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Review Article

A COMPREHENSIVE ANALYSIS OF CANNABIS'S THERAPEUTIC POTENTIAL IN RELATION TO THE HUMAN BODY

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ABSTRACT

Cannabis has emerged as a subject of intense scientific interest due to its multifaceted therapeutic potential across a broad spectrum of human physiological and pathological conditions. This comprehensive analysis explores the pharmacological properties, therapeutic applications, and mechanistic insights of cannabis and its bioactive constituents, primarily cannabinoids such as delta-9-tetrahydrocannabinol and cannabidiol, to the human endocannabinoid system. The manuscript delves into the roles of cannabis in pain modulation, neuroprotection, inflammation, psychiatric disorders, oncology, and gastrointestinal and metabolic disorders, supported by both pre-clinical and clinical findings. Emphasis is placed on the interaction between cannabinoids and cannabinoid receptors (CB1 and CB2), as well as non-cannabinoid targets, illustrating the systemic effects of cannabis on homeostasis and disease modulation. While the therapeutic promise of cannabis is compelling, the analysis also highlights the challenges posed by dosage standardization, psychoactive side effects, legal restrictions, and limited long-term safety data. This review underscores the necessity for rigorous, evidence-based research and regulatory frameworks to unlock the full medicinal potential of cannabis while ensuring patient safety and therapeutic efficacy.

Keywords: Cannabidiol, Cannabis, Endocannabinoid system, Marijuana, Tetrahydrocannabinol.

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INTRODUCTION

Cannabis is a plant that belongs to the *Cannabaceae* family. Scientifically known as "*Cannabis sativa*," it is known for its various chemical properties. It has also been used for energy, fiber, food, and as a source of medicine or drugs [1]. Native to central Asia, *C. sativa* has a rich history of recreational, medicinal, and industrial applications. Over the years, research has identified many ingredients, and the total increased from 489 in 2005 to 537 in 2009 [2]. Medical uses of marijuana have increased from 70 to 109. Medical in marijuana date back thousands of years, making it one of the oldest medicinal uses of psychotropic plants known to man [3]. With its extensive history, various chemical compounds including tetrahydrocannabinol (THC) and cannabidiol (CBD), marijuana has been used for medicinal, recreational, and ritual purposes. Its systematic place in the plant kingdom is "Kingdom: *Plantae*, Subkingdom: *Tracheobionta*, Superdivision." Division: *Magnoliophyta*, Class: *Magnoliopsida*, Division: *Spermatophyta*. Order: Class; Family: *Cannabaceae*; Family: Cannabis; Subclass: *Hamamelididae*, Species classified as – *C. sativa* l." *C. sativa* continues to be cultivated worldwide for its diverse uses, contributing to various aspects of human life [4].

Cannabis has sparked widespread interest due to the multitude of (Fig. 1) chemical elements it carries, with ongoing studies revealing new compounds. Among these ingredients, THC and CBD were the number one attention of sizable observers [5]. The therapeutic capability of those compounds has garnered attention, with hashish being used to deal with numerous medical situations. In addition, its historical use in ritual and leisure contexts highlights the plant's cultural and societal importance over centuries [6] (Fig. 2). As the exploration of cannabis maintains, its complex chemical makeup and versatile packages position it as a subject of tolerating fascination and research. Research on hashish has discovered its complicated chemical makeup, which includes over 60 unique chemical materials known as cannabinoids [7]. Among those cannabinoids are famous compounds which include CBD, cannabinol (CBN), and the fundamental psychoactive constituent delta-9-tetrahydrocannabinol (Δ^9-THC) [8]. These chemical constituents play a vital function within the plant's behavioral and psychotropic homes, with THC, mostly produced in the leaves and flower buds, being attributed to the plant's psychoactive consequences. In addition to THC, non-psychoactive cannabinoids such as CBD, cannabichromene (CBC), and cannabigerol have also been diagnosed and located to possessing several medicinal capabilities [9].

The wide range of compounds in cannabis extends beyond cannabinoids, including terpenoids, flavonoids, carbohydrates, and hydrocarbons with over 200 compounds isolated from cannabinoids and terpenoids alone, it is clear that cannabis has a complex chemical composition is helpful for medical applications *C. sativa*'s rich history of human use, spanning thousands of years, underscores its enduring importance and cultural relevance [10]. From industrial to medicinal curiosity applications, the chemical composition of the plant continues to inspire extensive pharmacological and biological research, revealing new insights into potential benefits with continued discovery and growing knowledge of its components. Cannabis is a subject of great interest and investigation [11] .

CHEMICAL CONSTITUENTS – CANNABIS

Cannabinoids

Cannabinoids are the primary active compounds in *C. sativa* and interact with the endocannabinoid system (ECS). Over 100 cannabinoids have been identified. The most well-known include Δ^9-THC, CBD, CBC, and CBN [12] .

Terpenes

Terpenes are aromatic compounds that contribute to the plant's (Fig. 3). smell and may enhance cannabinoid effects (the "entourage effect"). Examples include myrcene, pinene, caryophyllene, limonene, etc.

Flavonoids
Flavonoids are polyphenolic compounds contributing to the plant's pigmentation and potential therapeutic properties. Examples include Cannflavins A, B, and C, Quercetin, and apigenin.

Other compounds
C. sativa contains various minor constituents, including alkaloids, fatty acids, phenolic compounds, vitamins, and minerals.

WHAT IF CANNABIS IS INTOXICATED?

When consumed orally
Prolonged use of cannabis may be harmful. Serious adverse effects have been associated with edible cannabis that contains 50 mg or higher of THC. Frequent heavy cannabis consumption may result in cannabinoid hyperemesis syndrome (CHS). Severe nausea and vomiting caused by CHS are not relieved by standard anti-nausea medications. In addition, cannabis use for a minimum of one to 2 weeks might lead to dependence [11].

If sprayed in the mouth
One particular cannabis extract (Sativex) may be safe when sprayed into the mouth. In the UK and Canada, this product is only available with a prescription. In the US, it is not authorized.

When inhaled
Prolonged use of cannabis may be harmful. Breathing issues and an increased risk of heart attack and stroke are associated with smoking or vaping cannabis. THC-containing vaping devices have been connected to severe lung damage on prolonged usage.

Pregnancy
It is not safe to use cannabis when pregnant. Through the placenta, cannabis can decrease the fetus's growth and raise the chance of malformations, childhood leukemia, premature birth, stillbirth, and the need for critical care after delivery. In addition, it may cause the child to grow up with emotional issues and reduced IQ. Likewise, it raises the risk of hypertension and anemia during pregnancy.

Breast-feeding
Cannabis use while lactating is probably dangerous. Even after cannabis usage has been discontinued, the compounds in cannabis enter breastmilk and remain there for more than 6 weeks. These substances may cause the baby's development to stall. Hence, it is not advised.

Heart disease
Cannabis consumption may result in elevated blood pressure and rapid heart rate (tachycardia).In addition, it may make heart attacks and strokes more prevalent.

Allergies to fruits and vegetables
People who have food allergies such as citrus fruit, tomatoes, and bananas may be more susceptible to an allergic reaction if they use cannabis.

Diabetes
Using cannabis may make blood sugar regulation more difficult. It may also raise the chance of developing long-term diabetes problems. Use cannabis with caution until further information is available.

Epilepsy
People with epilepsy may experience seizures after taking large quantities of cannabis. High dosages of cannabis have been linked to seizures in a number of cases.

Weakened immune system
Cannabis is also associated with an increased risk of fungal infections in those with compromised immune systems since cannabis can be contaminated with fungus.

Liver disease
Whether cannabis exacerbates chronic liver disease is unknown. Use cannabis with caution until more data are provided.

Lung diseases
Cannabis can exacerbate lung conditions. Lung cancer risk may rise with regular use. Emphysema is a type of lung disease that some people have (Fig. 4).

Arrythmia
People who are at high risk for these diseases may be more susceptible to harmful irregular heartbeats (arrhythmias) if they use cannabis.

Schizophrenia
Using cannabis might produce symptoms of schizophrenia and could exacerbate them if overused.

Smoking habit
Using cannabis might make it harder to quit smoking and can lead to a chain smoker.

Surgery
Cannabis has an impact on the brain. When taken with anesthesia and other drugs both during and post-surgery, it may cause the central nervous system (CNS) to slow down excessively. Give off cannabis use at least 2 weeks before the planned approach.

MEDICINAL USE OF THE MAGICAL HERB - CANNABIS

The plant *C. sativa* has been abandoned because its usefulness has been underestimated. Its ostracism to the harm of its human values has resulted from the alleged negative component of this commercial crop being discussed. The first recorded usage of cannabis for health and medical purposes dates back to the 28th century B.C [102] Cannabis was utilized in China during this time because of its calming qualities, ability to treat pain and illness, ability to counteract the power of evil spirits, and general psychedelic effects, according to Shen Nung, a mythical Chinese emperor and chemist [12].

Generally speaking, cannabis use expanded from China to neighboring Asian nations. Of particular significance was its acceptance in India, where it was used for religious purposes. It is listed as one of the five sacred plants in the Atharva Veda, one of the more ancient Hindu texts [13]. As a result, the plant received the respect and protection that come with being accepted by society or religion.

In addition, an Israeli scientist discovered physical proof of marijuana use as medicine when they discovered marijuana residue in the body of a young lady who appeared to have died during childbirth. 1600 years in the past [14].

According to the discoverers, marijuana was utilized to hasten the birthing process and reduce the discomfort that came with it. Egyptian papyri and Assyrian tablets had previously shown indications that cannabis had been used during childbirth [15].

It was not until the 1800s that cannabis was used more methodically as a medicinal substance. For instance, cannabis was utilized to treat mental diseases by Parisian physician Jacques Moreau in the middle of the 1800s [16]. Dr. William O'Shaughnessy, an Irish physician, gave much more legitimacy to the medical usage of marijuana in 1838 when he reported its use for a variety of ailments, such as cholera, rheumatism, pain, rabies, and convulsions cannabis was also frequently utilized in the US for a variety of ailments. Long into the 20th century, it was acknowledged as a medicinal substance [17]. For instance, cannabis was prescribed in the United States dispensaries for the following conditions: cholera, rabies, convulsions, hysteria, mental depression, delirium tremens, gout, neuralgia, rheumatism, and insanity. Today, marijuana's therapeutic applications are far more limited. Current therapy efforts have mostly relied on synthetic drugs that chemically resemble cannabinoids, such as levontradol, nabilone, and marinal. THC active ingredients are supplied by these synthetics in a more stable form, and they can also offer improved solubility [18].

However, the synthesis was made possible by THC from cannabis.

In addition, smoking marijuana produces a faster effect than taking synthetic THC orally. As a result, natural marijuana acts more quickly and effectively than synthetic THC [19]. Recently, there has been a renewed push to legalize marijuana for medical use. A large portion of this effort has been sparked by the rise in marijuana usage among AIDS patients, who say that it helps them regain weight lost during their sickness by stimulating their appetite and reducing nausea and vomiting brought on by the disease [19].

These groups buy marijuana in quantity and give it to patients suffering from cancer, AIDS, and other illnesses – sometimes for free [20].

SPECIFIC HEALTH PROBLEMS FOR WHICH CANNABIS IS PRESCRIBED IN SYNTHETIC FORMS ARE

Glaucoma

The general term for ocular conditions involving elevations in intraocular pressure is glaucoma. One of the main causes of blindness in the US is this pressure, which harms the optic nerves (Maiston *et al*., 1999). Although there are medication and surgical options, their efficacy varies. Cannabis is preventative since it has been demonstrated to lower intraocular pressure, yet patients have had adverse effects whether the drug was smoked, injected, or taken orally [21].

Nausea and Vomiting

Chemotherapy-induced nausea and vomiting were evaluated in 26 research (37 reports; 1772 individuals). Fourteen studies evaluated nabilone, while three evaluated dronabinol, one evaluated nabiximols, four evaluated levonantradol, and six evaluated THC. A group receiving dronabinol in conjunction with prochlorperazine or ondansetron was also included in two investigations [22]. There were eight studies with a placebo control, three with an active comparator as well, and 20 with just an active comparator. Prochlorperazine (15 trials), chlorpromazine (2 studies), and domperidone (2 studies) were the most often used active comparators. In separate investigations, the comparators alizapride, hydroxyzine, metoclopramide, and ondansetron were assessed. Although they did not approach statistical significance in every study, all of them indicated that cannabis was more beneficial than both active comparators and a placebo. Cannabinoids (dronabinol or nabiximols) were associated with a higher average number of patients exhibiting full nausea and vomiting response than placebo (odds ratio, 3.82 [95% confidence interval, 1.55–9.42]; 3 studies). This analysis showed no signs of heterogeneity (I^2 = 0%), and the outcomes for dronabinol and nabiximols were comparable [23].

Cachexia

Cachexia is characterized by "wastes away" physiologically, frequently as a result of cancer or HIV infection. It may be suggested that marijuana be used with patients who are experiencing cachexia to boost appetite and consequently weight gain, based in part on anecdotal claims that marijuana usage is linked to increased eating frequency and quantity [24]. In addition, vigor and a sense of well-being may be produced by appetite and weight. There is some empirical evidence to substantiate these anecdotal tales. Plasse *et al*. (1991) discovered a connection between hunger and marijuana use. Because of this, some people who suffer from diseases such as cachexia have started using marijuana to stop their weight loss and gain weight [25].

Other medical uses

Research has demonstrated the widespread usage of cannabis and THC synthetics in the treatment of depression, anxiety, hypertension, muscle spasticity, convulsant activity, sleeplessness, and pain. Nevertheless, there has been conflicting evidence to support these uses (Workshop on the Medical Utility of Marijuana, 1997). To determine the effectiveness of cannabis in the medical treatment of these and other conditions, more research is required [26].

Agricultural and commercial uses of *C. sativa*

For many years, the fiber of the cannabis plant was the main reason it was gathered. Rope, clothing, and ship sails were all made from these robust hemp fibers (Maiston *et al*., 1999). In addition, jars constructed of fibers thought to be from the cannabis plant were found by archaeologists at a site in Taiwan [27]. The Jamestown settlers in Virginia around 1611 cultivated the cannabis plant for its fiber in the North American Colonies. George Washington, among many others, planted hemp shortly after it became established as a fundamental stable crop. Beginning in New England in 1629, cannabis was grown there and continued to be a staple crop in the United States until the end of the Civil War [28].

Recreational uses

However, cannabis was only used recreationally to a limited extent, and reports of its psychotropic effects were uncommon. However, cannabis consumption expanded throughout the 1920s. The prohibition of alcohol was blamed for the rise in marijuana use the significant commercial trade in marijuana for recreational use did not begin until the Volstead Act of 1920 and the 18th Amendment increased the cost of alcoholic beverages, made them harder to obtain, and made them of lower quality. Since then, its popularity has remained high [29].

PHARMACOLOGICAL ACTIONS OF CANNABIS

CNS

Cannabis has a wide range of effects on the central nervous system, with the main psychoactive ingredient, Δ^9-THC, responsible for most of these effects. Some of the psychoactive effects of cannabis in the CNS and feelings of joy, relaxation, and a sense of well-being. However, rare cases of ischemic stroke and other CNS injuries have been reported with marijuana use, highlighting the potential risks associated with its use in addition to the mental effects, cannabis publicity has been related to diverse bodily signs and symptoms which includes CNS excitation, CNS depression, cardiac problems, nausea and vomiting, stomach ache, or even psychosis [30]. One particular case worried an affected person experiencing excessive persistent sharp pain in the penis following cannabis exposure, Furthermore, the classification of marijuana disorders into categories such as abuse, dependence, poisoning, and other unspecified disorders highlights the complexity of its effects on the CNS and overall health It need to consider other undesirable effects that may interfere with its medical use. Given these potential risks and complications of cannabis use, especially in terms of effects on the central nervous system is necessary for individuals to be well informed before using marijuana for recreational or medical purposes An understanding of the difference between Δ^9-THC (psychoactive actions) and CBD (non-psychoactive) is necessary to they have made informed decisions about marijuana use [103]. Furthermore, the occurrence of unexpected adverse effects, including the rare occurrence of acute ischemic stroke, after marijuana use highlights the need for caution and careful consideration of potential risks. Medically, marijuana and cannabis used to treat diseases or relieve symptoms are referred to as medical marijuana [31]. However, it is important to consider potential psychotropic effects and other unwanted effects on the CNS, which may limit its therapeutic use. Furthermore, it is important to emphasize the potential effects of marijuana on cognitive function and memory, which can manifest as deficits in memory, judgment, attention, planning, and emotion. As our knowledge of cannabis and its effects on the central nervous system continues to evolve, it is important to prioritize education, awareness, and evidence-based guidelines to ensure cannabis consumption role in a safe and knowledgeable community [32].

Reproductive System

Cannabis is a commonly used drug that has been found to have various effects on the human body, including the reproductive system. Cannabis use has been linked to several adverse effects on the male reproductive system. Research suggests that chronic cannabis use can significantly reduce sperm quality and lead to fertility problems. Moreover, the presence of receptors for THC in the testes, the main psychoactive ingredient in cannabis, indicates the potential for interference with the body's natural protective mechanisms against reproductive and urologic diseases [33]. This interference may increase the risk of developing

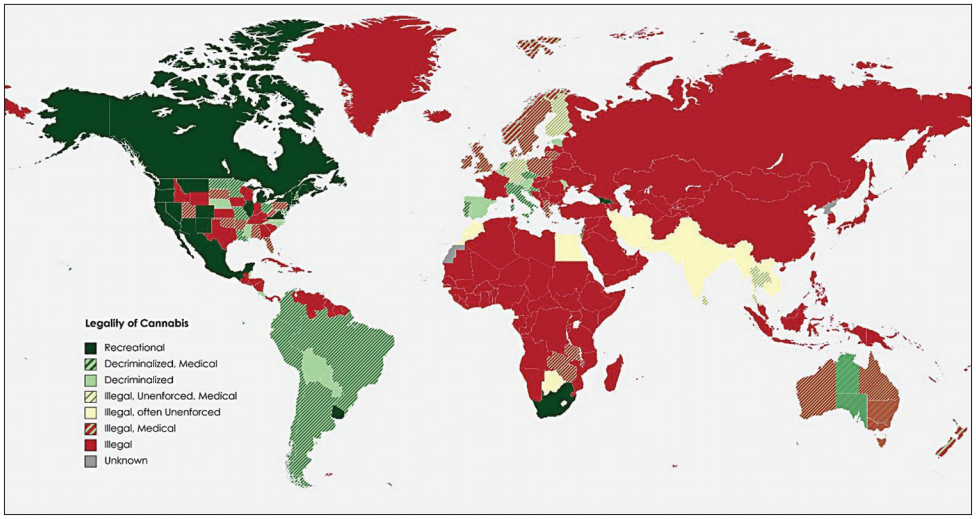

Fig. 1: Global legality of cannabis. This map depicts the legal status of cannabis use across various countries and U.S. states. The classifications are based on a combination of legal policy, enforcement patterns, and medical allowances

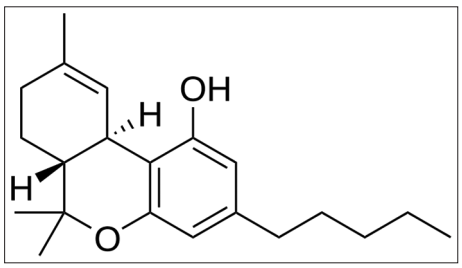

Fig. 2: Structure of delta-9-Tetrahydrocannabinol

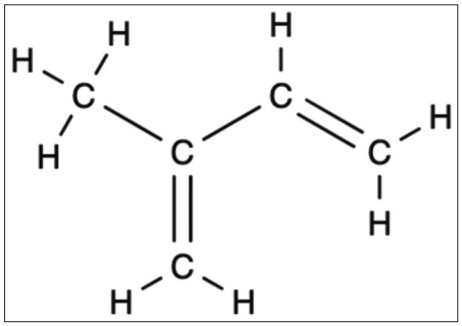

Fig. 3: Structure of terpenes

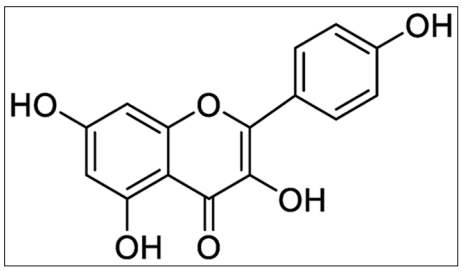

Fig. 4: Structure of flavonoids

Table 1: Cannabis's medicinal use, as well as the range of illnesses and mechanisms of action it treats

Therapeutic uses	Medical conditions treated	Mechanism of action
Pain management	Chronic pain, arthritis, neuropathic pain	Modulates pain perception via CB1 and CB2 receptors in the endocannabinoid system
Neurological disorders	Epilepsy, multiple sclerosis, Parkinson's disease	Reduces neuronal excitability and inflammation
Mental health	Anxiety, post-traumatic stress disorder, depression	Regulates serotonin and dopamine levels, reducing stress and mood disorders
Anti-inflammatory	Crohn's disease, ulcerative colitis, rheumatoid arthritis	Reduces cytokine production, modulating immune response
Anti-nausea and stimulation	Chemotherapy-induced nausea, cachexia in HIV/AIDS patients	Activates CB1 receptors, reducing nausea and increasing appetite
Glaucoma	Intraocular pressure reduction	Decreases intraocular pressure via vasodilation
Sleep disorders	Insomnia, sleep apnea	Promotes relaxation by modulating neurotransmitter release
Anti-cancer potential	Various cancers (investigational)	May induce apoptosis and inhibit tumor growth in some studies

urologic dysfunctions, similar to cancer, within the male reproductive system. Furthermore, there is evidence to suggest that cannabis can affect the swimming behavior of sperm, although the exact impact on fertility is still unclear [34]. The ongoing research on the effects of cannabis on the male reproductive system highlights the need for a more comprehensive understanding of the potential risks associated with its use. Research also indicates that chronic cannabis use may have epigenetic effects on sperm cells, although the specific impact of these alterations on fetal programming is not yet fully understood [35]. In addition to the direct effects on the male reproductive system, there are concerns about passive exposure to cannabis, especially during infancy and later stages of development. Fathers and other household members who smoke cannabis increase the likelihood of infants being passively exposed to the drug. Some studies have reported impairment in male fertility, semen quality, and hormone levels, while others have found no significant changes in these parameters among cannabis users. In

Table 2: Pharmacokinetics of cannabis based on route of administration [25]

Route of administration	Inhalation	Oral
% of Dose consumed	50% (lost due to pyrolysis)	100%
Circulation trajectory	Lungs-bronchi-bronchiole- alveoli	Stomach-small intestine-portal vein-liver
Liver metabolism (1st pass)	Bypassed	Metabolized by CYP450 enzyme
Bioavailability	4–58%	< 20%
Onset of action	Immediate	60–90 min
Duration	2–4 h	6–8 h

summary, the use of cannabis has been shown to have various effects on the male reproductive system, including potential interference with protective mechanisms, epigenetic alterations in sperm cells, and the risk of passive exposure in offspring. Further research is essential to gain a deeper understanding of these effects and their implications for male fertility and reproductive health [36]. It is important to note that while there is a significant amount of research regarding the impact of cannabis on the male reproductive system, studies also suggest potential effects on the female reproductive system. Molecular studies have indicated a widespread presence of cannabinoid receptors in both male and female reproductive systems. Older studies raised concerns about the adverse effects of cannabis use on reproductive outcomes for both men and women. However, more recent investigations are challenging this paradigm by suggesting similar reproductive outcomes for cannabis users of both genders [37].

The relationship between cannabis usage and male sexual function is still debatable, despite a growing body of studies on the topic. The effects of cannabis on sexual and reproductive health are especially important because most users are men of reproductive age. Due in large part to altered semen characteristics, some research has concentrated on the possible detrimental effects of cannabis usage on fertility [38]. The active component of cannabis is Δ^9-THC, which binds to cannabinoid receptors present in various locations, including the reproductive organs. Over the course of 8 weeks, a decrease in the number of viable sperm and a rise in the percentage of faulty spermatozoa were linked to a complete decrease in the cauda epididymal sperm viability proportion. A few alterations in the proliferation of germ cells into the prostate, as well as vacuolization and pyknotic nuclei in a few cauda epididymal cells, were observed over 8–21weeks [98].

Sperm count, motility, and viability were all reduced by 14% as a result of restrictive alterations in testicular weight [all doses]. The circulating testosterone stage significantly decreases as a result of a decrease in testicular enzyme activity. Gonadotropin-releasing hormone inhibitory activity resulted in a significant improvement in the levels of fatty acid amide hydrolase protein and CB1 and CB2 receptors in the testes of mice. Conflicting literature exists regarding the effect of cannabis on the reproductive system. While some studies have suggested that cannabis impairs male fertility, semen quality, and hormone levels, others have reported no significant changes in these parameters among cannabis users. In conclusion, while there is substantial evidence regarding the impact of cannabis on the male reproductive system, further research is needed to fully understand its effects on the female reproductive system and to resolve the conflicting findings related to male fertility and sexual function [39]. This ongoing investigation is crucial for comprehensively understanding the potential risks and implications of cannabis use on reproductive and sexual health for both men and women. As research on the effects of cannabis on reproductive and sexual health continues to evolve, it is crucial to consider the potential impact on male sexual function. The association between cannabis use and male reproductive health remains a topic of significant interest and debate. Numerous studies have explored the potential negative impact of cannabis use on fertility, largely focusing on impaired semen parameters. One of the main active components of cannabis is Δ^9-THC, which binds to cannabinoid receptors, including those found in the male reproductive organs [40]. Conflicting literature exists regarding the effect of cannabis on the male reproductive system. While some studies have indicated that cannabis impairs male fertility, semen quality, and hormone levels, others have reported no significant changes in these parameters among cannabis users. It's evident that further research is essential to fully comprehend the precise effects of cannabis on male reproductive health. Moreover, as the majority of cannabis users are men of reproductive age, understanding the potential risks associated with cannabis use is of particular importance [41]. Ongoing research is imperative to address the controversy and gain a comprehensive understanding of the effects of cannabis on male sexual function. In addition to the male reproductive system, the female reproductive system is also influenced by the ECS, which raises concerns about the potential effects of cannabis on female reproductive health [87]. Continued investigation into the impact of cannabis on both male and female reproductive systems is essential for developing a thorough understanding of the risks and implications associated with cannabis use [42].

Endocrine system

Cannabis and its active component, Δ^9-THC, have been shown to interact with the ECS, a critical biological system involved in the regulation of neurodevelopmental processes and modulation of stress effects. Research has suggested that cannabis use may have an impact on the reproductive system, particularly in males. Some studies have indicated that cannabis impairs male fertility, semen quality, and hormone levels. However, there are conflicting findings, with other studies reporting no significant changes in semen parameters and testosterone levels among cannabis users [43].

In addition, the ECS influences the female reproductive system, indicating that repeated cannabis exposure during the preconception period may interfere with normal ovulation and menstrual cycles [44]. Furthermore, as the main psychoactive component of cannabis, D9-THC can readily cross the placenta, potentially leading to adverse effects of in-utero exposure and adverse birth outcomes such as low birth weight.

The ECS is involved in various stages of reproduction, including early pregnancy and maintenance, and hence any imbalance due to cannabis use at key moments is likely to have deleterious effects [45]. This raises concerns about the increasing use of cannabis among women of reproductive age, particularly in light of the diminishing awareness of its risks [101]. Understanding the potential impact of cannabis on the endocrine and reproductive systems is crucial for public health and healthy child neurobehavioral development, especially in the face of rising cannabis use and major disasters [46].

Immune system

Cannabis produces damaging effects on the immune system. This is due to the interaction of chemical compounds from cannabis with the ECS, an important system for modulating and controlling immune system activity. The biological effects of cannabinoids rely on their interaction with this system. As a result, cannabis consumption can lead to impairment of the immune system, affecting the body's ability to mount an effective immune response [47]. This impairment can make individuals more susceptible to infections and illnesses. Furthermore, the use of cannabis at key moments in reproduction can also induce deleterious effects due to the involvement of the ECS in different stages of reproduction and early pregnancy [48]. The growing interest in cannabis as a medical therapy has prompted extensive research into the underlying mechanisms of action of its chemical compounds. It is crucial for medical professionals and researchers to continue studying the effects of cannabis on the immune system, especially during pregnancy and in the context of infectious diseases. Understanding the specific mechanisms through which cannabis affects the immune

system can inform the development of targeted interventions to mitigate its detrimental effects [49]. In addition, the renaissance in the study of the therapeutic effects of cannabinoids underscores the importance of balancing the potential benefits with the known risks, particularly to immune system function. Continued research in this area is essential for advancing our understanding of the complex interactions between cannabis and the immune system, ultimately contributing to more informed medical and public health practices. As research into the effects of cannabis on the immune system continues to expand, it is becoming increasingly evident that cannabis consumption can have damaging effects on several bodily functions, including the immune system [50]. Cannabinoids, the active components of cannabis, have been found to exert a wide array of effects on not only the central nervous system but also on peripheral sites such as the immune, cardiovascular, digestive, reproductive, and ocular systems. It is crucial to note that some adverse effects of cannabis on the immune system can be attributed to the cannabinoids themselves rather than to the mechanism of consumption. The use of cannabis has been linked to an increase in susceptibility to infectious diseases, regardless of whether they are caused by bacteria, viruses, parasites, or fungi [51]. As a result, the long-term effects of gestational cannabis use on the immune system during infectious diseases are of particular concern and warrant further research. In the context of the renaissance in the study of the therapeutic effects of cannabinoids, it is important to carefully consider the potential risks and benefits associated with cannabis use, especially in relation to immune system function [52]. Continued research into the underlying mechanisms of cannabis action on the immune system is essential for informing medical and public health practices, as well as for developing targeted interventions to mitigate the detrimental effects of cannabis consumption [53].

Cardio-vascular system

Cannabis has a wide range of effects on the central nervous system, with the main psychoactive component, Δ^9-THC, being responsible for most of these effects. The psychological effects of cannabis on the CNS include feelings of euphoria, relaxation, and a sense of well-being [54]. However, rare cases of CNS injury, such as ischemic stroke, have been reported in connection with cannabis usage, highlighting the potential risks associated with its use. In addition to the psychological effects, cannabis exposure has been associated with various physical symptoms such as CNS excitation, CNS depression, cardiac problems, nausea and vomiting, abdominal pain, and even psychosis [55]. One particular case involved a patient experiencing severe, persistent, sharp pain in the penis following cannabis exposure, emphasizing the diverse and sometimes unexpected effects of cannabis on the body. Furthermore, the classification of cannabis harms into categories such as abuse, dependence, poisoning, and other unspecified harms underscores the complexity of its impact on the CNS and overall health [56]. The term "medical cannabis" is used to describe the physician-recommended use of cannabis and cannabinoids to treat diseases or alleviate symptoms, but it's important to consider the potential psychotropic and other undesired effects on the CNS that may limit its use for medical purposes. Given these potential risks and the complexity of cannabis use, particularly to its effects on the central nervous system, it's crucial for individuals to be well-informed before using cannabis for either recreational or medical purposes [57]. Understanding the differences between psychoactive and non-psychoactive components, such as Δ^9-THC (psychoactive) and CBD (non-psychoactive), is essential in making informed decisions about cannabis use. Moreover, the presence of unexpected side effects, including the rare occurrence of acute ischemic stroke after cannabis usage, emphasizes the need for caution and thorough consideration of the potential risks. While cannabis has shown therapeutic potential, particularly in medical contexts, its use must be approached with careful consideration of the potential impact on the central nervous system and overall health [58]. In medical contexts, the use of cannabis and cannabinoids to treat diseases or alleviate symptoms is known as medical cannabis. However, it is crucial to consider the potential psychotropic and other undesired effects on the CNS that may limit its medical use. Furthermore, it is important to emphasize the potential impact of cannabis on cognitive function and memory, which can manifest as deficits in memory, judgment, attention, coordination, and perception [59]. Chronic cannabis use has also been linked to cognitive deficits and an increased risk of psychosis, highlighting the importance of understanding the long-term effects of cannabis on the central nervous system. Medical cannabis users, in particular, need to be well-informed about the acute and chronic central nervous system effects of cannabis, as well as its potential impact on pulmonary function, social functioning, and the increased risk of motor vehicle accidents [60]. As our knowledge of cannabis and its effects on the central nervous system continues to advance, it is imperative to prioritize education, awareness, and evidence-based guidance to ensure the safe and informed use of cannabis within the community [100]. This comprehensive approach reflects a commitment to both individual well-being and public health considerations [61].

Digestive System

Cannabis, also called marijuana, is a plant that contains numerous compounds, such as cannabinoids. These cannabinoids will have a big effect on the digestive system. The immoderate intake of hashish has been connected to a situation called CHS, characterized through intense nausea and vomiting. This situation may be related to mutations inside the dopamine receptor D2. Research has shown that drugs concentrated on those transmitters can have an effect on the digestive system, and this correlation may also provide perception into the underlying mechanisms of CHS [62]. The underlying cause of CHS is complex, with many mechanistic ideas trying to explain the precise pathology. These ideas are divided into two main categories: The potential of cannabinoid receptors in the mind, primarily within the hypothalamus, to regulate temperature and the digestive system; and the dose-dependent build-up of cannabinoids and the related effects of cannabis toxicity [63]. CB1 and CB2, two types of G-protein-coupled cannabinoid receptors, are bound by cannabinoids and function by blocking adenylate cyclase. The discovery of endogenous arachidonic acid derivatives that bind to the CB1 and CB2 receptors, also known as endogenous cannabinoids or endocannabinoids, coincided with the development of these receptors. Cannabinoids have been shown to have therapeutic potential and are used as antiemetics to reduce nausea and vomiting as well as in the treatment of many illnesses, including acquired immune deficiency syndrome and the majority of malignancies [64]. CHS acute episodes typically last 24–48 h, and stopping treatment works well. Various treatments for coughs and colds don't work for this illness. Inflammatory bowel disease (IBD) can be improved by altering CB1 and CB2 activity. The CB1 and CB2 receptors in the human ileum and colon have been the subject of much research on endocannabinoids and their relationship to IBD. For chemotherapy-induced nausea and vomiting, cannabinoids should be considered [65].

Musculoskeletal system

Understanding the Impact on Bone and Muscle Health," Cannabis is a complex and widely discussed subject, especially in the medical field. Its growing popularity and the ongoing debates surrounding its use have prompted psychologists to address questions and concerns from their patients [66]. The ethical challenges and decision points that psychologists face when dealing with cannabis use highlight the need for a deeper understanding of its implications on mental health. The impact of cannabis use on cognitive function and academic performance has also been a subject of study [67]. The severity of consumption and its correlation with cognitive impairment emphasizes the need for a careful examination of the effects of cannabis on individuals' academic success. Furthermore, the therapeutic potential of marijuana and its potential role in treating various conditions have been a topic of interest, often clouded by anecdotal evidence and political influences [68]. There is a growing movement supporting the use of medicinal marijuana, and ongoing clinical trials aim to provide more concrete evidence of its benefits and drawbacks. The effects of cannabis on the central nervous system are also of critical interest, as it acts as a depressant and exhibits similarities to the acute effects of alcohol. Understanding the synergistic effects of cannabis with other depressants is essential in evaluating its

overall impact on the human body [69]. As such, it is imperative for psychologists and medical professionals to stay current with the latest research and openly communicate both the known and unknown risks and benefits of cannabis use with patients and their families [70].

Excretory system

Cannabis consumption has been associated with the accumulation of urinary CBD and THC metabolites over ten days, and this has raised concerns about potential health impacts. Research suggests that the carcinogens found in tobacco smoke are also present in cannabis smoke, which raises questions about the potential association of bladder cancer with CBD [71]. Furthermore, the detrimental effects of cannabis use appear to be most pronounced in younger individuals, particularly adolescents. Studies have shown that the administration of a CB1R agonist to adolescent rats can impair the maturation of inhibitory processes in the brain, which may have long-term neurological consequences [72]. This highlights the need for preventative strategies aimed at reducing cannabis use in at-risk adolescents, especially given the increasing prevalence of cannabis use and the rising potency of Δ^9-THC in recent years. The pharmacological properties of THC, the psychoactive component of cannabis, continue to be at the center of substantial research efforts. While most studies have focused on adult male rodents, there is a growing recognition of the need to understand the impact of cannabis in animal models that better capture variations in sex, age, and route of exposure [73]. This is particularly important considering the expanding legal use of cannabis products by individuals of all ages. In addition to recreational use, cannabis is also being used for therapeutic purposes. A survey addressing cannabis for therapeutic purposes for individuals with spinal cord injuries found that it was commonly used to control bowel/bladder management, spasticity, pain, and anxiety [74]. This highlights the diverse applications of cannabis and the need for further research into its effects and actions on the body, particularly within the context of therapeutic use for specific medical conditions [75].

ECS

The ECS is a complex cell-signaling system in the human body that plays a crucial role in regulating a range of physiological and cognitive processes. Named after the plant that led to its discovery, the ECS consists of endocannabinoids, cannabinoid receptors, and enzymes [76]. The ECS is involved in the regulation of a variety of functions, including mood, memory, appetite, pain sensation, and immune response. Cannabis, a plant known for its psychoactive properties, contains compounds called cannabinoids, which interact with the body's ECS. The two primary cannabinoids found in cannabis are THC and CBD, each with distinct effects on the body and mind [77]. Research into the ECS and its interaction with cannabis is ongoing, with potential implications for medical treatments targeting conditions such as chronic pain, epilepsy, and anxiety. Understanding the intricate workings of the ECS and its modulation by cannabis holds promise for the development of novel therapeutic interventions. The ECS's connection to cannabis has sparked significant interest in the medical community [78]. Studies have shown that cannabis-derived compounds, such as CBD, have potential therapeutic benefits for various health conditions. For example, CBD has been researched for its potential in managing chronic pain, reducing seizures in some forms of epilepsy, and alleviating symptoms of anxiety disorders [79].

A one-on-one correspondence indices for median lethal doses LD50 was performed, and as a result, synthetic and plant cannabinoids were found to be less harmful than the majority of NSAIDs. The Wiener index for synthetic cannabinoids, such as nabilone and THJ-2201, is almost double that of their plant counterparts [99]. Both CBD and CBN have the highest LD50 values, meaning they are the least harmful, due to their close topological index values and little psychoactivity [80]. There are negligible changes in toxicity and topological indices between the Δ^8-THC and Δ^9-THC positional isomers, which differ in the double bond's location. Current research on ECS and Cannabis [81]. The complexity of the ECS and its interaction with cannabis has spurred substantial research in recent years. Scientists and medical researchers are delving deeper into the molecular mechanisms underlying the ECS and the effects of cannabis-derived compounds on this intricate signaling system [82]. One area of active investigation is the specific pathways through which cannabinoids, such as THC and CBD, exert their effects on the ECS. Understanding these pathways is crucial for developing targeted therapies that can modulate the ECS to alleviate symptoms of various medical conditions. Moreover, emerging studies are shedding light on the potential of cannabis-derived compounds in managing not only chronic pain, epilepsy, and anxiety, but also in addressing a broader spectrum of health issues [83]. Researchers are exploring the impact of cannabinoids on neurodegenerative disorders, inflammatory conditions, and even certain types of cancer, opening new possibilities for therapeutic interventions. Furthermore, investigations into the interaction between the ECS and the body's immune response have revealed intriguing connections. This area of research has the potential to unveil novel strategies for harnessing the ECS to regulate immune function and potentially ameliorate autoimmune disorders [84]. As research continues to advance, the prospect of harnessing the ECS for targeted and personalized therapy is becoming increasingly compelling. Un addition, ongoing research is exploring the potential of cannabis-based treatments for conditions like multiple sclerosis (MS), inflammation, and even neurodegenerative diseases [85]. As researchers continue to unravel the complexities of the ECS and its interaction with cannabis, the potential for groundbreaking medical advancements remains high. Understanding these mechanisms could lead to the development of more targeted and effective therapies for a range of medical conditions [86] (Table 1 and 2).

CONCLUSION

To wrap up, even though cannabis has been abused recreationally and misused, its therapeutic potential cannot be disregarded. Recent studies and clinical uses demonstrate how well it works to treat chronic pain, lessen chemotherapy-induced nausea, ease the symptoms of neurological illnesses such as MS and epilepsy, and even improve mental health issues like post-traumatic stress disorder and anxiety [88]. To guarantee that patients obtain the greatest therapeutic benefit while lowering hazards, the medical profession is still investigating its advantages under restricted and regulated use [89]. The use of cannabis to treat chronic pain and spasticity was supported by moderate-quality data. Low-quality evidence suggested that cannabis was linked to benefits in HIV weight gain, Tourette syndrome, sleep difficulties, and chemotherapy-induced nausea and vomiting. Short-term adverse events were linked to a higher risk of cannabinoids [90]. Therefore, rather than concentrating on the possibility of abuse, the emphasis should be on proper medical use and additional research [92-96].

Researchers carried out a thorough systematic study of the advantages and side effects of medical cannabinoids for a variety of ailments [91]. The bulk of the 79 randomized controlled trials (6462 people) that were assessed included chronic pain and spasticity from MS, and paraplegia, or nausea and vomiting brought on by chemotherapy [92]. Less than five studies assessed other patient categories.

Although the majority of research indicated that cannabis was linked to symptom relief, not all of these findings were statistically significant. Cannabinoids may be useful for treating chronic neuropathic or cancer pain (smoked THC and nabiximols) and MS-related spasticity (nabiximols, nabilone, THC/CBD capsules, and dronabinol), according to moderate-quality evidence based on the GRADE system [93]. There was very low-quality evidence for improvements in chemotherapy-induced nausea and vomiting (dronabinol and nabiximols), weight gain in HIV (dronabinol), sleep disorders (nabilone, nabiximols), Tourette syndrome (THC capsules), and anxiety as assessed by a public speaking test (CBD) [94]. Low-quality research suggested that cannabis had no effect on psychosis, while very low-level evidence suggested that nabiximols had no effect on depression [95]. The use of cannabinoids was associated with a higher risk of short-term adverse

events, including serious ones. Asthenia, issues with balance, confusion, dizziness, disorientation, diarrhea, euphoria, sleepiness, dry mouth, exhaustion, hallucinations, nausea, somnolence, and vomiting were among the common adverse events, although many cases have been treated with the use of cannabis in various form like smoke, with food which has proved to improve the symptoms [97].

DATA AVAILABILITY

The data that support this manuscript are available from the corresponding author upon reasonable request.

AUTHOR'S CONTRIBUTIONS

JI, MIAW: Conceptualization. JBJ, PKK: Literature collection and writing. SMO, DR: Manuscript design and final draft preparation. All the authors have read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no competing interests.

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