Cannabis Use in Adolescents: Effects and Treatment Approaches

Pradhi Waghray

ABSTRACT

This research paper intends to focus on the neurological effects of recreational cannabis use, particularly in adolescence. The use of cannabis recreationally in the United States has increased immensely over the last decade. However, more information is needed to further analyze the effects on the developing brain over time. This paper will cover the effects on neuro-physical responses as a result of chronic cannabis use such as neurological, emotional, physical, and cognitive effects. The correlation between cannabis and neurological and mood disorders will also be discussed. The underlying effects of chronic use of cannabis will also be explored through a discussion of treatments and possible therapies to reverse the damaging results of the drug. The purpose of this paper is to shine a light on this topic in hopes of informing those of the consequences of using cannabis during adolescence.

INTRODUCTION

Cannabis, more commonly known as marijuana, is one of the most widely used substances in the world (Archie & Cucullo, 2019). Specifically in the last 50 years there has been a significant increase in its recreational use by adolescents in social settings for its elevation in feelings of happiness and sociability (Hall & Degenhardt, 2009). Additionally, plant-breeding techniques in coordination with other cultivation methods have drastically increased the potency of cannabis use over the last 20 years (Ashton, 2001). In 2021, 18.7% of people aged 12 or older in the United States had used cannabis in the past year (NIDA, 2023). In the following year, the report studied the use among young students and they found that the use of cannabis in the past year among those in the 8th grade was about 8.3%, among 10th graders was approximately 19.5%, and among 12th graders was 30.7% (NIDA, 2023). Due to this recent increase in cannabis use among younger populations, more research is needed to further analyze the effects on the developing brain over time.

The history of cannabis and the endocannabinoid system will be discussed in this paper to help readers better understand the chemical underpinnings associated with cannabis use . The primary effects of recreational use will be examined from a neurological, emotional, physical, and cognitive aspect. This paper will also cover the short-term and long-term effects on neurophysical responses as a result of chronic cannabis use. The association between the use of the drug with neurological disorders will also be analyzed. The underlying effects of chronic use of cannabis will also be explored through a discussion of treatments and possible therapies to reverse the damaging results of the drug.

What is Cannabis?

Cannabis, commonly known as marijuana is globally one of the most widely used drugs. This cannabis plant was initially grown in Central Asia but eventually spread to be cultivated worldwide (Archie & Cucollo, 2019). The three most common strains are the Cannabis sativa, Cannabis indica, and Cannabis ruderalis. These strains have differing levels of tetrahydrocannabinol, or THC, a major psychoactive type of cannabinoid in the plant with C. sativa having the highest proportion out of the three (Archie & Cucollo, 2019). Cannabinoids are a type of compound that can bind to different cannabinoid receptors in our body (Archie & Cucollo, 2019). These generally exist in the stalks, leaves, flowers, and seeds of the cannabis plant, as well as the resin emitted by the female plant (Ashton, 2001).

THC can be consumed in several ways, including the use of tincture or oil such as in vape, in edible forms when infused into food and snacks, or by smoking– one of the more common forms of consumption. Approximately 50% of the THC from a joint of cannabis is inhaled through the mainstream smoke, which is almost immediately absorbed through the lungs and entered into the bloodstream, reaching the brain in a matter of minutes. The effects, such as the “euphoric” feeling of a cannabis high would appear almost immediately. After this absorption, THC and other cannabinoids are administered to all the other tissues, however, the rate at which this occurs depends on the blood flow (Ashton 2001). Cannabinoids have high lipid solubility, meaning they have the ability to dissolve well in lipids. It is this that causes cannabinoids to pile up in fatty tissues, remaining there and reaching maximum concentrations in about 4-5 days.It is only after this that they are delivered back into the brain, as well as in the different chambers of the human body (Ashton 2001). This would explain why an average user may still have a single dose of cannabis in their system for up to 30 days, and why the aftereffects may be prolonged.

However, this immediate release of the tetrahydrocannabinol in the bloodstream is not always the case. Slightly different effects can be observed in another common form of consuming cannabis– oral ingestion, where it is absorbed in food or beverages. According to the National Institute on Drug Abuse, when consumed orally, primary effects are delayed in comparison to smoking the drug. They typically appear within 30 minutes to 2 hours, however the duration of these effects is extended due to slow digestion through the gut (Ashton, 2001). This could possibly result in the user taking more doses of cannabis than needed to experience the reaction.

Evidently, through repeated administration, significant amounts of cannabinoids can amass within the body and maintain their passage to the brain. Inside the brain, the dispersion of THC and other cannabinoids occurs in a varied manner. Notably elevated levels concentrate in regions such as the neocortex, limbic system, sensory processing areas, and motor regions (Ashton, 2001).

Model of Addiction

Drugs of abuse increase dopamine (DA) release, which plays a crucial role in their reinforcing effects. Delta9-tetrahydrocannabinol, one of the main components of cannabis, appears responsible for its highly addictive capability. This is why those who use cannabis can end up becoming severely dependent on the drug, and it can also explain as to why chronic users of cannabis may feel symptoms of withdrawal when they do not consume the drug. Acute administration of THC leads to striatal DA release in both animals and humans (Zehra et al., 2018). This dopamine release may contribute to cannabis users feeling a sense of satisfaction in the moment, potentially driving them to associate this positive feeling with the drug.

In the human brain, the actions of THC are regulated through cannabinoid CB_1 (cannabinoid receptor type 1) receptors. It has been hypothesized that CB_1 receptors may play an important role in the model of addiction in humans. CB_1 receptors are a type of G-protein coupled receptors and can be found in neurons where they help with neurotransmission (the transport of information between neurons) (Howlett et al., 2010). These receptors also play a key part in memory and learning as well as addiction disorders (Howlett et al., 2010). The highest densities of CB_1 receptors are located in basal ganglia, hippocampus, cingulate cortex and the molecular layer of cerebellum.

Various animal models, utilizing rodents and other non-human primates, have been established to study cannabis exposure. In these rodents, downregulation of cannabinoid receptors in the brain had been noticed upon exposure to cannabis (Hirvonen et al., 2012). Although it was still unknown as to how exactly these effects would take place in a human brain, in 2011 a study was conducted where male chronic cannabis smokers were observed closely for 4 weeks, alongside those who were not users of cannabis (Hirvonen et al., 2012). At the baseline, the density of CB_1 receptors of those who used cannabis was found to be lower in cannabis smokers than in the control subjects in certain brain regions (Hirvonen et al., 2012). This effect on the CB_1 receptors could possibly result in impaired memory and cognition, both of which are needed for daily activities. An illustration of the cannabinoid receptors can be seen in Figure 1.

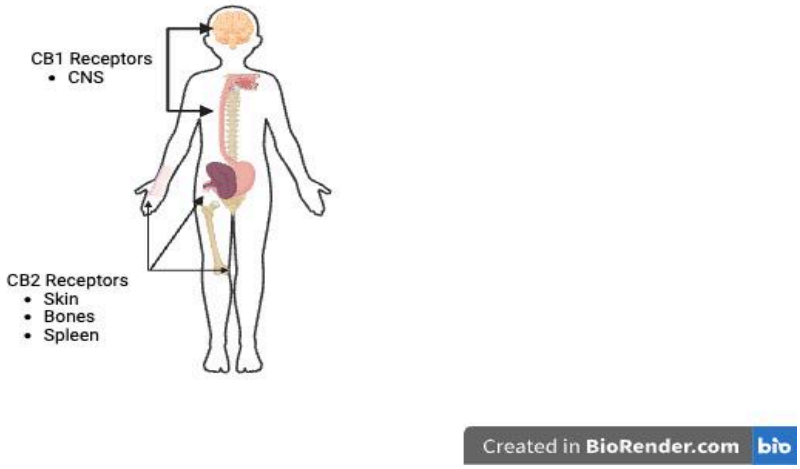

Figure 1. “Schematic illustration of the primary location of CB1 and CB2 receptors (Created in BioRender.com)

EFFECTS OF CANNABIS USE

There have been a variety of reported effects of cannabis use, affecting different parts of the body. This section will examine the neurological, cognitive, physical, and psychological effects of cannabis use, focusing on gray/white matter structure, executive functioning, memory, IQ, body lethargy, and mood, considering both the short-term and long-term effects of chronic use. As previously mentioned, the tetrahydrocannabinol cannabinoid is responsible for the addictive properties of cannabis.

Neurological Effects

Results surrounding the effect of cannabis use on brain structure are complex, and have been greatly varied. In studies involving chronic users of large amounts of cannabis, there have been associations linked to structural changes. However, many studies have not found a significant association between cannabis use and morphology of the brain (Cousijn et al., 2012).

The correlation between the use of cannabis and the changes in brain structure vary greatly and depend on the different unique characteristics of the form of cannabis use and dependence of each individual (Cousijn et al., 2012). This may even possibly differ based on the age at which individuals may be using cannabis. Specifically, many studies have looked at the association between cannabis use and grey matter volume. Research has found that chronic consumption of large quantities of cannabis can affect the grey matter volume in the forebrain and striatum (Cousijn et al., 2012). The grey matter regulates perception, movement, learning, speech and cognition due to its make-up of dendrites and synaptic interactions (Mancall & Brock, 2011). Moderate users of cannabis do not experience much effect on frontal or striatal grey matter. However those who are long-term heavy users may undergo certain changes (Cousijn et al., 2012).

White matter is made up of myelinated axons that connects regions of gray matter throughout the brain, helping with the transfer of information in the brain and mediating cognitive functions such as “attention, memory, language, visuospatial skills, and executive function” (Filley & Douglas, 2016).Studies have also found that duration of cannabis use is inversely correlated with cerebellar white matter volume (Cousijn et al., 2012). This indicates that the longer period of time someone has used cannabis, the smaller volume of white matter in their brain. Cannabis use can also lead to a reduction in the volume of white matter in the hippocampus (Cousijn et al., 2012).

The hippocampus has also been shown to be affected due to cannabis use. There is an inverse relationship between cannabis use and hippocampal volume for heavy users, meaning that the more cannabis someone consumes, the smaller the size of their hippocampus, and the more damaged their ability for long-term memory (Cousijn et al., 2012). In a addition to the hippocampus, studies have also found that cannabis use reduces the volume of the amygdala and cerebellum in adults that are heavy users, affecting their emotional and vestibular processes(Cousijn et al., 2012).

Cognitive Effects

The effects of cannabis use on cognition and executive functioning skills has been heavily researched in recent years. Cannabis, with its psychoactive compounds such as THC, interacts with the brain's endocannabinoid system, which plays an important role in cognitive processes. In this section, the impact of cannabis use on various aspects of cognition will be studied, including executive functioning skills such as attention, decision-making, impulsivity, and working memory, as well as the euphoric feelings and hallucinations. By delving into the research and evidence, it is possible to determine how cannabis use may affect crucial cognitive abilities.

The effects of cannabis use are similar to the effects of alcohol and benzodiazepines which include "slowing of reaction time, motor incoordination, specific defects in short-term memory, difficulty in concentration and particular impairment in complex tasks which require divided attention" (Ashton, 2018). These effects are found to be dose-related with higher doses of cannabis leading to greater effects on cognition. Attention and concentration are both functions that are impaired with prolonged cannabis use. For example, studies have shown that cannabis users have slower information processing when abstinent (Crean et al., 2011). This may explain why those addicted to the drug could feel the urge to use it, perceiving it as something that "enhances" their concentration, whereas in the long run it is actually degrading it. Another decision-making task found that, compared to the placebo group, subjects receiving THC were significantly less likely to make correct decisions (Ramaekers et al. 2006). Additionally, those in the THC groups required longer planning times (latency to respond) than the placebo group. In a more recent study involving chronic cannabis users, it was observed that severe intoxication caused drastic damage in working memory. It was also found that the subjects who were administered a higher dose of THC took a notably longer time to accomplish the task at hand (Crean et al., 2011). This observation may also be an implication of a more significant long term effect on a chronic cannabis user's memory and ability to perform tasks daily. Overall, there is evidence that acute cannabis use has observable deficits in aspects of planning and decision making particularly with regard to response speed, accuracy and latency (Crean et al., 2011).

Another aspect that cannabis may have an effect on is an individual's impulsivity. Studies show that acute cannabis use results in more impulsive action, and "less inhibition of maladaptive responses" (Crean et al., 2011). These instigation of impulsive behaviors may explain why one might drive while under the influence, unintentionally/intentionally inflict harm on others, or overindulge in activities.

Cannabis is also known to produce perceptual changes. This may contribute to colors seeming brighter, hallucinations, or music more lucid and lifelike. Additionally, individuals' spatial and time perception may also be hindered. Perceived time upon use of cannabis may also be noticed as going "faster" than clock time (Ashton, 2018). The perception of time is a very critical factor in human consciousness. This impaired view of time can overall alter one's ability to view the world around them, shifting their sense of self as their memories, present senses, and perception of the future may all be altered.

Psychological Effects

The use of cannabis can cause a wide range of psychological effects, influencing emotions, mood, and even mental health. These psychological effects are mainly due to the euphoric or “high” feeling one gets when using cannabis. The high feeling is one of the main reasons why several people tend to use cannabis. This euphoric feeling can be induced with low doses of THC, can take effect within just a few minutes of smoking and can last for up to 2 or more hours – depending on the dose consumed (Ashton, 2018). The high may comprise feelings of intoxication, decreased anxiety, alertness, depression and tension, and increased sociability (Ashton 2018). (discuss how people with anxiety disorders may resort to the use of cannabis, new paragraph??) Along with this high, Some people may even experience heightened emotions, being more meaningful and significant (Ashton, 2018). This may also be a driving factor of addiction, as people may view cannabis as making their environment “better” overall.

However, the use of cannabis may also induce dysphoric reactions, such as severe anxiety and panic, paranoia, and psychosis, much of which depend on the dose and how vulnerable individuals may be psychologically (Ashton, 2018). This could possibly mean that those who are socially anxious may take the drug intending to feel more “comfortable” or “joyful” but regardless, this may not always be the case upon immediate use. It is more than possible that they may experience the other effects mentioned above.

Physical Effects

Recreational cannabis use has long been associated with an array of physical effects that warrant careful consideration. This section will explore the tangible impact of cannabis on the body, including hyperemesis syndrome, cardiovascular issues, cannabis withdrawal symptoms, and body lethargy.

One noteworthy physical effect is Cannabinoid Hyperemesis Syndrome (CHS), a condition characterized by periodic vomiting due to chronic cannabis use (Sorensen et al., 2016). One paper noted that CHS emerges as a result of consistent cannabis consumption, typically occurring on a daily to weekly basis (Sorensen et al., 2016). This syndrome, although not fully understood, signifies a significant physiological response to prolonged cannabis exposure. Cardiovascular issues also emerge as a concern linked to cannabis use. The comprehensive study conducted by Archie and Cucullo (2019) underscores a range of cardiovascular complications, including an increased risk of peripheral vascular diseases, pneumomediastinum, pneumothorax, and pneumopericardium. These adverse effects shed light on the intricate relationship between cannabis use and the cardiovascular system, suggesting that careful consideration of the potential risks is paramount.

Furthermore, the emergence of cannabis withdrawal symptoms adds another layer to the physical effects of cannabis use associated with the withdrawal process. The research conducted by Archie and Cucullo (2019) elucidates the presence of withdrawal symptoms among individuals who discontinue cannabis use. The manifestation of withdrawal symptoms reinforces the body's adaptation to the substance and highlights the significance of recognizing and addressing potential physiological shifts. Another observable physical impact of cannabis use is the phenomenon of body lethargy. Cannabis use can contribute to a sense of reduced energy and motivation, often referred to as body lethargy (Archie & Cucullo, 2019). This feeling

of physical inertia not only impacts daily functioning but also underscores the complexities of how cannabis can interact with the body's physiological processes.

In summary, cannabis's effects indicated complex connections across multiple domains. Neurologically, cannabis's impact on brain structure varies widely (Cousijn et al., 2012). Cognitively, acute use affects attention, memory, and perception (Ashton, 2018; Crean et al., 2011). Psychologically, it induces euphoria but also dysphoric reactions, especially in vulnerable individuals (Ashton, 2018). Physically, concerns include Cannabinoid Hyperemesis Syndrome, cardiovascular risks, withdrawal symptoms, and lethargy (Sorensen et al., 2016; Archie & Cucullo, 2019). This underscores the importance of informed choices as cannabis use becomes more widespread.

NEUROLOGICAL AND MOOD DISORDER ASSOCIATIONS

Both chronic and acute use of cannabis can be linked with many detrimental results on the peripheral system and central nervous system. (Archie & Cucullo, 2019). This section delves into the intricate interplay between cannabis use and nervous system disorders.

Mood Disorders

Mood disorders are conditions that may disrupt one’s common emotions, such as bipolar disorder or manic depressive disorder (Sekhon & Gupta, 2023). Two disorders that have been linked to cannabis use are schizophrenia and psychosis. Schizophrenia is an acute psychiatric disorder in which individuals may “present emotional and behavioral dysfunction,” and cognitive impairment (Zhuo et al., 2023). Psychosis There are numerous causes for these disorders, such as hormonal factors or genetics (Sekhon & Gupta, 2023). Cannabis use can be identified as an “independent risk factor for psychosis and the development of schizophrenia”, as depicted by results from trajectory studies (Jonsson et al., 2014). This could mean that those who are not aware of or have not been diagnosed with these disorders could have their symptoms be heightened by persistent cannabis use. Research shows that cannabis use in adolescence has a significant link to psychosis and the spread of schizophrenia when the disorder begins in adulthood (Jonsson et al., 2014). With this, it can also be assumed that the adolescent brain is more likely to be susceptible to the negative effects of cannabis use. These disorders may not develop upon immediate use but may be a result of the long-term use of cannabis.

Ischemic Strokes

Cannabis use has also raised concerns in its potential association with the neurological condition of ischemic strokes. Ischemic strokes occur when blood flow to the brain is significantly compromised due to the obstruction of a blood vessel. Recent research indicates that cannabis use might be linked to an increased risk of experiencing ischemic strokes, which further highlights the potential health risks associated with cannabis consumption.

These causative links between cannabis use and cerebral ischemia are prevalent in existing literature. One study suggested that there was a causal relationship between cannabis use and several occurrences of ischemia and infarction (Moussouttas, 2004). This research underscores the need for a more thorough understanding of the mechanisms through which cannabis might contribute to such cerebrovascular complications.

Another pair of studies focusing on young subjects and their risk factors for stroke provide further insight into the association between marijuana and ischemic stroke. This research identified marijuana use as a significant risk factor for ischemic stroke (Thomas et al., 2014). Additionally, research by Travni and Treadwell showed that chronic cannabis inhalation has been identified as a potential risk factor for cerebrovascular disease such as ischemic stroke (Travni & Treadwell, 2009). This further supports the notion that prolonged and consistent cannabis use may have real physical repercussions on the brain and vascular system.

Reversible cerebral vasoconstriction syndrome

Reversible cerebral vasoconstriction syndrome has recently been reported with cannabis abuse. This is characterised by an association of severe headaches (often described as thunderclap headaches) with or without additional neurological features (for example, cerebral hemorrhages, ischaemic strokes, transient ischaemic attacks) and a ‘‘string and beads’’’ appearance of cerebral arteries, which resolves spontaneously in 1–3 months. Since headaches often precede neurological complications by a few days, it is proposed that vasospasm starts distally and progresses towards medium-sized and large arteries. Although specific effects of cannabis on cerebral perfusion have not been fully elucidated, studies have suggested that cerebral blood flow is affected by cannabis use. Xenon inhalation studies showed that cannabis users had overall lower regional cerebral blood flow measurements which then improved with abstinence. Mathew et al used the same technique to analyze acute changes in cerebral blood flow associated with cannabis smoking and found that experienced smokers showed an increase, and inexperienced smokers a decrease, in cerebral flow after smoking cannabis (Travni & Treadwell, 2009).

TREATMENTS FOR CANNABIS USE DISORDER

Treatments for cannabis use disorder (CUD) include a variety of psychotherapeutic and pharmacological modalities. This section will explore evidence-based approaches such as behavioral therapies, cognitive-behavioral therapy (CBT), motivational enhancement therapy, and contingency management. In addition medications, for treating CUD will be discussed, including agents that target certain neurotransmitters in the brain related to addiction.

Psychotherapeutic Treatments

Clinical trials of various treatments for CUD have likewise increased, focusing primarily on psychotherapy treatments, specifically motivational enhancement therapy, cognitive behavioral therapy, and contingency management (Sherman & McRae-Clark, 2016).

Cognitive Behavioral Therapy is the process that helps patients identify the events of using behavior, develop relapse prevention, and seek “other prosocial behaviors” (Sherman & McRae-Clark, 2016). It includes methods such as self-monitoring and cognitive restructuring, both of which are methods used to help patients examine their mannerisms with and without the use of cannabis, in hopes of creating alteration in the. This may eventually lead to a halt in the persistent use of cannabis.

Another commonly used treatment for CUD is Motivation Enhancement Therapy (MET), a treatment based on “motivational interviewing principles” (Sherman & McRae-Clark, 2016). MET increases the drive to change by employing methods such as nonjudgemental feedback or

collaborative goal setting (Sherman & McRae-Clark, 2016). These may be especially useful to those struggling with self-esteem or other social issues that have led them to seek aid through cannabis use. MET strives to motivate and encourage those with CUD to eventually quit chronic cannabis use.

Pharmacologic Treatments

Medications evaluated for CUD treatment include a variety of categories, such as antidepressants and anxiolytics, agonist therapy, and agents targeting specific neurotransmitters thought to be involved in addictive processes. (Sherman & McRae-Clark, 2016). Notably, N-acetylcysteine and gabapentin emerge as promising candidates in this field. However, it's important to note that despite these advancements, no single pharmacologic treatment has definitively proven efficacy, highlighting the ongoing need for innovative approaches in addressing cannabis use disorder (Sherman & McRae-Clark, 2016).

Cannabinoid Agonists

The potential of using cannabinoid agonists as a treatment for cannabis use disorder was explored by Sherman and McRae-Clark (2016). They examined dronabinol, a synthetic form of THC, in a trial involving cannabis-dependent adults. Participants received dronabinol or a placebo alongside therapy. While both groups reduced cannabis use and dronabinol helped with retention and withdrawal symptoms, it didn't significantly reduce cannabis use. This suggests that using cannabinoid agonists for treatment is complex and needs more research, including exploring newer compounds like nabilone and nabiximols. This study shows the challenges in finding effective treatments for cannabis use disorder and the need for further investigation into different approaches.

Anticonvulsants and Mood Stabilizers

Anticonvulsants and mood stabilizers were also explored as a way to treat cannabis use disorder in the study by Sherman and McRae-Clark (2016). They looked at how these medications affect people who are dependent on cannabis. One study involving a mood stabilizer called Divalproex didn't show any significant effects on reducing cannabis use or improving psychological well-being. However, another trial with an anticonvulsant called gabapentin had more promising results. Even though the trial had limitations, those who took gabapentin reported using less cannabis and experienced fewer withdrawal symptoms.

Glutamatergic Agents

The use of N-acetylcysteine (NAC), a compound derived from cysteine, shows promise in treating cannabis use disorder through its impact on glutamatergic processes. The research by Sherman and McRae-Clark (2016) highlights that NAC normalizes the

exchange of cysteine and glutamate, reducing drug-seeking behavior in animal models. In trials with young cannabis users, NAC led to decreased self-reported cannabis use and cravings. In a larger study, participants receiving NAC alongside counseling and contingency management had over twice the chance of testing negative for cannabis in urine tests compared to those on a placebo. These findings indicate NAC's potential to be a useful tool in treating cannabis dependence across different age groups.

In summary, findings suggest that a combination of these three modalities (psychotherapeutic and pharmacologic treatments) produces the best abstinence outcomes, although abstinence rates remain modest and decline after treatment. Overall, the research shows the need to explore different treatment options and improve our understanding of how to address cannabis dependence effectively.This underscores the complex nature of treating this disorder and the need for comprehensive approaches.

DISCUSSION

Cannabis, often referred to as marijuana, stands as one of the most widely used drugs globally. Originally cultivated in Central Asia, its popularity has spread worldwide (Archie & Cucullo, 2019). The primary strains, Cannabis sativa, Cannabis indica, and Cannabis ruderalis, contain varying levels of tetrahydrocannabinol (THC), a major psychoactive compound (Archie & Cucullo, 2019). These strains are distinct in their THC composition, with C. sativa containing the highest proportion. Cannabinoids, which can bind to cannabinoid receptors in our body, are present in various parts of the cannabis plant (Ashton, 2001). THC can be consumed in different ways, such as smoking, vaping, or ingestion through edibles, each affecting the body's response time and duration differently (Ashton, 2001).

THC interacts with the endocannabinoid system within the body, including CB1 receptors that play a role in addiction and neurotransmission (Howlett et al., 2010). This system is instrumental in THC's psychoactive impact. Animal models, involving rodents and primates, have been instrumental in understanding cannabis's effects on the brain, with observations of CB1 receptor downregulation among cannabis users (Hirvonen et al., 2012). This downregulation could contribute to impaired memory and cognition. The intricate interplay between cannabis compounds and brain receptors underscores the complexity of its impact on the human body.

Cannabis use has intricate connections with various aspects of human well-being. The neurological effects of cannabis exhibit a complex interplay between brain structure and cannabis use, with inconsistent findings likely stemming from individual differences in consumption patterns (Cousijn et al., 2012). Acute cannabis use leads to deficits in attention, memory, and decision-making, while also altering perceptual experiences and time perception (Ashton, 2018; Crean et al., 2011). The psychological effects encompass a spectrum of emotional responses and altered mental states, ranging from euphoria and decreased anxiety to dysphoric reactions like anxiety, paranoia, and psychosis, particularly in vulnerable individuals (Ashton, 2018). Meanwhile, the physical effects unveil concerns such as Cannabinoid Hyperemesis Syndrome inducing periodic vomiting, cardiovascular issues associated with vascular diseases, cannabis withdrawal symptoms reflecting the body's adaptation to the substance, and the phenomenon of body lethargy highlighting cannabis's impact on energy

levels and motivation (Sorensen et al., 2016; Archie & Cucullo, 2019). It is important that further research be conducted to elucidate the harmful symptoms associated with cannabis use.

Cannabis use can also affect both the peripheral and central nervous systems. The mood disorders associated with cannabis use, such as schizophrenia and psychosis, highlight its intricate impact on mental health. Research establishes cannabis as an independent risk factor for these disorders, with implications more pronounced when use begins in adolescence (Jonsson et al., 2014). Additionally, concerns about its connection to ischemic strokes have emerged, as evidence suggests a causal link between cannabis use and instances of cerebral ischemia and infarction (Moussouttas, 2004). Young subjects with marijuana use history showed a higher risk of ischemic stroke (Thomas et al., 2014), and chronic cannabis inhalation has been associated with cerebrovascular disease (Travni & Treadwell, 2009). Reversible cerebral vasoconstriction syndrome, characterized by severe headaches and neurological features, has also been linked to cannabis abuse, further emphasizing the intricate relationship between cannabis use and neurological health (Travni & Treadwell, 2009). This analysis underlines the need for a comprehensive understanding of the potential neurological and mood-related implications of cannabis consumption.

CONCLUSION

In conclusion, this research paper has aimed to explain the mechanisms of cannabis within the body and its impact on mental and physical health. Additionally, a significant focus has been directed toward comprehending its effects on adolescents, a crucial demographic in the context of evolving cannabis perceptions and policies. The examination of the drug's interaction with the endocannabinoid system has shed light on its psychoactive effects, while the neurological consequences remain intricate and multifaceted.

The effects of cannabis encompass a wide range, from cognitive impairments such as attention and memory deficits to alterations in mood and physical manifestations like hyperemesis syndrome and cardiovascular complications. The association between cannabis use and mood disorders like schizophrenia, as well as its potential role in strokes, underscores its significant impact on neurological and mental well-being.

Moving forward, further exploration is necessary to deepen our understanding of the complex interactions between cannabis and the human body. This includes potential therapeutic applications and the development of comprehensive interventions. A holistic approach that considers biological, psychological, and neurological aspects will be pivotal for making informed decisions and designing impactful interventions for cannabis use among adolescents.

In an era of changing attitudes towards cannabis, this research paper assumes a critical role. It deepens our comprehension of how cannabis interacts with the human body, revealing its potential advantages and hazards. This paper is an important resource for healthcare professionals, policymakers, and the public, guiding evidence-based decisions about cannabis use, regulation, and its potential medicinal uses. By delving into all the aspects of cannabis use, this research empowers society with the knowledge necessary to navigate the complexities of cannabis in an informed manner.

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