

# Cannabis Unveiled: An Exploration of Marijuana's History, Active Compounds, Effects, Benefits, and Risks on Human Health

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**ABSTRACT:** Marijuana, also known as cannabis, is a psychoactive drug that comes from the Cannabis plant. Marijuana can be smoked, vaporized, or consumed through edibles in a variety of ways. Perception changes, changes in mood, and problems with coordination are all possible side effects. Marijuana is used for both recreational and medical purposes to treat a variety of health conditions. The literature review on the effects of marijuana on the human body has increased in recent years as more states legalize its use. It is important to investigate the benefits and harmful effects of marijuana on individuals due to the widespread use of cannabis-derived substances like marijuana for medical, recreational, and combined purposes. The paper will review different aspects of marijuana in 4 main domains. A thorough discussion of marijuana's definition, history, mechanism of action, pharmacokinetics, and effects on human cells will be given in the first domain. The second domain will concentrate on marijuana's negative effects, while the third domain will look at marijuana's possible positive impacts, such as its usage in controlling multiple sclerosis, treating obesity, lowering social anxiety, and managing pain. The fourth domain will concentrate on marijuana's effects on anxiety, educational attainment, and social consequences. Additionally, this paper also will provide a highlight of the history of marijuana use and governmental legislation, both of which play a significant role in determining how the public views marijuana. In conclusion, this paper provides a comprehensive review of marijuana's effects, which may be of interest to a large readership. This review adds to the continuing discussion about the use of marijuana by analyzing the data that is currently available about the possible advantages and disadvantages of marijuana usage.

**KEYWORDS:** Marijuana, cannabis, benefits, harmful, human body, social impacts, education attainment, legislation

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## Introduction

Marijuana and cannabis are often used interchangeably, but they technically refer to different things. "Cannabis" is the scientific name for the plant species that includes both marijuana and hemp. "Marijuana" specifically refers to the strains of cannabis that contain high levels of the psychoactive compound delta-9-tetrahydrocannabinol (THC), which is responsible for the plant's intoxicating effects. "Hemp" on the other hand is a strain of cannabis that contains very low levels of THC and is mostly used for industrial and medical purposes.<sup>1</sup>

The use of marijuana for both recreational and medicinal purposes can be traced back 6000 years.<sup>1</sup> THC interacts with cannabidiol (CB) receptors present in various organs, including the heart, brain, peripheral nervous system, skeletal muscles, and myocytes.<sup>2</sup> Marijuana is a naturally occurring substance that contains various chemicals. It is derived from hemp, a plant mainly grown for fiber production, and is part of the Cannabis species that contains cannabinoids.<sup>3</sup> The World Health Organization reports that marijuana is the most commonly used drug worldwide, with a global prevalence of 2.5%. It is a popular drug that can be consumed through smoking or orally. Marijuana usage is notably prevalent in the United States, with more than 22 million individuals aged 12 years or above having used it at least once in their lives.<sup>4</sup>

The purpose of this review article is to provide an overview of marijuana, differentiate between the terms, highlight their historical use and touch upon the historical use of marijuana and governmental legislation. It also aims to establish the presence of various active substances in marijuana, explain their mechanism of action, and discuss the pharmacokinetics of cannabis. Furthermore, this article intends to explore the effects of marijuana on human cells, both beneficial and harmful, as well as its impact on education attainment, cardiovascular disorders, addiction potential, mental health, and its relationship with cancer. Lastly, it aims to address the social impacts of marijuana.

### *The history of marijuana*

In the United States, marijuana was commonly consumed for recreational purposes until 1941, and it was also medically prescribed to alleviate symptoms such as arthritis, nausea, and labor pains.<sup>1,3</sup> During the 1930s, marijuana was portrayed as a substance that induced violent behavior in people, while in the 1960s it became a symbol of counterculture and rebellion against societal norms.<sup>1</sup> In 1970, the Controlled Substance Act classified marijuana as a Schedule 1 drug.<sup>3</sup> Despite this, the use of marijuana for both recreational and medicinal purposes has risen in the United States. This is in part due to a survey



showing that 81% of American adults believe it has at least 1 medical benefit.<sup>5</sup>

For more than 4000 years, marijuana has been utilized both for medicinal and recreational objectives. Its earliest known medicinal usage was documented in a Chinese artifact from 2700 B.C., which suggests that cannabis was used to treat a range of conditions including malaria, poor memory, gout, and rheumatism.<sup>1</sup> After originating in China, marijuana spread to other regions including Korea, India, and East Africa. The cultivation of hemp, which has strong fibers, also contributed to its spread.<sup>1,2</sup> For example, the Spanish brought it to America in the mid-1500s for cultivation.<sup>1</sup>

### *The history of marijuana use and governmental legislation*

In the United States, cannabis legalization has been a contentious issue in recent years. Cannabis has been legalized for medical and/or recreational use in some states, but not in others. As of April 2021, 36 states and the District of Columbia had legalized medical cannabis, while 15 states and the District of Columbia had legalized recreational cannabis, as reported by the Congressional Research Service.<sup>6</sup>

The legalization of cannabis has been significantly influenced by public opinion. A 2021 Seat Exploration Center overview saw that 91% of Americans support the utilization of clinical pot, while 60% help the sanctioning of sporting marijuana.<sup>7</sup>

The potential for tax revenue is yet another factor that is driving the legalization of cannabis. Tax revenues have significantly increased in states that have legalized cannabis. For instance, the monthly state marijuana tax and fee revenue that is posted in the Colorado state accounting system is shown in the Marijuana Tax Reports. The state's retail marijuana sales tax, which accounts for 15% of retail marijuana sales, and the state's retail marijuana excise tax, which accounts for 15% of wholesale sales and transfers of retail marijuana, all contribute to the state's tax revenue. Fees for marijuana licenses and applications generate revenue.<sup>8</sup>

Concerns about racial disparities in drug policing and shifting attitudes toward drug use and addiction have also had an impact on the legalization of cannabis. In many states, "cannabis policy is shifting from a criminal justice perspective to a public health and safety approach," as noted in a report by the National Conference of State Legislatures.<sup>9</sup>

The prohibition of cannabis has historically been used to oppress racial groups, according to the Drug War Statistics.<sup>10</sup> For instance, cannabis was portrayed as a dangerous and addictive drug in the early 1900s and was associated with Mexican immigrants and African American jazz musicians. Despite similar rates of drug use, Black Americans are significantly more likely than White Americans to be arrested for drug offenses. This stigma continues to this day.<sup>11</sup> The article also mentions that the failure of the War on Drugs played a role in the legalization of cannabis. The Conflict on Medications, which started during the 1970s, was planned to lessen drug use

and medication-related wrongdoing through forceful policing. Notwithstanding, pundits contend that the Conflict on Medications has been insufficient and has prompted the mass imprisonment of peaceful medication guilty parties.<sup>10</sup>

Several states have passed laws making cannabis legal for medical and/or recreational use to address these issues. Age restrictions and licensing requirements for dispensaries are 2 examples of the kinds of regulations that are typically included in these laws to lessen the negative effects of drug use.<sup>12</sup> However, the legalization of cannabis faces numerous obstacles, which may include worries about an increase in drug-related use and addiction.<sup>13</sup>

Despite these difficulties, the trend toward the legitimization of marijuana will continue in the near future.<sup>14</sup> The legal landscape pertaining to cannabis is likely to become increasingly complex as public opinion continues to shift in favor of legalization and as more states adopt policies that are favorable to the use of cannabis.<sup>7</sup> In general, the legitimization of marijuana is a complicated issue, with different social and political variables driving its sanctioning at the state level.<sup>15</sup> It will be crucial to take into account the various dangers and benefits of cannabis, as well as the potential impact of cannabis policy on public health and safety, as the debate over its legalization progresses.<sup>16</sup>

### *Active substances of marijuana*

More than 500 chemicals have been identified in cannabis. However, the most extensively studied are cannabinoids, which are chemicals with 21 carbon atoms.<sup>17</sup> The cannabinoids found in marijuana are referred to as Phytocannabinoids, which are naturally occurring chemicals.<sup>17</sup> The active chemicals are  $\Delta$ -9-tetrahydrocannabinol (THC), and cannabidiol (CBD). THC is the psychoactive ingredient, while CBD may also affect the brain and other organs in various ways.<sup>2,17</sup>

### *Mechanism of action of marijuana*

The human body has the endocannabinoid (eCB) system that plays a crucial role in the body by regulating functions such as sleep, eating, forgetting, relaxing, and protecting the body. The eCBs have a chemical structure that is similar to those of THC and CBD.<sup>17</sup> The common eCB is referred to as *N*-arachidonylethanolamine or anandamide (AEA), which is located in the brain.<sup>4,17</sup> The second cannabinoid ligand found in the gastrointestinal tract is referred to as 2-arachidonoylglycerol (2-AG), which is located in the intestine.<sup>4</sup> After oral administration, THC and CBD will be hydrolyzed by the liver and then bind to the 2-AG receptors in the gastrointestinal tract.<sup>17</sup>

The active  $\Delta$ -9-tetrahydrocannabinol (THC) binds to the cannabinoid receptors in the brain cells, where it can interfere with various physical and mental functions.<sup>4,17</sup> The brain functions commonly affected by THC include memory, pleasure, balance, posture, and reaction time depending on the area of the brain.<sup>5</sup> These effects may be explained primarily by

cannabinoids binding to the G- protein-coupled cannabinoid receptors CB1 and CB2.<sup>17</sup>

The endocannabinoid system comprises the receptors CB1 and CB2, which respond to cannabinoids, the natural endogenous cannabinoids known as *N*-arachidonylethanolamine (also called anandamide or AEA) and 2-arachidonoylglycerol (2-AG), as well as their respective enzymes for degradation, which are fatty acid amide hydrolase (FAAH) and monoacylglycerol lipase.<sup>18</sup>

CB1 receptors are mainly found on presynaptic peripheral and central nerve terminals, with lower expression in various other peripheral organs. In contrast, CB2 receptors are predominantly concentrated in peripheral tissues and immune cells, where they regulate the release of cytokines and cell migration. However, CB2 receptors are also present in the nervous system, albeit to a lesser extent.<sup>19</sup>

CB1 receptors are primarily located in the cortex, hippocampus, spinal cord, cerebellum, basal ganglia, and hypothalamus.<sup>17</sup> The hippocampus and the cortex are regions of the brain connected to learning and memory. As a result, THC binding to CB1 receptors can impede an individual's ability to create new memories or shift focus.<sup>5</sup> Similarly, THC and CBD may interfere with the normal functioning of the cerebellum and basal ganglia, which are essential for maintaining balance, reaction time, coordination, and posture.<sup>5</sup>

Phyto-cannabinoids also bind with transient receptor potential (TPR) channels that are responsible for the transmission of ions, which may interfere with the transmission of neural signals.<sup>17</sup> THC, which has a stronger affinity than CBD, also attaches to monoamine transporters such as serotonin, norepinephrine, and dopamine<sup>17</sup> triggering the release of dopamine results in higher than normal levels.<sup>17</sup> Elevated dopamine levels produce 2 main effects. Firstly, it activates the reward system which created a euphoric effect. Secondly, since the system governs behavior such as sex and eating, THC makes marijuana to be addictive as other drugs.

Marijuana's ability to interact with various endocrine systems forms the foundation for its potential use as a treatment for various conditions. Studies have shown that certain nervous system disorders such as migraines, Parkinson's disease, multiple sclerosis, fibromyalgia, and irritable bowel syndrome may be caused by endocrine deficiencies due to genetic or physical factors.<sup>17</sup> Therefore, compounds like THC and CBD may be used to improve the management of these conditions as they have similar mechanisms to the cannabinoids found in the human body. However, the wide range of effects of marijuana suggests that it should only be used under medical supervision as it can have negative effects if abused.

### *Pharmacokinetic of cannabis*

The way that THC, the psychoactive component of cannabis, is metabolized in the body depends on the method of consumption.<sup>17,20</sup> When taken orally, it is processed by the liver

and converted into different metabolites, with the majority being eliminated in the feces and urine.<sup>6</sup>

When consumed orally, THC is metabolized by the CYP450 enzyme system into 2 active metabolites: 11-OH-THC, which is psychoactive, and 11-COOH-THC, which is not. The majority of cannabis is eliminated from the body through feces as the 11-OH-THC metabolite (65%) and urine as the 11-COOH-THC metabolite (20%).<sup>20</sup> Research has shown that the amount of THC that can enter the bloodstream after being consumed orally is low, with a bioavailability of 4-12%.<sup>17</sup>

Moreover, since THC is highly lipid-soluble, it is rapidly stored in fat tissues where it accumulates.<sup>17</sup> From these fat deposits, THC is slowly released back into the bloodstream.<sup>17</sup> On the other hand, if THC is inhaled its metabolites enter the bloodstream more quickly through the lung, and effects are felt within 6 to 10 minutes.<sup>17</sup> Furthermore, a study has shown that CYP2C9 polymorphisms can also lead to significant changes in THC bioavailability.<sup>20</sup> It has been found that CYP2C9 polymorphisms result in a reduction of CYP2C9 metabolic activity which leads to an increase in THC exposure 2- to 3-fold. This type of CYP2C9 polymorphism is highly prevalent up to 35% in white individuals compared with other racial groups.<sup>20</sup>

Like THC, CBD, another chemical found in cannabis, enters the body and is metabolized into multiple metabolites, with the most prevalent being hydroxylated 7-COOH derivatives.<sup>17</sup> The pharmacokinetics of CBD compound is complex. When inhaled, its bioavailability is between 11% and 45%, but when taken orally it is around 6%.<sup>20</sup> Furthermore, like THC, CBD is highly lipid-soluble and distributes quickly into the brain, adipose tissues, and other organs. CBD can act as either an agonist or antagonist to their binding site.<sup>17</sup>

Research indicates how THC and CBD interact with specific enzymes in the body especially cytochrome P450 isoenzymes, which can affect the metabolism of other drugs.<sup>17,20</sup> Some studies have shown that THC is a CYP1A2 inducer which leads to reduced drug concentration by increasing metabolism and consequently decreasing the drug effect.<sup>17,20</sup> On the other hand, CBD has been found to inhibit the activity of CYP3A4 and CYP2D6 enzymes, which can lead to an increase in drug concentration due to a reduction in metabolism, potentially leading to significant adverse effects.<sup>17,20</sup>

## **The Effects of Marijuana on the Human Body**

### *The effects on human cells*

THC and CBD also have a wide range of effects on human cells. The primary effects of THC on the cellular level include the formation of reactive oxygen species (ROS) formation which leads to alteration in lipid metabolism and triggers the release of inflammatory cytokines.<sup>21</sup>

Inflammatory cytokines are classified into 2 categories: pro-inflammatory and anti-inflammatory. Pro-inflammatory cytokines cause inflammation and pain, while anti-inflammatory

cytokines can decrease pain and reduce inflammation. It's crucial to maintain a balance between the 2 types of cytokines. THC's impact on this balance can lead to tissue damage, particularly in organs that are sensitive such as the lungs, liver, and kidneys. Furthermore, THC can cause oxidative stress by producing more reactive oxygen species (ROS) than the body's antioxidant defense system can handle.<sup>22</sup> Oxidative stress results in the formation of free radicals, which are unstable radical molecules with unpaired electrons. Free radicals interact with biomolecules such as carbohydrates, proteins, and lipids, which can cause permanent changes.

Cannabinoids can also contribute to the development of atherogenesis in 2 main ways. Firstly, ROS, which is primarily caused by CB1 receptor agonists, can cause damage to endothelial cells. Additionally, CB2 receptor agonists can increase inflammation and decrease the expression of cell adhesion molecules. Furthermore, lipid metabolism may also be affected by the oxidation of low-density lipoprotein (ox-LDL), which can increase the expression of CB1 and CB2 receptors and enhance the production of endogenous cannabinoids.<sup>23</sup> As a result, it causes the accumulation of lipids in macrophages, which are specialized cells present in the liver and lungs that help eliminate harmful organisms.<sup>23,24</sup> Thus, the active compounds in cannabis can harm different types of cells, particularly in the lungs, liver, kidney, and heart.

### *Harmful effects of marijuana*

The growing legalization and acceptance of marijuana have led to an increase in its use in America for both medicinal and recreational purposes.<sup>25</sup> In 2016 and 2017, more than 39 million Americans reported having used marijuana in the past year.<sup>23</sup> Delta-9-tetrahydrocannabinol (THC) is the most psychoactive in marijuana.

Various organs of the human body contain cannabinoid (CB1 and CB2) receptors, including the brain, peripheral nervous system, liver, skeletal muscles, and myocytes.<sup>23</sup> Due to the location of the cannabinoid receptors on multiple organs, marijuana can have various harmful effects, including interfering with learning ability, mental disorders, addiction, cardiovascular disorders, and certain types of cancers.

### *Cardiovascular disorders*

Marijuana may also increase the risk of individuals developing cardiovascular disorders. Approximately 2 million Americans who have been diagnosed with cardiovascular disorders reported using marijuana.<sup>26</sup> It has been found that smoking marijuana is associated with cardiotoxicity, similar to the effects of smoking cigarettes.<sup>27</sup> Research has shown that smoking marijuana has similar cardiovascular risks as smoking cigarettes. Despite smoking fewer puffs, users inhale deeper and hold the smoke longer, raising the risk of cardiotoxicity.

Additionally, marijuana increases the risk of patients diagnosed with cardiovascular disorders such as atherosclerotic or developing coronary artery disease.<sup>26</sup>

A study previously revealed that cannabis consumption can raise heart rate and blood pressure, thereby increasing the demand for oxygen in the heart. Furthermore, prolonged use of marijuana may cause oxidative stress that leads to cellular damage, platelet activation, induction of an inflammatory response, and the formation of oxidized low-density lipoprotein cholesterol (ox-LDL). THC may also cause a release of catecholamines and beta-adrenergic stimulation, increasing the likelihood of arrhythmias. People who smoke marijuana have a 3.3 times greater risk of experiencing a cerebrovascular event.<sup>21</sup> Marijuana increases the risk of thrombosis and ischemia, which may contribute to the development of peripheral artery disease.<sup>27</sup> Thus, marijuana use can lead to multiple cardiovascular disorders, particularly in individuals who already have these conditions.

### *The relationship with cancer*

Research has been conducted on the potential use of marijuana and specific compounds found in the plant, such as THC and CBD, to alleviate symptoms associated with cancer and cancer treatments, such as chemotherapy. Some evidence suggests that certain cannabinoids may be effective in managing these side effects.<sup>14</sup> It is important to note that marijuana can have adverse effects and potential complications. Choosing to avoid or postpone conventional medical treatment for cancer or relying solely on marijuana to manage the symptoms of cancer, can lead to serious health risks.<sup>28</sup>

Studies on the compounds in marijuana, known as cannabinoids, have indicated that certain cannabinoids may be useful in managing symptoms of nausea and vomiting associated with chemotherapy, as well as in treating neuropathic pain.<sup>28</sup> Marijuana use introduces cannabinoids, including THC, into the body, but it also includes harmful substances such as toxins and carcinogens found in tobacco smoke that can harm the lungs and cardiovascular system.<sup>29,30</sup> While more research is needed to determine the effects of marijuana on lung and other respiratory cancers, limited evidence suggests a connection between marijuana smoking and testicular cancer.<sup>14,31</sup>

The concentration levels of active compounds in marijuana vary depending on the form in which it is consumed, which may explain the different effects on different individuals. Further research is necessary to fully comprehend the effects of marijuana use on cancer.<sup>32</sup>

Another research suggests that using marijuana can increase the risk of developing certain types of cancer. For instance, a study conducted in New York Hospital found that individuals who use marijuana have a 2.6 times higher risk of upper aerodigestive tract cancer. Similarly, there is significant evidence linking marijuana use to Human papillomavirus-16 (HPV-16)

positive head and neck cancer.<sup>33</sup> Additionally, some studies have indicated that marijuana use can increase the risk of developing lung cancer by 8.2 times. However, it is worth noting that heavy cannabis use for over 10 joint years primarily puts adults aged 55 years and older at a higher risk of developing lung cancer.<sup>34</sup>

Marijuana use for over 10 years has been associated with a 1.5 times higher risk of testicular cancer. Additionally, paternal marijuana use has been linked to an increased risk of myeloid leukemia in their children, and maternal marijuana use during the first trimester may increase the risk of neuroblastoma in the child by 4 times.<sup>33</sup>

The effects of cannabis on cancer risk vary depending on the type of cancer, the affected organ, and the receptors that are stimulated.<sup>35</sup> This is due to changes in the representation of CB1 and CB2 receptors observed in various types of cancers.<sup>35,36</sup> For instance, in Hodgkin lymphoma and cellular hepatocarcinoma, the expression of CB1 receptors is increased.<sup>35</sup> Conversely, ovarian cancers are associated with increased severity when CB2 receptors are expressed. Additionally, there is a high correlation between the overexpression of CB2 receptors and human breast adenocarcinoma and glioma, both of which are linked to breast cancer and malignant brain tumors.<sup>35</sup>

In addition, research has linked variations in CB1 and CB2 receptors to poor outcomes following surgery for stage IV colorectal cancer.<sup>35</sup> THC is the primary compound that has been linked to an increased risk of cancer development, and the specific tissue where CB1 and CB2 receptors are disrupted determines the likelihood of cellular abnormalities and changes in enzymes and neurotransmitters.<sup>36</sup> Dysregulation of the endocannabinoid system occurs when there is an overproduction or underproduction of CB1 and CB2 receptors, which can lead to several health problems, including cancer.<sup>36</sup> For instance, up-regulation of CB1 receptors without changes in the regulation of CB2 is associated with an increase in the risk of pancreatic cancer. Conversely, inhibiting CB1 receptors in the colon tissue may increase the risk of colon cancer.

### *Benefits of cannabis*

Cannabis has been cultivated and used by people for recreational and medicinal purposes since ancient eras for the past of hundreds of years.<sup>23</sup> The main component with medicinal purposes is cannabidiol (CBD). CBD attaches to the endocannabinoid system, potentially influencing the nervous system by triggering the release of hormones and other natural compounds like dopamine. As a result, marijuana may be useful in the management of several disorders such as anxiety, psychiatric disorders, pain, and obesity.<sup>23</sup>

Several studies have discovered the efficacy of cannabis in alleviating pain. For example, a study conducted by Wallace et al<sup>37</sup> found that moderate use of marijuana with a THC content of 4% was associated with pain relief. However, high doses

(7%THC) of marijuana were found to increase pain<sup>38</sup> and low doses (1%THC) of marijuana did not have any impact on pain levels.<sup>12,37</sup> The main cannabis element that is used for pain management is Anandamide, which acts as an autocrine or paracrine messenger.<sup>38</sup> The chemical is broken down into arachidonic acid and ethanolamine. The chemical can modulate nociceptive signals that cause pain by activating local CB1 receptors.<sup>38</sup> Marijuana could also be used as an alternative to opioids to relieve pain, despite its risk of addiction, but it is not life-threatening as opioids.

Chronic pain is among the major health issues with a high burden on individuals and society in the US. About half of the physician visits are due to chronic pain, resulting in a total medical cost of approximately \$600 billion annually.<sup>38</sup> Pain is often described as a subjective experience that involves sensory-physiological, cognitive-evaluative, and motivational effective components. In humans, there are 3 main types of pain: nociceptive, neuropathic, and central.<sup>38,39</sup> Nociceptive pain is caused by damage to the tissue and is considered a defensive mechanism. On the other hand, neuropathic pain is caused by damage to the sensory and spinal nerves. Central pain is caused by consistent damage to the central nervous system amplifying pain signals from the periphery.<sup>40</sup>

Other drugs have been used to treat pain, including alcohol and nicotine. However, discontinued use of addictive substances increases pain sensitivity. Marijuana reduces pain by binding CB1 and CB2 receptors that are activated by tissue injury.<sup>38</sup> It also reduces pain by binding to transient receptor potential cation channel subfamily V member 1 (TRPV1) receptors which are mainly found in the nociceptive neurons of the peripheral nervous system.<sup>39</sup> TRPV1 receptors are also found in the central nervous system where they involve in the transmission and modulation of pain, as well as the integration of painful stimuli.<sup>39</sup>

Targeting the endocannabinoid system to modulate pain is a promising way of managing pain, especially chronic pain. Anandamide (AEA) is also produced in injured cells, where it activates the local CB1 receptor, however, AEA is unable usually to activate all the CB1 receptors due to an enzyme called fatty acid amide hydrolase (FAAH) which converts it into Ethanol-amide or arachidonic acid (AA). Exogenous cannabinoids (cannabis) inhibit the FAAH enzyme, and this allows more CB1 receptors activation.<sup>4</sup> Additionally, 2-arachidonoyl glycerol (2-AG) is activated by CB1 receptors and acts as a massager for pain.<sup>38</sup> Since 2-AG is an endocannabinoid, it plays a central role in modulating pain. Therefore, cannabis may suppress pain in a similar way to endocannabinoids by activating CB1 and CB2 receptors.<sup>38-40</sup>

Several research studies have demonstrated that cannabis is remarkably proficient in alleviating pain. For example, a randomized controlled trial found that there is a therapeutic window for using marijuana to reduce pain, particularly when it is smoked.<sup>12</sup> However, another research suggests that oral forms

of marijuana can also reduce pain. While the onset of effects may be slower compared to smoking, the pain relief provided by oral consumption is typically longer-lasting.<sup>41</sup> Additionally, in a different randomized clinical trial, it was observed that the individuals in the intervention group had greater pain relief than those in the placebo group.<sup>42</sup> Cannabis is commonly used to manage chronic pain in individuals with multiple sclerosis and arthritis.<sup>42</sup>

Recent advancements in treating pain among individuals with multiple sclerosis are using drugs that contain cannabis extracts, Sativex.<sup>18</sup> The main extracts that are used to treat pain that is not suppressed by traditional painkillers are cannabidiol and THC.<sup>42</sup> Moreover, Sativex (Nabiximols) is an oro-mucosal and is added in a ratio of 1:1 formulation of THC: CBD to increase the efficacy of suppressing pain. In a randomized blind control, 50% of patients reported experiencing pain reduction compared to only 30% in the placebo group.<sup>42</sup> Additionally, medical marijuana is used by approximately 9.33% of patients to manage joint pain associated with arthritis.<sup>42</sup> Medical cannabis can effectively alleviate pain from various chronic conditions, offering hope for many patients who experiencing chronic pain.

Cannabis can also be used to treat obesity, which is a risk factor for chronic illnesses such as diabetes and cardiovascular disorders. The chemical d-9-tetrahydrocannabinol (d-9-THCV) found in marijuana can be used to treat obesity. d-9-THCV has anti-obesity effects by reducing food intake and increasing energy expenditure, leading to weight loss.<sup>43</sup> Additionally, Cannabis blocks CB1 receptors and activates CB2 receptors that can potentially treat disorders such as obesity and chronic liver disease, particularly if the conditions are associated with inflammation.<sup>43</sup>

Cannabis may also be used to reduce social anxiety due to its neural, symptomatic, and electrodermal effects on fearful faces. Cannabis activates the limbic and paralimbic regions which reduce subjective anxiety and autonomic arousal.<sup>43</sup> Several human and animal studies have shown that CBD possesses anxiolytic properties that reduce social anxiety disorders. Additionally, research has indicated that CBD may be able to prevent acute psychosis. Marijuana is preferred over other antipsychotic drugs because it has relatively fewer side effects.<sup>43</sup>

Cannabis can also be used to manage multiple sclerosis due to its anti-inflammatory and immunosuppressive properties that can assist individuals with hyperactive immune systems.<sup>19</sup> Moreover, cannabis has an apoptotic effect on immune cells, which may help patients with conditions such as rheumatoid arthritis, asthma, and other immune diseases.<sup>39</sup>

## The Effects of Marijuana on the Daily Lives of Individuals

### *The effects of marijuana use on education attainment*

Marijuana has various side effects on the brain that may interfere with learning ability and reduce lifetime achievement in young people. Studies have shown that marijuana use is linked

to decreased learning ability which leads to lower educational attainment, particularly in individuals with high rates of marijuana use.<sup>25</sup> One possible explanation could be related to the adverse effect of marijuana on cognitive functions during acute intoxication and for days after use.<sup>25</sup> The use of marijuana can negatively impact academic performance by hindering a student's natural abilities.

A review conducted by Silins et al,<sup>44</sup> indicated that marijuana use in adolescence can affect academic performance negatively if started early. The study found that people who started using cannabis before the age of 17 were less likely to complete secondary school or pursue higher education. Brook et al<sup>45</sup> in their longitudinal review found that marijuana use at an early age was connected to lower adult income and lower educational attainment.

Prolonged use of marijuana can also negatively affect memory and focus, which are essential for learning. The severity of these effects is heightened with regular use and early initiation. Furthermore, research suggests that the earlier someone starts using marijuana, the less education they are likely to attain. Those who begin using it at a younger age are less likely to achieve as much as those who start using it later in life.

Silins et al<sup>44</sup> found that adolescents who used marijuana frequently had a lower chance of graduating from high school than those who did not use it or used it sparingly. A study by Lynne-Landsman et al<sup>46</sup> found that teenagers who used marijuana frequently in adolescence had a lower chance of finishing high school or getting a degree from a college. Marijuana use can adversely affect work status as well as instructive results compared with the people who didn't utilize marijuana or utilized it just once in a while.

Prolonged use of marijuana can have a detrimental impact on an individual's overall life outcomes. Studies have shown a strong connection between marijuana use and factors such as low income, dependence on social services, criminal behavior, unemployment, and a lower sense of satisfaction with life.<sup>25</sup> The factors discussed are interconnected, where low income can lead to dissatisfaction with life and increase the likelihood of committing crimes and may be caused by unemployment which could be a result of criminal records. Additionally, low income can impede an individual's ability to achieve their goals, such as buying a house or a car. Furthermore, marijuana use can negatively impact educational attainment, leading to unemployment or low wages, and ultimately, lower lifetime achievements.<sup>25</sup>

### *Potential development of addiction*

Marijuana is also an addictive substance and can lead to various social, economic, and physical issues. The addiction properties are mainly attributed to THC, which acts as a partial agonist for CB1, CB2, and peroxisome proliferator-activated receptors.<sup>47</sup> As a result, smoking marijuana can cause feelings of euphoria, easy laughter, talkativeness, and heightened sensitivity to external stimuli, which can make people willing and more likely to

use the drug repeatedly. The level of addiction is determined by several factors, including vulnerability to mental illness, personality traits, and the content of THC.<sup>48</sup>

The amount of THC has significantly increased from 8.5% in 1999 to 20% in 2004 through crossbreeding of hemp plants that contain high THC content.<sup>48</sup> Cannabis addiction shares similarities with other types of addiction, as it is a chronic condition characterized by repeated use, abstinence, and relapse. Additionally, individuals may experience withdrawal symptoms when they stop using marijuana.

Marijuana may have rewarding or aversive effects on the brain by interacting with CB1 and CB2 receptors in the ventral tegmental area (VTA) in the brain.<sup>49</sup> The rewarding effects of cannabis are caused by the activation of CB1 receptors on VTA GABAergic neurons, leading to an increase in dopamine release in the nucleus accumbens (NAc), resulting in feelings of euphoria.<sup>50</sup> However, when cannabis binds to CB1 receptors in the brain's VTA and blocks the release of the neurotransmitter glutamate from glutamatergic neurons, it results in a decrease in dopamine activity in the reward center, leading to aversion and negative effects.<sup>51</sup>

### *Mental health*

The frequent use of marijuana is often linked to anxiety, a condition characterized by excessive fear. Marijuana's impact on the brain can be particularly harmful to adolescents, whose brains are still developing, potentially altering the structure and function of various regions of the brain, such as the cerebellum, temporal, and frontal cortex, depending on the amount of marijuana used.<sup>33</sup> Moreover, cannabis may affect the amygdala located in the limbic system which may limit the ability of people to process emotions, which could affect the mood of the user. Cannabis may impact the limbic system, specifically the amygdala, which can affect a person's ability to process emotions and affect their mood. It may also negatively impact the hippocampus and ventromedial prefrontal cortex, which can affect the brain's ability to learn and remember. Long-term use may also lead to depression and psychoses, especially in those with a genetic vulnerability or preexisting mental illnesses such as schizophrenia.<sup>23</sup> Previous research suggests that starting to use marijuana at an early age can worsen the progression of mental disorders like schizophrenia, potentially causing the onset of a first psychotic episode 2 to 6 years earlier.<sup>25</sup>

Marijuana use, especially in high doses and on a regular basis, can lead to disorientation as well as occasionally unpleasant thoughts or feelings of anxiety and paranoia, according to the Centers for Disease Control and Prevention (CDC).<sup>13</sup> People who use marijuana are more likely to develop both short-term psychosis (such as hallucinations and paranoia) and long-term mental disorders, such as schizophrenia.<sup>52</sup> The link between marijuana use and schizophrenia is stronger in people who start Pot use and has additionally been connected to

despondency; social phobia; thoughts of suicide, attempts at suicide, and ultimately suicide.<sup>14</sup>

A Systematic Review examined the use of cannabinoids to treat PTSD, anxiety disorders, and mood disorders. The authors indicated that cannabinoids may be effective in treating these conditions, but they suggested more research is needed to figure out the best cannabinoid dosages and formulations for different patient populations. In addition, the authors point out that there are risks associated with using cannabinoids to treat mental health conditions, such as the possibility of compulsion and adverse effects. The article emphasizes the necessity of continuing research in this area to better comprehend the likely benefits and risks of using cannabinoids in emotional wellness treatment.<sup>53</sup>

### *Social impacts of marijuana*

Marijuana use can differently affect school, work, and public activity, both positively and negatively. The Public Organization on Chronic drug use states that marijuana use can impede mental capacities, such as memory, consideration, and learning. According to NIDA (2020), this can negatively impact academic achievement and performance, resulting in lower grades and decreased motivation to succeed in school.<sup>54</sup>

Marijuana use can have an impact on a person's work performance as well as their academic performance. Marijuana use was linked to lower job performance and higher absenteeism, according to a study that was published in the *Journal of Addictive Diseases*.<sup>55</sup> As a result, there may be fewer job opportunities, lower income, and negative consequences. In addition, marijuana use can slow down one's reaction time and motor skills, which can be dangerous in certain workplaces, like those where one must drive or operate heavy machinery.<sup>54</sup>

Social life can also be impacted by marijuana use. While certain individuals might find that utilizing marijuana upgrades their social encounters by decreasing social stress and increasing feelings of relaxation, it can lead to unfavorable results. Marijuana use can prompt social withdrawal, diminished relational abilities, and diminished inspiration to participate in friendly exercises.<sup>54</sup>

In addition, excessive marijuana use can result in addiction, which can have negative effects on every facet of life. The National Institute on Drug Abuse (NIDA) estimates that approximately 1 in 10 marijuana users will develop an addiction to the drug, and this percentage rises to 1 in 6 for adolescents who begin using marijuana.<sup>54</sup>

It is essential to keep in mind that a variety of factors, including frequency and quantity of use, age at onset, and individual differences in susceptibility to the effects of the drug, can have an impact on how marijuana use affects school, work, and social life. Additionally, if marijuana use is stopped, some of the negative effects, such as impaired cognitive abilities, may be reversed.<sup>54</sup>

## Conclusion

Marijuana is a substance that is used for both recreational and medical purposes in large quantities, it is still one of the most widely used drugs in the United States and around the world. Marijuana has complicated pharmacokinetics that can have a variety of effects on cells, including the production of reactive oxygen species, changes in the formation of lipids, and the release of inflammatory cytokines. To better comprehend the pharmacological effects of marijuana on human health, additional research is required.

Even though cannabis has been shown to have several health benefits that could help treat and manage conditions like pain, obesity, anxiety, and multiple sclerosis, it is worth mentioning that it also has the potential to cause adverse effects. Marijuana use may still be linked to an increased risk of addiction, mental health disorders, certain types of cancer, impaired learning, and lower lifetime achievement despite having fewer side effects than prescription drugs like antipsychotics and opioids. As a result, when weighing the potential advantages and disadvantages of marijuana use, careful consideration is required.

While marijuana use can improve social interactions, it can also have a negative impact on social, academic, and professional functioning. The utilization of marijuana can hurt relational connections, reduce work environment efficiency, and weaken mental capacities. Public opinion, potential tax revenue, concerns about racial disparities in drug policing, and shifting attitudes toward drug use and addiction all have an impact on the contentious issue of legalizing cannabis in the United States. Concerns about an increase in drug-related addiction persist despite the fact that several states have legalized cannabis for medical and/or recreational use. The legal framework surrounding cannabis is anticipated to become increasingly complex as public opinion shifts toward legalization.

One limitation of the review article is that it does not explore the ideas and thoughts of individuals regarding their perceptions of the meaning, benefits, harms, or needs associated with their cannabis use. While the article may provide valuable knowledge and analysis based on available research and data, it does not dive into the subjective experiences and perspectives of the individuals themselves.

## Author Contributions

The author confirms responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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