, having been diagnosed with insomnia or multiple sleep disorders or demonstrating mild insomnia severity on the ISI, were also identified as being 1.8-2.3 times more likely to be currently using cannabis for sleep. While it makes intuitive sense that those who struggle with sleep would be more likely to use cannabis as a sleep aid than those who do not, it is unknown why those with mild insomnia severity had greater odds of cannabis use for sleep when those with moderate to severe insomnia severity did not differ in odds from individuals with no insomnia symptoms. Previous research has found that patients with clinical insomnia are more likely to seek medical help and that those who seek medical assistance are more likely to be taking sleep medication (Torrens Darder et al., 2021). Thus, one potential explanation is that since those with moderate to severe insomnia meet the clinical cutoff, they are more likely to seek help from their health care provider and receive more commonly prescribed

medications for sleep instead of cannabis. In contrast, those with mild insomnia severity who do not meet the clinical cutoff may be more likely to try home-remedies or treatments that do not require consultation of a physician or psychologist.

Consistent with existing research on general cannabis use in young adults (Parekh et al., 2020), we found those who partook in heavy drinking, defined as drinking 5 or more drinks on one occasion (Canada, 2023), were 2.7 times more likely to use cannabis for sleep. Other research has highlighted the association between binge drinking and cannabis use (Al-Rousan et al., 2022; Crawford et al., 2021). Furthermore, heavy drinking and binge drinking have been associated with higher rates of insomnia (Haario et al., 2013). Thus, as heavy drinkers may be more likely to both use cannabis and experience poor sleep, this may explain the present finding why they are more likely to use cannabis as a sleep aid.

Participants who received hormone therapy were almost three times as likely to be using cannabis for sleep than participants who received no adjuvant therapies. Previous, longitudinal research patients with prostate cancer who were exposed to hormone therapy reported significantly and consistently higher ISI scores than those who were not, and in both prostate and breast cancer patients, this relationship was mediated by night sweats (Savard et al., 2015). While having higher insomnia severity may partially explain why individuals are more likely to use cannabis for sleep, this research also shows associations between both chemotherapy and radiotherapy with insomnia, so it remains unclear why only hormone therapy is associated with higher cannabis use for sleep in the present study.

Finally, participants with gastrointestinal, genitourinary, or hematological cancer had higher odds of cannabis use for sleep. There are side effects of these cancers and their treatment that can lead to a poor sleep such as nausea, reflux (Numico et al., 2015), pain, and digestive or

urinary problems (Allart-Vorelli et al., 2015; Lou et al., 2022), however, these side effects are experienced with other cancer types as well, so this alone does not explain higher rates of cannabis use for sleep. More research is needed to examine these associations.

Study Limitations

Although this study is the first assessment of the factors associated with use of cannabis as a sleep aid in cancer survivors, there were some limitations of this study that should be acknowledged. First, several significant effects have wide-ranging confidence intervals, making results difficult to interpret and trust. There were only seven individuals who did not report their gender identity as a man or woman, and although we found they were 11 times more likely to use cannabis for sleep, the confidence interval is extremely large (1.306, 119.656) so further study with a larger sample of gender diverse individuals is needed to determine this association. Further, the confidence intervals for gastrointestinal and hematological cancers are also quite large at ([1.645, 11.274] and [1.836, 12.229], respectively), and the sample size for bone cancer was quite small (n=8), so we cannot put full trust in these results. Future research with larger sample sizes should further examine these associations. Second, the measures were self-report, which are vulnerable to response bias, recall bias, and socially desirable responding. However, we chose this design as we wanted to hear from cancer survivors themselves about their personal qualities, lifestyle factors, disease characteristics, and cannabis use. Finally, despite being demographically representative, the sample was limited to participants who have registered on the Angus Reid platform.

Conclusion

The current study demonstrated that age, medical conditions, psychological conditions, sleep disorders, typical number of drinks on one occasion, cancer type, adjuvant therapy, and

insomnia severity are associated with current cannabis use as a sleep aid. There is very little research examining the factors associated with cannabis use as a sleep aid; previous research has largely focused on medicinal or non-medical use in the general population. No studies have focused on factors associated with cannabis use specifically for sleep and few have used a cancer sample—even fewer in Canada. There is a profound need for research to understand how the factors associated with cannabis use as a sleep aid among Canadian cancer survivor may influence its use and effectiveness. Further research should also examine whether the factors that associated with cannabis use as a sleep aid are also barriers to accessing CBT-I that could be mitigated so people can receive a more evidence-based and low-risk treatment should they wish to do so. Since poor sleep is a long-lasting effect of cancer treatment that can be detrimental to quality of life and health, it is important that cancer survivors have information on and access to methods to help them improve their sleep.

Chapter 4:

Putting the Results into Context and Recommended Future Research

Summary of Main Findings

This thesis explored the use of cannabis as a sleep aid among Canadian cancer survivors. The first study in this investigation examined the prevalence, patterns of use, and perceived effect and side effects of cannabis use for sleep among 1464 participants. One in four ($n = 344$) Canadian cancer survivors reported current cannabis use for the purpose of sleep, whereas 14.4% reported past use of cannabis for sleep. Together, this means over a third (37%) of Canadian cancer survivors in our study have tried using cannabis as a sleep aid. Insomnia was clearly an unmet need among cancer survivors–of current consumers, 69.8% were experiencing at least mild insomnia symptoms. Cannabis was not being used as a short-term effort to improve sleep, but rather most consumers (70.9%) have been using cannabis for sleep for over a year. Half of participants reported using cannabis regularly for sleep, at least 4 times a week. Reported benefits to sleep included relaxation (59.3%), falling asleep faster (48.3%), improving sleep quality (40.1%) and fewer nocturnal awakenings (36%). Different cannabinoid contents and ingestion methods seemed to impact sleep in different ways. Over a third (38.7%) experience no side effects when using cannabis for sleep and 73.7% experience no next-day effects. Three quarters of the cannabis products being consumed were purchased from the regulated market (either the non-medical market or through health care provider authorization), and one quarter (23.8%) of products were being obtained from the unregulated market or through growing it themselves. The most common ingestion methods were edibles, smoking, and oils/sprays. About one third each were using cannabis containing mostly THC (35.8%) and mostly CBD (32.8%). A smaller portion used cannabis with balanced amounts of THC and CBD (22.7%) or did not know the formulation of the cannabis they consume (8.5%).

The second study in this investigation examined the personal qualities, lifestyle factors, and disease characteristics related to cannabis use as a sleep aid of 940 Canadian cancer survivors. Factors associated with greater odds of cannabis use for sleep at the multivariable level include having been diagnosed with multiple medical conditions, two psychological conditions, insomnia or multiple sleep disorders, having been diagnosed with bone, gastrointestinal, genitourinary, hematological, or an unlisted type of cancer, having received hormone therapy only, partaking in heavy drinking, and having mild insomnia severity on the ISI. Factors associated with lesser odds of cannabis use for sleep at the multivariable level include older age and having been diagnosed with sleep apnea.

Clinical Implications

The finding that a quarter of Canadian cancer survivors currently use cannabis as a sleep aid has significant clinical implications and highlights the need for healthcare providers to be educated on its use and be open to discussing it with their patients. There is a legal online system set up for patients to access medicinal cannabis, but in the present sample, only 19.2% had medical authorization from their doctor even though two thirds reported their doctor was aware of their cannabis use. This may be a result of health care providers' lack of knowledge and ability to monitor effects. Only 10% of physicians in Canada are medically authorized to prescribe cannabis due to significant gaps in medical education (Arboleda et al., 2020). Further, up to 84% of health care providers believed they did not have sufficient knowledge about cannabis (e.g., monitoring use, prescribing accurate doses and strains) to make evidence-based recommendations to inquiring patients (Arboleda et al., 2020; McLennan et al., 2020; Ng et al., 2022), and this is likely reflective of the lack of research around these factors. While some health care providers do not prescribe cannabis as they feel apprehensive about their ability to provide

guidance, others are against any discussion of cannabis, even with their patients who inquire (Arboleda et al., 2020; McLennan et al., 2020; McTaggart-Cowan et al., 2021). As a result of this stigmatizing disapproval, some patients willingly withhold if they are using cannabis to treat their cancer-related symptoms because they fear the reaction of or rejection from their healthcare provider (McTaggart-Cowan et al., 2021). This could be unsafe for the patient as their healthcare provider may prescribe other medications without being informed of potential interactions. As there are now other legal means of obtaining cannabis, healthcare providers' reluctance to provide medical authorization for medicinal cannabis leads to more cancer survivors using cannabis without any guidance or supervision from their healthcare team (Arboleda et al., 2020; McLennan et al., 2020). Favourably, it has been found that 53% of oncology healthcare providers are interested in receiving more training about the use of cannabis in oncology (McLennan et al., 2020), and this study highlights the need for this to become a reality.

It is already known that the effects of cannabis are likely influenced by dose, cannabinoid content, timing, and ingestion method (Babson et al., 2017), but it is also possible that its effects may differ based on personal qualities, lifestyle factors, or disease characteristics. Thus, there is a potential for tailored consumption depending on the above factors as well as the desired sleep outcome. Certain ingestion methods may be more conducive to a person's lifestyle (e.g., using an oil or edible since smoking cannabis is not legal in a rented property (Canada, 2018)), certain doses or cannabinoid contents may differ in effectiveness depending on certain demographic characteristics (e.g., women may need a smaller dose (Sholler et al., 2021)), and these may differ again depending on the sleep problem one is aiming to fix and its severity (e.g., inhaling cannabis may be better for improving time to fall asleep due to its fast onset time but ingesting cannabis orally may be better for sleeping through the night due to its longer lasting effects

(Grotenhermen, 2003; McCartney et al., 2021)). In addition to tailored cannabis consumption, there is also a need for tailored education and counselling programs for cancer survivors who are considering or are already using cannabis for sleep. These programs could provide evidence-based information about dosing, cannabinoid content, and ingestion method, as well as the risks and benefits of cannabis use.

A meta-analysis conducted in 2015 found moderate-quality evidence supporting cannabis use to alleviate chronic pain and low-quality evidence supporting cannabis use to reduce chemotherapy-induced nausea and vomiting (Whiting et al., 2015). The use of cannabis for these concerns, if indeed helpful, would be especially therapeutically beneficial to cancer survivors. Despite these benefits, it is important to consider the potential risks associated with cannabis use. One of the main concerns associated with the use of cannabis for sleep in cancer survivors is the potential for adverse effects. The biggest concerns for adverse effects arise from smoking cannabis (Feeney & Kampman, 2016; Gruber et al., 2003), which was one of the most common ingestion methods used by cancer survivors in the present study. Cognitive impairment is one potential adverse effect of smoking cannabis (Feeney & Kampman, 2016; Gruber et al., 2003); smoking cannabis has been associated with increased likelihood of neurocognitive problems, lower academic achievement, (Brook et al., 2008) and self-perceived cognitive impairment (Conroy et al., 2015). As cognitive impairment is already a struggle for many cancer survivors (Argyriou et al., 2011; Hermelink, 2015; Hodgson et al., 2013; Janelsins et al., 2014), this should be an important consideration in the decision to use cannabis for sleep. Another potential adverse effect is developing a substance use disorder. Individuals may be at a greater risk of developing a substance use disorder when consuming cannabis depending on certain demographic characteristics, such as being male, single, having lower income (Stinson et al., 2006), or having

pre-existing psychological conditions (Marel et al., 2019) so the risks may outweigh the benefits for these individuals. Future research should examine whether this is a concern for a Canadian cancer sample and/or older adults. Finally, for those who smoke or vaporize cannabis, there is a concern for the development of respiratory issues (Brook et al., 2008; Feeney & Kampman, 2016) such as bronchitis, coughing, phlegm production, and wheezing (Moore et al., 2005). Thus, individuals with certain cancer types who already experience respiratory issues, such as lung cancer, may want to consider ingesting cannabis through a method other than inhalation. As CBD is not intoxicating (Pertwee, 2008), is safe for short-term use (Canada, 2022), and it does not foster abuse or dependency (Bergamaschi et al., 2011), ingesting CBD in the form of oils, sprays, capsules, or edibles may be the safest way to consume cannabis. This is something that healthcare providers and cancer survivors must be aware of so they can make better, informed decisions, monitor for negative side-effects, and weigh the risks and benefits of cannabis or consider the need for alternative interventions.

If it is determined by either a healthcare provider or cancer survivor themself that the risks of cannabis use for sleep outweigh the benefits, there are other potential interventions for sleep that can be considered. Objectively, CBT-I is better at addressing sleep problems than cannabis in the noncancer population (Arnedt et al., 2023), however, CBT-I is inaccessible to many cancer survivors because of the cost, time, and access to a psychologist. An alternative, more accessible option could be an online (Zachariae et al., 2018) or mobile-app (Babson et al., 2015) delivered CBT-I intervention. Virtual CBT-I has not only been shown to be highly effective in improving sleep among cancer survivors (Amidi et al., 2022; Zachariae et al., 2018; Zhou & Recklitis, 2020), but it also has been shown to lead to a decrease in cannabis use among those with cannabis use disorders (Babson et al., 2015). Thus, online or mobile-app based CBT-I

is a promising sleep aid that is affordable, accessible, and effective for cancer survivors with no associated health risks that can be used as an alternative to cannabis if individuals have the time and energy to commit to improving their sleep.

Directions for Future Research

Since the current evidence-based sleep aids are inaccessible or undesirable to many cancer survivors, it is important that researchers continue to investigate methods to remove barriers and alternate sleep aids. Cancer survivors need information and guidance on methods they can use to improve their sleep. Future research should examine the feasibility and effectiveness of other potential sleep-aids such as mindfulness-based and exercise interventions (Matthews et al., 2018) especially among cancer survivors. Mindfulness-based interventions can improve fatigue (Johns et al., 2015) and insomnia (Garland et al., 2014) among cancer survivors, however its impact on sleep is still poorly understood (Christodoulou & Black, 2017; Shallcross et al., 2019) and a potential direction for future research. Existing research on exercise as a sleep intervention for cancer survivors shows mixed results (Coles et al., 2018; Hidde et al., 2020; Rogers et al., 2017) with potential cancer-related mediating factors (Rogers et al., 2015). Some cancer survivors may find exercise challenging due to cancer-related fatigue (Kim et al., 2020), so it may not be ideal for all. Further research should investigate the potential of using exercise as a sleep-intervention for cancer survivors and the factors related to increased likelihood of beneficial sleep effects.

The current study demonstrated that many cancer survivors are already turning to cannabis to manage their poor sleep or insomnia symptoms, despite the lack of research on its efficacy and safety. Thus, there is an immense need for further study into its use for sleep, including optimal dosing and administration to achieve a desired sleep outcome. Evidence must

be experimental, unbiased, and robustly controlled. Similarly, most studies use pharmaceutically derived cannabinoids, which tend to only include CBD and THC, however, many consumers are using natural products that would contain over 100 active cannabinoids. (Choi et al., 2020; Pertwee, 2006). There could be unknown effects from the less studied cannabinoids in natural cannabis that are being missed in studies using pharmaceutically derived cannabis. Future research should examine the cannabis products that are being used by consumers. There is also a need for more research into other potential adverse effects so we can better understand its safety among cancer survivors. In the present study, individuals consuming cannabis for sleep had worse insomnia symptoms than those not currently consuming cannabis for sleep. It is possible that individuals using cannabis for sleep had poorer sleep than non-consumers to begin with, and their cannabis use had improved their sleep but not up to the level of non-consumers who did not struggle as much with their sleep before. It is also possible that the levels of insomnia between consumers and non-consumers were comparable to begin with and cannabis use had worsened sleep. Future research should study the relationship between cannabis use and sleep longitudinally to determine the efficacy and safety of cannabis as a sleep aid in this population. Future research should also investigate potential interactions between cannabis and other medications (Vazquez et al., 2021), such as those commonly used by cancer survivors, and those used to treat other comorbid medical and psychological conditions, especially those used for sleep. In the present study, we found that those with multiple medical or psychological conditions were more likely to use cannabis for sleep, so it is important to examine whether cannabis is safe for these individuals who are taking certain medications. Finally, we need to better understand the factors associated with one's decision to turn to cannabis to improve their

sleep instead of existing evidence-based sleep aid options, and how this may impact its use and effectiveness.

Strengths

Recruitment for this research took place via the Angus Reid forum. This allowed us to recruit a large, geographically representative sample of the Canadian population. Further, this approach ensured an appropriate demographic balance that reflects the general population and captures the diversity of sub-segments of the population. Angus Reid's community panels are maintained through advanced sampling techniques and frequent verifications of personal identity, contact information, and demographic characteristics. We were able to obtain a sample experiencing a wide range of cancer types, statuses, and stages, as well as a representative balance of other demographic data such as gender, Canadian province, household income, and education level. The online, cross-sectional survey design as it guaranteed participant confidentiality and anonymity, allowing us to recruit a large sample. If we had used other research methods, recruitment likely would have been especially challenging due to the sensitive nature of the topic, and we would not have been able to study as large and representative of a sample. The large sample size increases the generalizability of the findings.

Another strength of the present research is the study of a new demographic, namely, Canadian cancer survivors. There has been limited Canadian research on the use of cannabis among cancer survivors, especially for the purpose of sleep. Existing literature examining cannabis use for sleep is very preliminary and mixed (Babson et al., 2017; Choi et al., 2020; De Feo et al., 2023; Edwards & Filbey, 2021; McLennan et al., 2020; Mondino et al., 2021); relevant research is made up of studies examining cannabis use in cancer survivors (e.g., (Daris et al., 2019; Do, 2020; Donovan et al., 2022; Fallon et al., 2017; Lichtman et al., 2018; Macari et

al., 2020; Webster et al., 2020; Zylla et al., 2021)), cannabis use in Canadians (e.g., (Ng et al., 2022; Walsh et al., 2013)), and cannabis use for sleep (e.g., (Babson & Bonn-Miller, 2014; Babson et al., 2017; Belendiuk et al., 2015; Bhagavan et al., 2020; Bolla et al., 2008; Kaul et al., 2021; Moltke & Hindocha, 2021; A. Suraev et al., 2020; Walsh et al., 2021)), or a combination of two of the three. Few studies focus on cannabis use among cancer survivors in Canada (Abdel-Rahman, 2021; Arboleda et al., 2020; Hawley et al., 2020; Martell et al., 2018; McLennan et al., 2020; McTaggart-Cowan et al., 2021), and those that do use this sample do not include sleep as a primary outcome, if at all. Studies examining cannabis use among cancer survivors for sleep as the primary aim do not use a Canadian sample (Cote et al., 2016; De Feo et al., 2023; Portenoy et al., 2012; Schloss et al., 2021; Zhou et al., 2021). While cancer survivors in the United States and Europe share some cultural similarities with Canadians, national differences in healthcare (Davis et al., 2014) and cannabis legislation (Addiction, 2017; Canada, 2018; Patton, 2020) pose significant challenges in generalizing across countries, so Canadian research is needed. This research addresses this gap in the literature. The first study in this investigation expands upon this existing literature by examining on cannabis use among Canadian cancer survivors specifically for sleep, giving an in-depth look at patterns such as frequency, duration, average time of use before-bed, ingestion method, cannabinoid content, mode of obtainment, and more, while also providing in-depth cancer characteristics of the sample, such as status, stage, type, and treatments. The second study is the very first examination of the factors that are associated with cannabis for sleep, specifically, and the first to focus on cancer survivors. Existing research examining factors associated with cannabis consumption focuses largely on either medicinal cannabis use obtained with medical authorization or non-medical cannabis use in the general population.

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A final strength of the present study is the use of the ISI, a well-validated, reliable measure of insomnia symptom severity, in relation to the use of cannabis for sleep as the primary aim. Much existing self-report research examines reasons for cannabis use and utilizes single-item or study-specific questions regarding sleep (e.g., (Donovan et al., 2022; Haug et al., 2017; Lichtman et al., 2018; Moltke & Hindocha, 2021; Zhou et al., 2021; Zylla et al., 2021)). Thus, it is difficult to compare sleep outcomes between studies or determine the validity or reliability of the results. The present study uses a measure that has already been well-validated in a cancer population and makes cross-comparison of ISI scores between existing or future research possible.

Challenges and Limitations

The first limitation that must be considered is selection bias, which would occur if individuals who chose to participate in the survey differ systematically from those who chose not to participate. Since our survey was advertised to be examining cannabis use among Canadian cancer survivors, it is possible that cancer survivors who do not use cannabis chose not to participate in the survey and thus, the proportion of cannabis use among Canadian cancer survivors was overestimated in our sample. We found that 23.5% currently use cannabis for sleep, 37.6% reported any lifetime cannabis use for sleep, and 64.3% reported any lifetime cannabis use for any reason, leaving only 35.7% of the sample who had never tried using cannabis. This sample was older, with a mean age of 65.1 ($SD = 11.3$), so it is possible that this proportion of cannabis use is accurate as many may have consumed cannabis at any point in their life for any reason, but it is also possible that this is an overrepresentation of cannabis consumers.

Although our sample was very representative in many ways, it was not racially diverse. Of our 1464 participants, 1356 identified themselves as being White (92.6%). This meant we could not examine if race is associated with cannabis use for sleep. Further, we are missing out on potential nuance in our findings by lacking racial and ethnic diversity. Perhaps this is because Angus Reid's panel of cancer survivors is mostly White, or perhaps people of colour are more hesitant to use cannabis and/or complete a survey about cannabis use because of the disproportionate criminalization of cannabis use compared to that of White individuals (Wiese et al., 2023). These potential factors need to be considered and addressed for future research to be more representative of the diverse, multicultural population of Canada.

Next, this research was cross-sectional; all assessments were completed at only one point in time. Thus, we cannot establish causality or directionality between variables. Further, cross-sectional survey data is limited to the information that can be collected in a single survey and may not provide a comprehensive understanding of all the factors contributing to cannabis use for sleep. There may be other key variables that may influence cannabis use for sleep. Although this study is an important step in understanding cannabis use for sleep in Canadian cancer survivors, further study is needed to clarify the relationships between insomnia symptoms, cannabis use, and personal/disease characteristics over time.

We did not ask participants what other sleep aids they were using at the time of the survey. While we did ask what other sleep aids they had ever used for sleep, we do not know if they were using them concurrently with cannabis. While this is not a large concern since our objective was not to examine the effectiveness of cannabis, ISI scores likely would have been impacted if participants were taking other sleep medications.

A final limitation of the present investigation is that all measures were self-report, which are vulnerable to recall bias, social desirability bias, or response bias. The present research may suffer from recall bias if individuals had difficulty remembering behaviours accurately, such as how often they use a specific ingestion method over another or when they began using cannabis for sleep. Other questions may be especially difficult to remember if participants did not have their cannabis on hand while taking the survey, such as the formulation of the cannabis they consume. Social desirability bias may be a problem as cannabis use is a socially stigmatized topic; it is possible that people were reluctant to disclose the extent of their cannabis use and under-reported it, providing answers that they believe are more socially desirable instead of being honest. To mitigate this, participants were informed that their data was anonymous and could not be tied back to them by the researchers in any way. Finally, response bias may have occurred if participants responded inaccurately to questions due to question order, extreme responding, or acquiescence. While we utilized two attention checks to help ensure anyone who was not paying attention was excluded and increase confidence in the quality of our data, participants were not being monitored by the researchers, so we can never be completely sure that everyone was paying attention and responding honestly. Despite potential limitations of self-report survey data, we chose this design as we wanted to hear from cancer survivors themselves about their personal qualities, lifestyle factors, disease characteristics, and cannabis use to generate patient-oriented hypotheses and methodologies for future experimental research.

Conclusion

This study provides important insights into the use of cannabis as a sleep aid among Canadian cancer survivors, including the prevalence, patterns of use, and personal, lifestyle, and disease factors associated with use. One in four Canadian cancer survivors reported currently

using cannabis to improve sleep. Reported benefits include relaxation, reduced time to fall asleep, fewer nocturnal awakenings, and improved sleep quality. Being older or having sleep apnea was associated with decreased likelihood of current cannabis use for sleep. Having multiple medical conditions or sleep disorders, two psychological conditions, having been diagnosed with insomnia, having bone, gastrointestinal, genitourinary, hematological, or an unlisted type of cancer, having received hormone therapy, partaking in heavy drinking and scoring in the mild range of insomnia severity were associated with increased likelihood of current cannabis use as a sleep aid. Poor sleep is very common among cancer survivors and can be debilitating, with the potential to negatively impact quality of life and precipitate or worsen physical or psychological health challenges. The increasing prevalence of cannabis as a means of addressing poor sleep underscores the importance of educating healthcare providers to offer guidance in clinical settings and conducting further research on its efficacy, safety, and ideal use for sleep.

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Appendix A

Sociodemographic and Medical History Questionnaire

Demographic Questions

1. How do you currently define your gender identity?
   a. Female
   b. Male
   c. Non-binary
   d. Not listed _____
   e. Prefer not to say
2. How old are you?
   a. Age _____
   b. Prefer not to say
3. Which of the following best describe your employment status? Select all that apply.
   a. Full-time
   b. Part-time
   c. Self-employed
   d. On disability
   e. Retired
   f. Unemployed
   g. Prefer not to say
   h. Not listed _____
4. What province/territory do you reside in?
   a. Alberta
   b. British Columbia
   c. Manitoba
   d. New Brunswick
   e. Newfoundland and Labrador
   f. Northwest Territories
   g. Nova Scotia
   h. Nunavut
   i. Ontario
   j. Prince Edward Island
   k. Quebec
   l. Saskatchewan
   m. Yukon
   n. I do not currently live in Canada
   o. I love in Canada, but prefer not to say which province or territory
5. How would you classify where you currently live?

     a. Rural

     b. Urban

     c. Prefer not to say

6. What is the highest level of education that you yourself completed?
   a. Some elementary or high school
   b. High school graduate
   c. Some college/trade school
   d. Graduated from college/trade school
   e. Some university
   f. University undergraduate degree, such as bachelor's degree
   g. University graduate degree, such as master's or PhD

7. Which of the following ranges best describes your total annual household income before taxes for 2021?
   a. Under $CAD 10,000
   b. $10,000 to less than $25,000
   c. $25,000 to less than $40,000
   d. $40,000 to less than $50,000
   e. $50,000 to less than $60,000
   f. $60,000 to less than $75,000
   g. $75,000 to less than $100,000
   h. $100,000 to less than $110,000
   i. $110,000 to less than $120,000
   j. $120,000 to less than $150,000
   k. $150,000 to less than $200,000
   l. $200,000 to less than $250,000
   m. $250,000 to less than $500,000
   n. Over $500,000
   o. Prefer not to say

8. What is your own ethnic or racial background? Are you: (Many people come from a mixed background. In that case, please just select all that may apply.)
   a. Indigenous Canadian
   b. White (Caucasian) from UK/France/elsewhere in Europe
   c. Black (e.g. African/Caribbean)
   d. South Asian (e.g. Indian/Pakistani)
   e. Chinese
   f. Filipino
   g. Other East Asian (e.g. Korean, Japanese, Southeast Asian)
   h. Middle Eastern/West Asian (e.g. Arab, Iranian, Afghani)
   i. Latin American (e.g. Mexico, Central/South America)
   j. Other (Specify):
   k. Prefer not to say

9. What is your current marital status?
   a. Single, never married
   b. Married
   c. Common law
   d. Separated

  e. Divorced
  f. Widowed

<u>Health and Lifestyle Questions</u>

1. In addition to cancer, what, if any, other medical conditions have you been diagnosed with? Select all that apply.
  a. Hypertension
  b. Diabetes
  c. High Cholesterol
  d. Arthritis
  e. Ischemic/Coronary Heart Disease
  f. Epilepsy
  g. Glaucoma
  h. Multiple Sclerosis
  i. Heart Failure
  j. Autoimmune Disorder
  k. Alzheimer's Disease/Dementia
  l. Chronic Pain
  m. Obesity
  n. Not listed_____ _____
  o. No other medical conditions
  p. Prefer not to say

2. What psychological conditions, if any, have you been diagnosed with? Select all that apply.
  a. Depression (e.g., Major Depressive Disorder, Seasonal Affective Disorder, Persistent Depressive Disorder, Dysthymia)
  b. Anxiety (e.g., Generalized Anxiety Disorder, Social Anxiety, Panic Disorder, Agoraphobia)
  c. Obsessive-Compulsive Disorder
  d. Bipolar Disorder
  e. Schizophrenia
  f. Attention Deficit Hyperactivity Disorder
  g. Eating Disorder (e.g., Anorexia Nervosa, Bulimia Nervosa, Binge-Eating Disorder)
  h. Post-Traumatic Stress Disorder
  i. Substance Use Disorder
  j. Not listed _____
  k. No psychological conditions
  l. Prefer not to say

3. How many cups of coffee (equivalent to a medium) do you drink a day?
  a. 0
  b. 1
  c. 2
  d. 3
  e. 4

       f. 5+

       g. Prefer not to say

4. How often do you drink alcohol?
   a. Never
   b. Monthly or less
   c. 2-4 times a month
   d. 2-3 times a week
   e. 4 or more times a week
   f. Prefer not to say

5. How many drinks containing alcohol do you have on a typical day when you consume alcohol?
   a. 1-2
   b. 3-4
   c. 5-6
   d. 7-8
   e. 9+
   f. Prefer not to say

6. On average, how many minutes a week do you engage in moderate-vigorous physical activity? (e.g., fast walking, swimming, aerobics, jogging, tennis)
   a. Minutes: _____
   b. Prefer not to say

7. Have you ever been diagnosed with any of the following sleep disorders? Select all that apply.
   a. Insomnia
   b. Sleep Apnea
   c. Narcolepsy
   d. Restless Legs Syndrome
   e. REM Sleep Behaviour Disorder
   f. Shift Work Disorder
   g. I have not been diagnosed with a sleep disorder
   h. Not listed _____
   i. Prefer not to say

Cancer-Related Questions

1. Have you ever been diagnosed with cancer?
   a. Yes
   b. No

2. Where is the primary site of your cancer?
   a. Site: _____
   b. Prefer not to say

3. What year was your first cancer diagnosis?
   a. Drop down years 1922-2022_____

4. What is your cancer stage?
   a. 0
   b. I

      c. II
      d. III
      e. IV
      f. N/A
      g. Unknown
      h. Prefer not to say

5. What is your current status?
      a. Still undergoing treatment but considered curable
      b. Living with active metastatic disease
      c. Completed treatment with no evidence of disease
      d. Prefer not to say
      e. Not listed _____

6. Have you ever had surgery for your cancer?
      a. Yes
      b. No
      c. Prefer not to say

7. Have you ever had chemotherapy for your cancer?
      a. Yes
      b. No
      c. Prefer not to say

8. Have you ever had radiotherapy for your cancer?
      a. Yes
      b. No
      c. Prefer not to say

9. Have you ever had hormonal therapy for your cancer?
      a. Yes
      b. No
      c. Prefer not to say

10. Have you had any other treatments for your cancer?
      a. Yes _____
      b. No
      c. Prefer not to say

Appendix B

Cannabis use Questionnaire

1. Within the last 30 days, have you used cannabis (containing cannabidiol - CBD or tetrahydrocannabinol - THC) in any form to help you sleep?
    a. Yes
    b. No
        i. If no: At any time in the past, have you <u>ever</u> used cannabis cannabis (containing cannabidiol - CBD or tetrahydrocannabinol - THC) in any form to help you sleep?
            1. Yes
                a. If yes, all the following questions will be worded in past tense
            2. No
                a. If no, participant answers question 13 about other reasons to use cannabis, then skips to ISI
2. How does cannabis help you sleep? Select all that apply.
    a. It helps me relax
    b. It helps prevent/minimize bad dreams
    c. It helps me sleep through the night
    d. It helps me fall asleep faster
    e. It improves my overall sleep quality
    f. Not listed _____
    g. It did not help with my sleep
3. How long have you been using cannabis to help you sleep?
    a. Less than 1 month
    b. 2-6 months
    c. 6 months - 1 year
    d. 1-2 years
    e. 2-5 years
    f. 5-10 years
    g. More than10 years
4. How old were you when you first tried using cannabis for sleep?
    a. _____
5. Did you start using cannabis for sleep before or after your cancer diagnosis?
    a. Before
    b. After
6. How frequently do you use cannabis for sleep?
    a. Less than once a month
    b. Once a month
    c. Two-three times a month
    d. Once a week
    e. Two-three times a week
    f. Four-six times a week
    g. Every day

7. When you use cannabis for sleep, how long before going to bed do you take it?
    a. _____ minutes
8. Do you experience any side effects when taking cannabis for sleep?
    a. Drowsiness/Lethargy
    b. Memory issues
    c. Dry mouth
    d. Nausea/Gastrointestinal irritation
    e. Constipation
    f. Sweating
    g. Paranoia
    h. Increased appetite
    i. Anxiety
    j. Not listed _____
    k. No side effects
9. Do you experience any next-day effects when taking cannabis for sleep?
    a. Hangover
    b. Feeling groggy
    c. Dry mouth
    d. Headaches
    e. Daytime sleepiness
    f. Not listed_____
    g. I do not experience any next-day effects
10. What else have you tried to help you sleep? (for each option, there is a slider for not helpful to very helpful)
    a. Benzodiazepines (e.g., clonazepam, lorazepam, temazepam)
    b. Non-benzodiazepine drugs (e.g., zopiclone, zolpidem, eszopiclone)
    c. Antipsychotic medications (e.g., seroquel)
    d. Antidepressants (e.g., trazodone)
    e. Over the counter medications (e.g., Sleep-eze, Unisom, Advil PM)
    f. Melatonin
    g. Cognitive-Behavioural Therapy for Insomnia (CBT-I)
    h. Sleep Hygiene practices (e.g., keeping room cold and dark, avoiding exercise 2 hours before bedtime, blocking blue light from screens)
    i. Meditation/relaxation practices
    j. Physical Activity
    k. Not listed _____
11. Which of the following medication and non-medication insomnia treatment options are you aware of?
    a. Benzodiazepines (e.g., clonazepam, lorazepam, temazepam)
    b. Non-benzodiazepine drugs (e.g., zopiclone, zolpidem, eszopiclone)
    c. Antipsychotic medications (e.g., seroquel)
    d. Antidepressants (e.g., trazodone)
    e. Over the counter medications (e.g., Sleep-eze, Unisom, Advil PM)
    f. Melatonin
    g. Cognitive-Behavioural Therapy for Insomnia (CBT-I)

     h. Sleep Hygiene practices (e.g., keeping room cold and dark, avoiding exercise 2 hours before bedtime, blocking blue light from screens)
     i. Meditation/relaxation practices
     j. Physical Activity

12. How long in months have you struggled with sleep difficulties? (1 year = 12 months)
     a. Months _____

13. Besides sleep, what other symptoms do you use cannabis for? (Select all that apply)
     a. Appetite
     b. Anxiety
     c. Nausea
     d. Pain
     e. Depression
     f. Not listed _____ _____
     g. No other symptoms

14. How does cannabis affect each of the above symptoms? (For each option, there are sliders from 0 = it does not help at all, 100 = it is extremely helpful; NA if they do not experience these symptoms)
     a. Appetite
     b. Anxiety
     c. Nausea
     d. Pain
     e. Depression
     f. Other (Please list) _____

15. How do you obtain your cannabis?
     a. From a Licensed Producer with authorization from my healthcare provider
     b. From a legal, government-regulated store or website
     c. From an unauthorized dealer or source (e.g., store, website, dealer)
     d. I grow my own or have someone grow it for me

16. Are your medical providers aware of your cannabis use for sleep?
     a. Yes
     b. No

17. What made you first consider using cannabis for sleep? (Select all that apply)
     a. Recommendation from a friend/family member
     b. Recommendation from a doctor
     c. My other medications had bad side effects
     d. My own research; to try something different
     e. I believe cannabis is more natural than medications
     f. Not listed _____

18. Of the times you use cannabis for sleep, how often do you:

	Never	Less than half of the time	Half of the time	More than half of the time	Every time
Smoke it?	○	○	○	○	○
Vaporize it?	○	○	○	○	○
Use an oil or spray? (Sublingually or adding it to food or drinks)	○	○	○	○	○
Use capsules?	○	○	○	○	○
Use edibles?	○	○	○	○	○
Use topical application such as a salve or balm?	○	○	○	○	○
Concentrated THC (e.g., hash, wax, shatter, dabs)	○	○	○	○	○
Concentrated CBD (e.g., hash, wax, shatter, dabs)	○	○	○	○	○

19. What is the cannabinoid content of the cannabis you typically use?
   a. Contains mostly CBD
   b. Contains mostly THC
   c. Contains balanced amounts of CBD and THC
   d. I don't know the formulation
20. When smoking dried flower for sleep, which of the following best describes the percentage (%) of THC? (Display only if smoke is not never)
   a. 0-9.9% THC
   b. 10-14.9% THC
   c. 15-19.9% THC
   d. 20-24.9% THC
   e. 25% or more THC
   f. Unknown

21. When smoking dried flower for sleep, which of the following best describes the percentage (%) of CBD? (Display only if smoke is not never)
    a. 0-9.9% CBD
    b. 10-14.9% CBD
    c. 15-19.9% CBD
    d. 20-24.9% CBD
    e. 25% or more CBD
    f. Unknown
22. When smoking dried flower for sleep, how many puffs do you typically consume? (Display only if smoke is not never)
    a. _____
23. When inhaling cannabis through a vaporizer for sleep, which of the following best describes the percentage (%) of THC? (Display only if vaporize is not never)
    a. 0-19% THC (0-190mg/g)
    b. 20-39% THC (200-390mg/g)
    c. 40-59% THC (400-590mg/g)
    d. 60-79% THC (600-790mg/g)
    e. 80-99% THC (800-990mg/g)
    f. Unknown
24. When inhaling cannabis through a vaporizer for sleep, which of the following best describes the percentage (%) of CBD? (Display only if vaporize is not never)
    a. 0-19% CBD (0-190mg/g)
    b. 20-39% CBD (200-390mg/g)
    c. 40-59% CBD (400-590mg/g)
    d. 60-79% CBD (600-790mg/g)
    e. 80-99% CBD (800-990mg/g)
    f. Unknown
25. When inhaling cannabis through a vaporizer for sleep, how many puffs do you typically consume? (Display only if vaporize is not never)
    a) _____
26. When consuming oils or sprays for sleep, which of the following best describe the amount of THC you consume? (Display only if oils/sprays is not never)
    a. 0-5mg/mL THC or less
    b. 6-10mg/mL THC
    c. 11-15 mg/mL THC
    d. 16-20 mg/mL THC
    e. More than 20 mg/mL THC
    f. Unknown
27. When consuming oils or sprays for sleep, which of the following best describe the amount of CBD you consume? (Display only if oils/sprays is not never)
    a. 0-5mg/mL CBD or less
    b. 6-10mg/mL CBD
    c. 11-15 mg/mL CBD
    d. 16-20 mg/mL CBD
    e. More than 20 mg/mL CBD
    f. Unknown

28. When using capsules or edibles for sleep, which of the following best describes the amount of THC you consume? (Display only if capsules or edibles is not never)
    a. 2.5mg THC or less
    b. 2.6-5mg THC
    c. 5.1-10mg THC
    d. More than 10mg THC
    e. Unknown
29. When using capsules or edibles for sleep, which of the following best describes the amount of CBD you consume? (Display only if capsules or edibles is not never)
    a. 2.5mg CBD or less
    b. 2.6-5mg CBD
    c. 5.1-10mg CBD
    d. More than 10mg CBD
    e. Unknown
30. How much does cannabis cost you each month? (If cannabis is covered by your insurance, please select only the remaining amount it costs you)
    a. Less than $50 a month
    b. $50-$100
    c. $101-150
    d. $151-250
    e. $251-$350
    f. More than $350 a month
31. Have you ever tried to stop using cannabis, but had trouble stopping?
    a. Yes
    b. No
    c. Prefer not to say
32. Has anyone ever told you that your cannabis use may be a problem?
    a. Yes
    b. No
    c. Prefer not to say

Other Cannabis Use
1. Do you currently, or have you ever, used cannabis for any reason besides sleep? Select all that apply. (Display only if answered no to both using cannabis for sleep currently or in the past for sleep)
    a. I have never tried using cannabis
    b. Appetite
    c. Anxiety
    d. Nausea
    e. Pain
    f. Depression
    g. Recreational use
    h. Not listed _____
    i. Prefer not to say

Appendix C

The Insomnia Severity Index

Q61 Please rate the current (i.e., last 2 weeks) severity of your insomnia problem(s).

	None	Mild	Moderate	Severe	Very
a. Difficulty falling asleep:	○	○	○	○	○
b. Difficulty staying asleep:	○	○	○	○	○
c. Problem waking up too early:	○	○	○	○	○

Q62 How satisfied/dissatisfied are you with your current sleep pattern?

○ Very satisfied

○ Satisfied

○ Neutral

○ Dissatisfied

○ Very dissatisfied

Q63 To what extent do you consider your sleep problem to interfere with your daily functioning? (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)

○ Not at all interfering

○ A little

○ Somewhat

○ Much

○ Very much interfering

Q64 How noticeable to others do you think your sleeping problem is in terms of impairing the quality of your life?

○ Not at all noticeable

○ A little

○ Somewhat

○ Much

○ Very much noticeable

Q65 How worried/distressed are you about your current sleep problem?

○ Not at all worried

○ A little

○ Somewhat

○ Much

○ Very much worried

Attention Check Questions

1. It is important that you pay attention to this study. Please select "Strongly disagree" for this question
   a. Strongly agree
   b. Somewhat agree
   c. Neither agree nor disagree
   d. Somewhat disagree
   e. Strongly disagree
2. The colour test is simple. When asked your favourite colour, you must enter the word 'puce' in the textbox below. Based on the text you read above, what colour have you been asked to enter?
   a. _____

Appendix E

Ethics Approval Letter

MEMORIAL
UNIVERSITY

**Interdisciplinary Committee on
Ethics in Human Research (ICEHR)**

St. John's, NL Canada A1C 5S7
Tel: 709 864-2561 icehr@mun.ca
www.mun.ca/research/ethics/humans/icehr

ICEHR Number:	**20222467-SC**
Approval Period:	March 16, 2022 – March 31, 2023
Funding Source:	
Responsible Faculty:	Dr. Sheila Garland Department of Psychology
Title of Project:	*Exploring the Use of Cannabis as a Sleep Aid in Canadian Cancer Survivors*

March 16, 2022

Ms. Rachel Lee
Department of Psychology, Faculty of Science
Memorial University

Dear Ms. Lee:

Thank you for your correspondence addressing the issues raised by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) for the above-named research project. ICEHR has re-examined the proposal with the clarifications and revisions submitted, and is satisfied that the concerns raised by the Committee have been adequately addressed. In accordance with the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (TCPS2)*, the project has been granted *full ethics clearance* for **one year**. ICEHR approval applies to the ethical acceptability of the research, as per Article 6.3 of the *TCPS2*. Researchers are responsible for adherence to any other relevant University policies and/or funded or non-funded agreements that may be associated with the project. If funding is obtained subsequent to ethics approval, you must submit a Funding and/or Partner Change Request to ICEHR so that this ethics clearance can be linked to your award.

The *TCPS2* **requires** that you **strictly adhere to the protocol and documents as last reviewed** by ICEHR. If you need to make additions and/or modifications, you must submit an Amendment Request with a description of these changes, for the Committee's review of potential ethical concerns, before they may be implemented. Submit a Personnel Change Form to add or remove project team members and/or research staff. Also, to inform ICEHR of any unanticipated occurrences, an Adverse Event Report must be submitted with an indication of how the unexpected event may affect the continuation of the project.

The *TCPS2* **requires** that you submit an Annual Update to ICEHR before **March 31, 2023**. If you plan to continue the project, you need to request renewal of your ethics clearance and include a brief summary on the progress of your research. When the project no longer involves contact with human participants, is completed and/or terminated, you are required to provide an annual update with a brief final summary and your file will be closed. All post-approval ICEHR event forms noted above must be submitted by selecting the *Applications: Post-Review* link on your Researcher Portal homepage. We wish you success with your research.

Yours sincerely,

James R. Drover

James Drover, Ph.D.
Vice-Chair, ICEHR

JD/bc

cc: Supervisor – Dr. Sheila Garland, Department of Psychology