CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORT

BACHELOR´S THESIS

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CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORT

Effect of cannabis in sports training.

Bachelor´s thesis

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Drafted: **Yalın Yücel**

Prague 2018

I declare that I have elaborated the thesis independently and that I have provided all the information sources and literature used. This work, or a substantial part of it, has not been presented to obtain another or the same academic title.

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I would like to thank my family and friends, as well as Dr. James Tufano for their support and insight throughout this process and helped writing this bachelor's thesis.

Yalın Yücel

Abstract

Title: Effect of cannabis in sports training.

Objectives: * Present the physiological and psychological effects of cannabis on human body.
* Identify harmful and beneficial effects of cannabis consumption in people who partake in recreational sporting activities as well as competitive athletes.
* Identify the perception of cannabis use in the sports world.

Methods: * Detailed literature research on cannabis and its primary components.
* Literature research on scientific requirements of sports training.
* Systematic review of previous surveys and experiments regarding the effects of cannabis on sports exercise parameters.
* Preparing a questionnaire for sportspeople (current and former Turkish and Czech American football players in general) and analyzing the results.

Results: * There hasn't been many recent scientific research about the specific effects of cannabis ingestion in sports performance.
* There are some beneficial attributes of cannabis in sport training as well as performance hindering attributes and potentially dangerous side effects.
* Questionnaire participants generally do not think cannabis is a performance-enhancing substance.
* There exists contrary opinions, beliefs and scientific evidence on almost all of the aspects of cannabis and its use in sport.

Keywords: *cannabis, sport, American football, athletic performance, marijuana, THC, exercise, workout*

Table of Contents

1. Introduction

Cannabis has historically been involved in the sports world for hundreds of years. In fact, cannabis was one of the ingredients used for an ointment for pain relief at the ancient Greek Olympics [1]. In the 19th century, cannabis was widely used for medicine for a large number of ailments such as asthma, controlling convulsions and muscle relaxation [2][11]. Cannabis has attracted polarizing opinions about many topics such as its health and performance-enhancing benefits and adverse effects. A less scrutinized perspective in the public as well as the loosened laws relating to cannabis in some parts of the world has led to popularization and increase of cannabis use in the community. The growing "medical marijuana" business has led to a belief that cannabis will create a positive advantage in the sporting world [2].

Trying to gain an advantage in any way, shape or form by any means necessary is a common theme among sports. This fearless and relentless, and in some cases reckless, approach of athletes increase in more competitive and professional areas of sports world. Because of this, any substance that is portrayed as potentially performance-altering can be largely consumed by many sportspeople. Cannabis is one of these aforementioned substances that was considered as performance-altering and can provide an edge over opponents by using it.

Cannabis is very well-known and widely used across the world. In 2007, cannabis is used by an estimated 160 million people worldwide [3]. A 2012 survey on drug use in USA has revealed that 7.6 million people who are over 12 years old have consumed a form of THC (tetrahydrocannabinol)-including product in the past month [4]. According to United Nations, 177 million people use marijuana worldwide in 2015 [5]. Although cannabis can be consumed in several different ways, inhalation via smoking is the most common form of marijuana use and therefore this form of consumption is the main focus of this paper.

The usage of cannabis in sports has become a prominent controversial issue debated by authorities ever since World Anti-Doping Agency (WADA) was conceived in the year 1999. Cannabinoids were indeed prohibited only in specific sports before 2004 and the establishment of World Anti-Doping Code (WADC) by WADA. Although the aim of the launch of the WADA by sports movements and governments is to fight

against doping in sports in all its forms, athletes around the world continue to consume cannabis in relation to their sport activities for various reasons. In this paper, these reasons are researched in-depth.

Figure 1.1: Different shapes of cannabis plants.

The reports about toxic effects of cannabis is conflicted [6]. Numerous studies portray that cannabis is a substance that has destructive effects on athletes' performance. On the other hand, other studies presented in favor of the effects of cannabis in sports training.

Playing professional sports has often detrimental effects on the human body which can persist even after retirement. Serious injuries can be suffered which can have lingering effects. Contact sports, unsurprisingly, have high injury rates. Perhaps the most risky sport for that matter is American football. To give an example of the severity, %15 of all NFL (National Football League) players suffered an injury in the first two weeks of 2015 season [7]. In recent years, discussions about marijuana being a safer alternative to painkillers and other related drugs commonly used in the sports world has been increased. This is coincidental with public opinion about medical marijuana changing and people being more open about the idea of using medical marijuana for treatment. Currently, 25 states have legalized medical marijuana but still it is banned in most sports organizations [8][9] .

In this paper, the potential of cannabis usage as a substance that boosts and enhances sports performance, the risks it presents to health of athletes and the stance of cannabis violating the Code in the world of sports will be investigated and analyzed. The history of cannabis usage will be covered along with its structure, effects on the major types of sports, and the reasons behind the controversy and prohibition around it.

Findings from related research papers, studies, experiments and questionnaires are cited throughout the paper. Research was mainly conducted from Google Scholar, with appropriate keywords. Only English language literature was reviewed. No funding is used in writing this thesis. The thesis was written with the intent on giving information about cannabis, its effects and uses and different perspectives about the benefits, drawbacks and potential harmful effects in humans in general and sports training in particular. References and other sources cited in searched materials were also investigated and related parts of those studies are included with reference and citations

in this paper. A questionnaire was prepared about cannabis and sport training and and 30 people participated with sports experience. Results were presented and commented in the paper.

Rest of the paper is as follows. A detailed analysis of cannabis, its chemical agents and structure, as well as its effects and uses is presented in section 2. Information about doping in sports, studies about athletes' perspective and opinion about doping is given in section 3. Studies monitoring effects of cannabis and sports performance are reviewed from different perspectives and its inclusion as a prohibited substance is reviewed in section 4. Historical use of cannabis in professional and amateur, youth sports and current stances on cannabis in sports world, along with a questionnaire and comments about the findings is presented in section 5. Conclusions, comments and future study recommendations are given in section 6. References are given in section 7. Finally, list of tables and figures are given in section 8.

2. Cannabis Structure, Effects and Uses

Cannabis contains over 400 different chemical compounds, including 130 cannabinoids [6]. Cannabinoids are chemical compounds created by the cannabis plant that are used to treat conditions. Cannabinoids mirror the endocannabinoids that human bodies naturally produce. Three main types of cannabinoids are:

*Phytocannabinoids – found in plants.

*Synthetic cannabinoids – produced in laboratories.

*Endocannabinoids – produced in the human body.

Most of the biological attributes related to cannabinoids rely on their interactions with the endocannabinoid systems in humans. Endocannabinoid system consists of: CB1 and CB2 which are G-protein coupled cannabinoid receptors and anandamide and 2-arachnidonylglycerol molecules [12]. Cannaboids are signals in the endocannabinoid systém. The endocannabinoid systém modulates memory, appetite and movement by different parts of the brain (hippocampus, hypothalamus, cerebellum respectively).

Endocannabinoids also thought to play a role in regulating physiological responses such as appetite, pain-sensation, mood, memory, inflammation, insulin sensivity and fat and energy metabolism [12]. 18 different classes of chemicals are influencing to the pharmacological and toxicological properties of cannabis. It's most active substance is Δ9-THC (Δ9-tetrahydrocannabinol) [6], however; other cannabinoids also contribute to its pharmacological effects.

The naturally occuring cannabis plants are cannabis sativa, cannabis indica and cannabis ruderalis [10]. Hashish and marijuana is derived from cannabis [6]. Female cannabis sativa produces the largest amounts of phytocannabinoids [12].

Marijuana (herbal cannabis) and hashish (resinous cannabis) are THC-containing cannabis products. Marijuana is produced by drying the leaves and flowering of the cannabis plant. They can be consumed by rolling them and ingesting their smoke. THC, cannabidiol (CBD), cannabichromene (CBC) and cannabigerol (CBG) are the most common cannabinoid acids. [13]. CBD impacts the brain without a high and THC has pain relieving properties. Because of these reasons, these two active chemicals in cannabis are thought to have use in medicinal applications [8]. Cannabidiol(CBD) doesn't have a psychoactive effect, meaning that this substance doesn't chance brain function or result in alterations in perception, mood, conscuisness or behavior. CBD possesses anxiolytic (anxiety-relieving), antipsychotic (tranquilizing) and alerting properties. [6]. THC in plants are mostly in the inactive form THC-COOH(11-Nor-9-carboxy-Δ^9 -tetrahydrocannabinol, often referred to as 11-nor-9-carboxy-THC or THC-11-oic acid),. THC is released by combustion or chemical processing [2].

THC is highly lipid and stored in the fat cells of the human body. Daily use result in slower release of THC from the body because it is stored in fat cells. Because of its lipidity, it is a poorly water-soluble material. THC has low bioavailability which means that a small percentage of the substance enters the circulation in the body. Cannabinoid concentrations in bodily fluids depend upon cannabis potency, consuming frequency and time since last use [6]. Groenthermen et al. found that its bioavailability of THC in the body is usually below 10 percent. [13]. After inhalation, THC is rapidly absorbed in the bloodstream. THC is metabolised in the liver by CYP 2C9 and CYP3A4 predominantly to 11-OH THC and subsequently THC-COOH [6]. The physchological euphoria “high” feeling starts around 20-30 minutes after inhaling and reaches its peak at around 45-60 minutes after inhaling, subsequently the plasma concentrations are falling in the bloodstream [2].

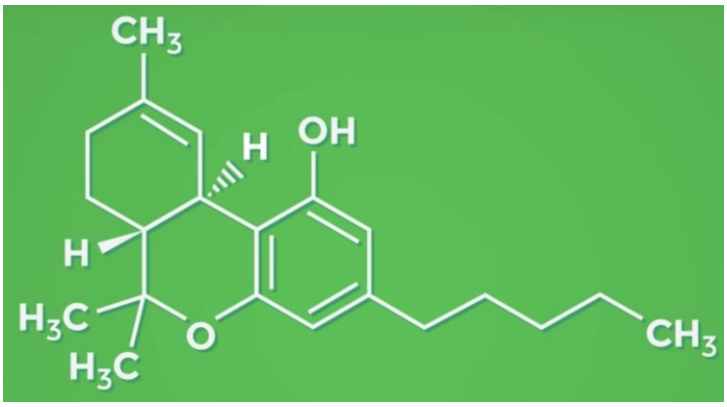


Figure 2.1 : Tetrahydracannabidol molecule

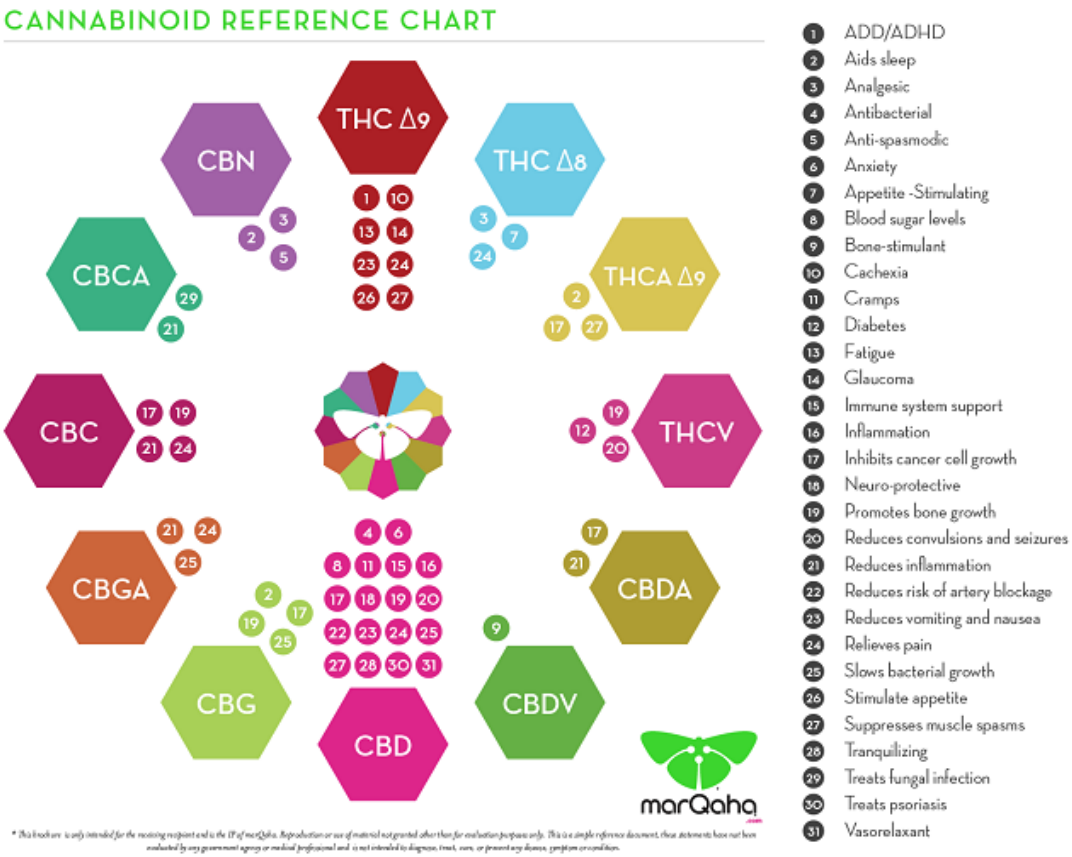


Figure 2.2: Cannabinoid chemicals found in cannabis and their potential uses (Taken from nhmarijuana.com)

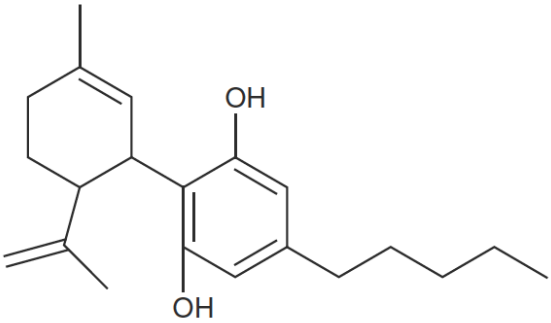


Figure 2.3: Chemical structure of Cannabidiol (CBD) [6]

Cannabinoid agent	Attributes and Effects
Δ9 THC (tetrahydrocannabinol)	Psychoactive, euphoria, sensory enhancement, pain relief, muscle relaxant, anti-inflammatory
CBD (cannabidiol)	Not psychoactive, Anti-depressant, improve blood circulations, mitigates spasms
Δ8 THC	Anxiolytic, improve appetite, analgesic
CBG (cannabigerol)	Not psychoactive, used in medical strains, lower blood pressure, anti-imflammatory
THCA Δ9 (tetrahydrocannabinolic Acid)	Most abundant in live plant, converts to THC
CBGA (cannabigerolic acid)	Becomes other forms such as THC and CBG via biosynthesis, provide medical elements
THCV (tetrahydrocannabivarin)	Not psychoactive, decrease appetite, mitigates seizures
CBC (cannabichromene)	Not psychoactive, contribute to overall analgesic effects
CBN (cannabinol)	Found very little in fresh plants, mild psychoactivity, drowsiness, mitigate spasms

Table 2.1 : Cannabinoid agents and beneficial effects.

THC is a partial agonist to CB1 and CB2 [2]. THC has two receptors in the human body; CB1 and CB2. CB1 is primarily found in the central nervous system and functional areas that lead to familiar behavioral effects of cannabinoids. CB2 receptors are in peripheral tissues, producing an analgesic, i.e. pain decreasing, effect. [6]. CB1 receptor density is high in the cerebellum and prefrontal cortex in the brain. These parts of the brain are responsible for motor control and decision making, respectively [6]. THC is distributed primarily to brain, heart, liver and kidneys.

Numerous cannabimimetics (cannabis receptor agonists) are being developed that have similar pharmacologic effects but limited negative side effects. Groenthermen and Müller-Vahl have explored the therapeutic potential of cannabis and cannabinoids and reported positive results on some ailments and diseases such as chronic pain and spasticity [14]. They stated that cannabinoids have antispastic, analgesic, antiemetic, neuroprotective and anti-inflammatory actions and are effective agaisnt certain psychaitric diseases [14].

The most common neurocognitive effect of putting cannabis in body is short-term memory loss. Also, motor skills, decision making and inhibitory control are also decreased [6]. Cannabis results in behavioural, physiological and biochemical changes in humans. An important point to add is that the behavioral and subjective effects of cannabis depends on the dosage. The physiological and subjective effects of cannabis appear after the first intake of a THC-containing product [6].

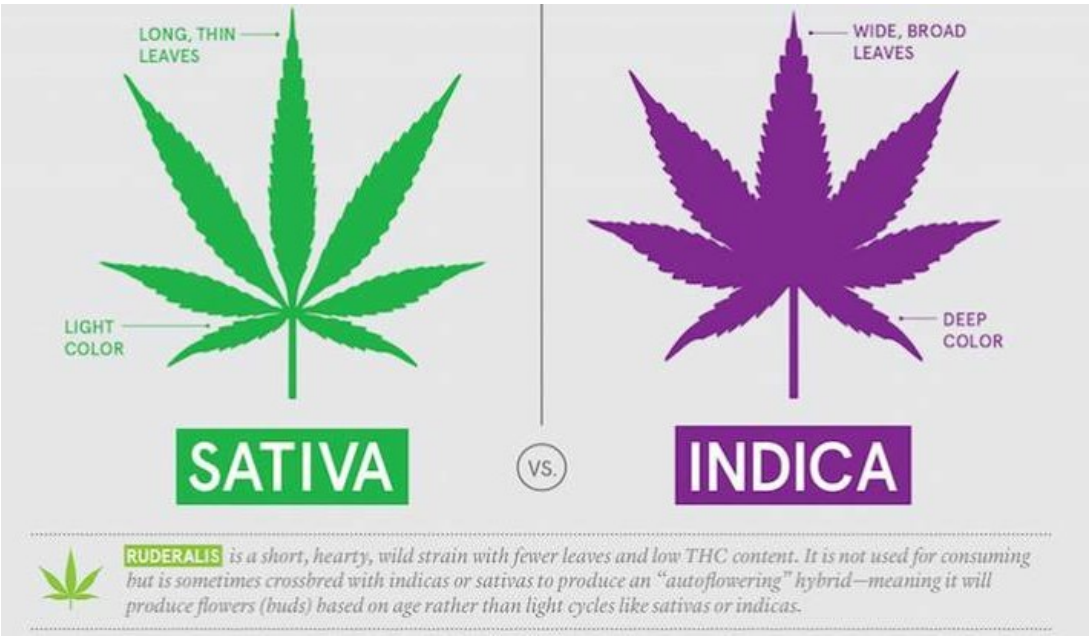


Figure 2.4: Cannabis leaves(image taken from nhmarijuana.com)

Cannabis Sativa	Cannabis Indica
Taller Plant	Shorter Plant
Thinner Leaves	Thicker Leaves
CBD – Dominant	THC – Dominant
Pain-relieving	Anxiety-relieving

Table 2.2: Comparative analysis of cannabis sativa and cannabis indica.

Acute psychological effects are varied from user to user. These effects are dependent of the dosage, tolerance and experience of the user. Also, they are dependent on the general mood and perception of the user. However, some functions are impaired including memory and reaction times. The impairment can be initialized after a single dose and can last up to three hours. Acute anxiety, panic attacks and hallucinations are possible to occur after a single large dose [15]. Other sensory and psychological effects of cannabis can be listed as euphoria, sedation, relaxation, lack of concentration, learning and memory difficulties, panic reaction and mood swings [6].

Cannabis possess a risk of overuse, dependency and abuse because stimulating effect of THC on the brain reward system has similar characteristics to other drugs of abuse such as cocaine and nicotine. To add to this, consistent cannabis use may build a tolerance on the user, which may lead to dependency [6].

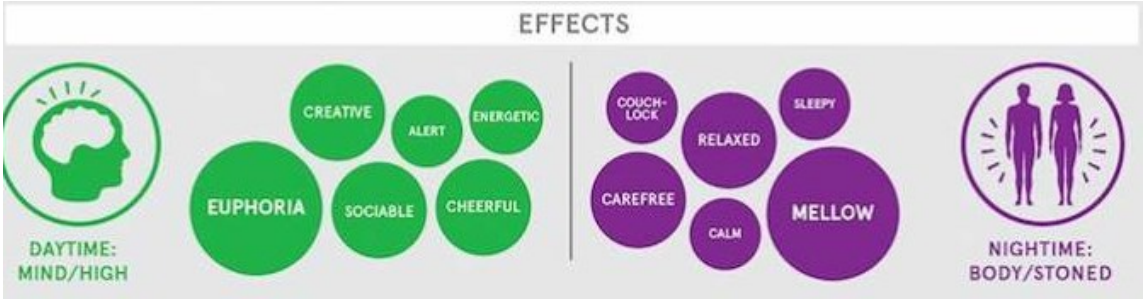


Figure 2.5: Pro-cannabis stance effects of cannabis (image taken from nhmarijuana.com) Green = sativa, Purple = indica

Physiological effects of THC includes pulmonary (lung functions) and cardiac (heart functions). Several research papers stated that long-term use of THC can be detrimental to pulmonary functions and can lead to coughing, wheezing and build-up of phlegm [2][6].

In an experiment conducted by Aldington et al., it has been found that one cannabis joint had a similar effect to 2.5 to 5 tobacco cigarettes in airflow abduction. Furthermore, a dose-response relationship (doses higher than a threshold produces a response with a graph shaped like a hyperbolic curve) was found between cannabis smoking and reduced airways conductane and total lung capacity [3]. On the other hand, a study published in Journal of the American Medical Association in 2012 found that marijuana does not impair lung function. Researchers tested the lung functions of 5115 young adults over the course of 20 years. While tobacco smokers lost lung function over the period of time, marijuana users didn't experience this effect [8].

Table 4 Regression coefficients for association between selected lung function variables and cannabis and tobacco use

Lung function variable	Cannabis association per joint-year OR (95% CI)	Tobacco association per pack-year OR (95% CI)
FEV_1/FVC ratio	−0.019 (−0.033 to −0.0048)	−0.15 (−0.20 to −0.096)
sGaw (/s.kPa)	−0.0017 (−0.0026 to −0.0009)	−0.007 (−0.01 to −0.004)
FRC (l)	0.0013 (−0.00013 to 0.0027)	0.0057 (0.0005 to 0.0109)
TLC (l)	0.002 (0.0004 to 0.004)	−0.0006 (−0.006 to 0.005)

FEV_1, forced expiratory volume in 1 s; FRC, functional residual capacity; FVC, forced vital capacity; sGaw, specific airways conductance; TLC, total lung capacity.

Figure 2.6 : Regression in different lung functions observed in study by Aldington et al. [3]

The universal cardiac response of cannabis intake is the increase of resting heart rate. [16]. This is usually followed by dizziness, disorientation, increased subjective feelings of euphoria (i.e. “high”) and intoxication (“stoned”). Other undesired mental effects such as psychosis, panic reactions and paranoia may also be observed [6]. Cardiovascular damage is associated with chronic cannabis exposure.

Studies investigating the effects of cannabis consumption by patients with coronary diseases showed that the patients smoking cannabis reached a point of extreme fatigue far more earlier than patients inhaling placebo cigarettes[2]. The effect of THC was probably due to the increased myocardial oxygen demands caused by the earlier increases in heart rate that commence within minutes of inhalation but an additional direct effect on the coronary circulation could not be excluded.

A report [3] has associated smoking cannabis with serious heart ailments and cardiovascular events such as cardiomyopathy stroke and peripheral arteritis, as well as sudden death [18].

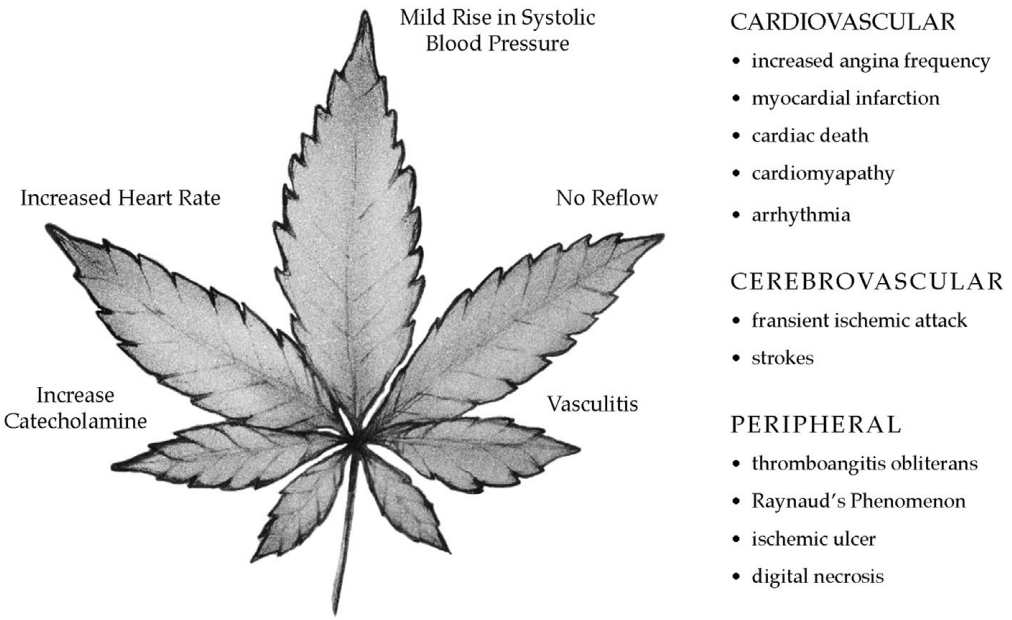


Figure 2.7 : Adverse cardiovascular, cerebrovascular, and peripheral vascular effects attributed to marijuana use. [18]

Scientists led by Battistella et al. claim that cannabis use is associated with gray matter volume reduction in parts of the brain where CB1 receptors which THC is binded are in high quantity [19]. These parts of the brain are associated with motivational, emotional and affective processing.

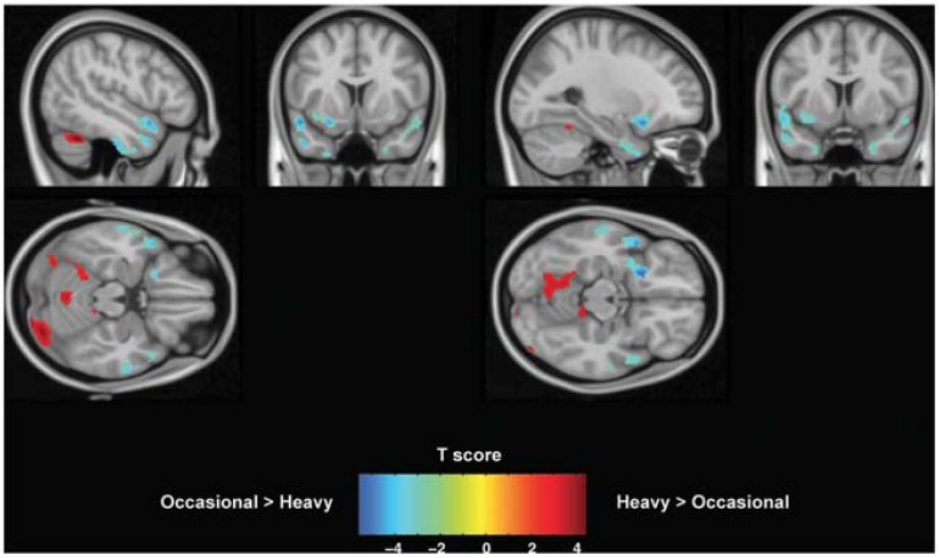


Figure 2.8: Voxel-Based Morphometry results on gray matter. Cold color = occasional smoker has more gray matter in that area. Hot color = heavy smoker has more than occasional smoker [19].

Adverse events associated with cannabis-based medicines.

Side effect	Most common	Common	Rare
Drowsiness/fatigue	✓		
Dizziness	✓		
Dry mouth	✓		
Cough, phlegm, bronchitis (Smoking only)	✓		
Anxiety	✓		
Nausea	✓		
Cognitive effects	✓		
Euphoria		✓	
Blurred vision		✓	
Headache		✓	
Orthostatic hypotension			✓
Toxic psychosis/paranoia			✓
Depression			✓
Ataxia/dyscoordination			✓
Tachycardia (after titration)			✓
Cannabis hyperemesis			✓
Diarrhea			✓

Figure 2.9: Adverse effects associated with cannabis-based medicines identified by MacCallum et al. [11].

Of the studies investigated by M. Kennedy about the relationship with cannabis and sports performance, none of the experiments showed any improvement in athletic performance. He claimed that THC does not enhance aerobic exercise or strength [2].

Not all users experience the adverse effects of cannabis. Atakan et al. Did a double-blind placebo-controlled experiment comparing the neural response of THC among healthy volunteers. They observed that acute psychotic symptoms were associated with activation of ventral and medial temporal cortex and cerebellum. This suggests that these regions mediate the effects of the drug on psychotic symptoms [20].

There is evidence that cannabis chemicals are effective in relieving symptoms of several diseases such as Dravet's Syndrome, eye disease glaucoma, Alzheimer's, as well as stopping cancer from spreading on the body. It also can be used for easing pain of muscle spasms and arthritis discomfort [8]. These studies suggest that medical marijuana can be used for treatment of some diseases. It can be concluded that it can be beneficial for the treatment and recovery after intense training sessions or games in sports world.

The large spectrum of different effects of cannabis makes it impossible to classify the substance as a stimulant, sedative, tranquilizer or hallucinogen [6]. While a person can feel carefree and happy, at the same time they are at the risk of stressed, depressed or paranoid moods [21].

The controversial and varying results and opinions about cannabis can be observed in studying the effect of cannabis and appetite. The relationship between marijuana and “munchies”- the inexplicable drive to eat especially craving for fast food or other forms of junk food, have long between investigated. Marjuana use is often associated with this snacking behavior [22]. It is argued that munchies is stimulated by the active ingredients of marijuana, the cannabinoids [5]. It is stated that endocannabinoids produced in mammals act as metabolic regulators with diverse effects such as regulating bodyweight [22].

A study published in American Journal of Medicine suggested [23] that marijuana users have a lower BMI than non-smokers. The same study also stated that smokers had a better bodily response to sugar than the control group [8]. Tasker et al. show that chemical actions happening through membrane receptors lead to fast

feedback inhibition of corticotropin-releasing factor (CRF) by glucocorticoids (GC). Also, similar GC action can be observed in the hypothalamus, that could explain GC effects on desire of food intake [24]. A dose-response relationship between marijuana and increased appetite is found in one study where smoking one cigarette didn't result in an increase in food intake while higher doses of marijuana showed increased caloric intake due to snacking between meals [22].

Even in a subject such as the effect of cannabis in appetite has vastly different arguments and scientific results. Further research must be done to get a concrete closure to the complex relationship between cannabis and appetite [22]. The CB1 receptors that mainly reside in the brain also appear in stomach and intestinal tissues. When CB1 receptors are agonized, the feeding behavior is stimulated [22]. the relationship between marijuana and bodyweight looks simple; stimulation of CB1 receptors causes weight gain, antagonism of CB1 receptors causes weight loss. However, studies have shown some surprising results as well.

3. Doping in Sport

In the subject of doping in sports, it's unsufficient to only study and investigate what happens to the body when performance enhancing substances are taken. To add to this point of view, to understand what the athletes believe and know about doping and also why they choose to use doping is essential for a better grasp of this subject. Drug use in sport can have a variety of motives behind it. These can be increasing strength, endurance, power, recovering, pain and tremor relieving, anti-inflammation and in some cases feeling calm and relaxed.

Just as drugs that enhance exercise capacity and/or athletic performance are often called "ergogenic," drugs that impair these functions can be termed "ergolytic."

In a survey of literature research conducted by J. Morente-Sanchez and M. Zabala, popular reasons given for an athlete using performance-enhancing substance (PES) are improving performance to obtain athletic accomplishments, monetary gain, creating an improvement in recovery, enhance nutritional quality and the belief that other athletes are using them [9]. Athletes are aware that doping is cheating , potentially dangerous for the body because of its possible side effects and risky because of the anti-

doping agenda in professional sports. However, they also recognize their positive effects and the support it gives for reaching their athletic goals.

WADA updates its Code (World Anti-Doping Code), i.e. the core document that harmonizes anti-doping policies, rules and regulations within sport organizations and public authorities, annually since its inaugural release in 2004 [25]. This Code and its related documents are used for outlining the international anti-doping standards. To be included in WADA prohibited list, two of the three following criteria must be met for a substance or method. These criteria are:

* Enhancing or having potential to enhance performance (article 4.3.1.1)
* Representing an actual or potential health risk to athlete
* Violating the spirit of sport described in the introduction of the code. [6][21]

The spirit of the sport is defined as protecting and providing a collection of essential values to be shared in sport. These values include ethics, fair play, honesty, health, respect for rules and laws, among others. These values are contrary to doping Before the creation of the WADC by WADA, cannabinoids were allowed in various sports [6]. With the inaugural Prohibited List by WADA, cannabinoids ban extended to all sports competition. In the WADA Code, it is stated that participating in doping-free sports events are defined as a fundamental right of an athlete [25]. Aims of the World Anti-Doping Code are given as follows; to promote health, equality and fairness for athletes worldwide, and to guarantee harmonized, coordinated and effecgtive anti-doping programmes for detecting, deterring and preventing doping in sports. [25]

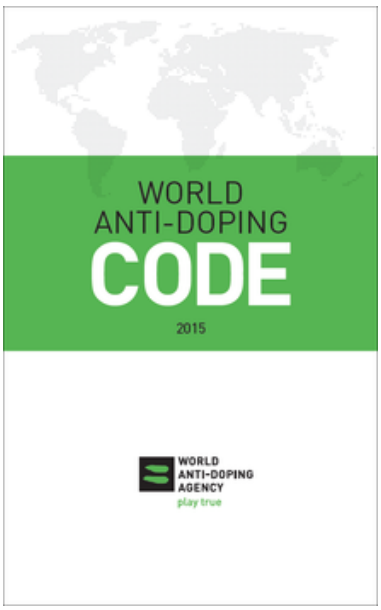


Figure 3.1 : World Anti-Doping Code

Most frequent answers given in surveys about reasons for doping use are presented below.

Strieger et al. (n=101) [9]:

1) Achieve athletic goals and success (%86)

2) Financial gain (%74)

3) Increase self-confidence (%30)

4) Social recognition (%24)

Nieper [26] (n=34 elite British junior athletes)

1) Protect health (%45)

2) Enhance immune system (%40)

3) Improve performance (%25)

Erdman et al. [9] (n=582 athletes)

1) Increase energy (%54.3)

2) Maintain health or prevent nutritional deficiency (%53.8)

3) Improve exercise recovery (%52.2)

Bloodworth et al. [27] (n=403)

* Supplement use is necessary to be successful in sport (%15)

Lentillon-Kaestner et al. [9] (n=8 elite young cyclists)

* Open to use doping substances after turning pro if it's necessary to continue their career (%100) .Another study showed that an individual's decision to take banned substances is influenced by the assumption that his or her competitors are also taking drugs.

(n=458 French elite student-athletes aged 16-24 [28]

* Doping is dishonest, unhealthy and risky (%95).

* Doping is a means to enhance performance (%69)

* Doping is a means to improve recovery (%42)

* Doping is a means to earn money. (%28)

Opinion about doping	# and Percentage
Dangerous and useless	242, %52.8

Dangerous but improves performance	103, %22.5
Dangerous but essential to achieve success	113, %24.7

Table 3.1: Identified groups of subjects in cross-sectional study [116].

WADA authorities consider a substance's potential health risk when deciding whether to include a method or a class of drugs to be included in the Prohibited List [6]. IOC has also adopted a similar stance when it was in charge of determining prohibited substances. It is clearly stated in World Anti-Doping Code section 4.3.1.2 that "medical or other scientific evidence, pharmacological effect or experience that the use of the substance or method represents an acutal or potential risk for the athlete".[29].

In WADA regulated rules, punishment for a positive urine test for cannabinoids range from warning to 2 year bans. Repeat offenders are in risk of lifetime bans [6].

4. Cannabis Use and Effects in Sports: Is it Doping?

To get the picture of the magnitude of cannabis involvement in sport circles, there have been some studies that use interviews and questionnaires with different target groups. From a social standpoint, it can be pointed out that cannabis is the most widely used illegal substance in many countries with peak ages are late teens to early 20s [30]. Statistics suggest that cannabis in sport would be prevalent and reflect the recreational use pattern in countries because elite athletes are generally young adults (18-25 years old).

Patrick Peretti-Watel, with the help of other researchers, has contributed to uncovering the relationships between cannabis use and sportspeople, especially young adults in France. A survey of 1305 French sport students from six universities resulted in 1152 completed questionnaires. This survey showed that 18-24 year olds use cannabis most frequently than other age groups. %31.8 of interviewed 18-24 year olds used more than 10 joints in the past 30 days. In another study, %12.5 of 10807 French students who play sports aged 14-19 raported that they use cannabis occasionally. %6.4 of them reported to use cannabis regularly. [31]. 12.5% of the French students stated

they used cannabis to enhance performance largely because of the relaxing properties of the drug [32].

It has been argued in many articles and studies that smoking cannabis can be addictive and can negatively affect health. Results of some of the scientific studies regarding marijuana has shed light on some of the mysteries about its effects on athletes. There are a few known pioneer experiments conducted in 1970s and 80s.

One of the first known studies regarding this subject was conducted by R. Steward and M. Singh in 1975[4][33]. The experiment results showed that while there were no changes in grip strength, resting heart rate, blood pressure and physical work capacity was seen to be decreased after smoking compared to smoking placebos. In another experiment, subjects are tested 10 minutes after smoking marijuana containing %1.7 Δ9-THC. The results showed that there has been a slight decrease in work capacity. Some other experiments conducted in late seventies demonstrate that THC can decrease psychomotor performance and reaction time [4][33].

A dose-response study of THC on human mood and skills performance was conducted in 1990 [15]. 0, 5, 10, 15 and 20 mg THC was given to volunteer groups of 16. because of the fact that linear regression of performance of volunteers was observed for up to 200 minutes after usage, orally induced THC was claimed to impair performance for a prolonged amount of time. Also, similar results were reported on the subjective “stoned” feeling suggesting a correlation between THC and effects on mood [15].

Acute effect	Effect on performance	THC dose
Resting heart rate and both systolic/ diastolic blood pressure were significantly elevated at rest	Physical work capacity at a heart rate of 170 decreased by 25% compared to placebo	18.2 mg of Δ^9-THC
Induced tachycardia at rest	VE, VO_2 and VCO_2 were increased above control at ≥50% max effort; Small, but significant reduction in maximal exercise duration; tachycardia up to 80% of maximum effort and during recovery	7 mg/kg marijuana (containing 1.7% Δ^9-THC)
Increased heart rate and the rate-pressure product at rest	No effect on blood pressure, ventilation or oxygen uptake during submaximal exercise (15 min at 50% of VO^{2max}); increased heart rate and the rate-pressure product during recovery	Smoking 7.5 mg of Δ^9-THC

Figure 4.1: Research results related to THC intake and sports performance [4].

Subjects	Dose	Parameter	Result
10 males 41–53 years with 75% coronary artery occlusion	19.8 mg THC Vs placebo	Bike exercise to angina	Earlier onset of angina with THC
10 males 43–55 years with 75% coronary artery occlusion	18.9 mg THC Vs nicotine 1.8 mg	Bike exercise to angina	Earlier onset of angina with THC
20 males 21–27 years (18 finish)	18.2 mg THC Vs placebo	Bike exercise	Fall in peak work capacity (PWC 170)
		Grip strength	No change in hand grip
6 males 21–27 years	7.5 mg THC Vs placebo	Bike exercise 40–50% VO2 max	THC caused increased peak double product, tachycardia persisted longer into recovery. Subjects considered exercise harder after THC
12 males 20–27 years	Chronic oral increased doses to maximum of 210 mg	Modified Masters Step test	blunting of haemodynamic responses causing 2 unable to complete study
9 males, 3 females 20–24 years	7 mg THC	Bike exercise to exhaustion	Decreased maximal workload $p < 0.05$
10 males 19–59	20 mg THC	Bike exercise to exhaustion	All decreased exercise duration
13 males, 1 female 19–40 years, regular users	3.7 ± 0.82 g cannabis/week	50% VO2 max for 35 min bike exercise	Plasma concentration THC increased $p < 0.001$
5 males, 1 female 25–34 years, regular users	15–30 g hashish or equivalent/week	60–70% predicted maximum pulse rate for 45 min bike exercise	THC concentrations increased $p < 0.001$
8 females, 4 males 22–28 years	5.9 ± 3.1 joints per day	10 sessions of 30 min at maximum tolerated level on treadmill (~60% VO2 max)	Decreased cannabis use
10 Drug free users ≥ 30 days 31–35 sex not stated	N/A	30 min of light exercise and 30 min of moderate exercise	cannabis craving decreased with moderate exercise
13 cannabis users, 18 cannabis + cigarettes users. 17 cigarette users, 17 used neither. All males	Smoked several times/week	Bike exercise to exhaustion	A fitness study on industry workers. No difference between cigarette smokers & cannabis users
5 females, 3 males 19–50 years	2% THC Vs isoproterenol 0.5%	Bike exercise 6–10 min, increasing exercise by 6–10 min or treadmill exercise	Inhibition of exercise induced asthma
16 males 21–44, 12 receive THC and Synhexal	THC 30–60 mg Synhexal 50–200 mg	Finger ergograph	"Weakness was clearly demonstrable" no quantitation provided

Figure 4.2: Studies searching the effect of cannabis and various sport performance variables reviewed by M. Kennedy [2].

Studies show that cannabis doesn't physically advance performance. However, because of the fact that THC is included in the prohibited list prepared by WADA, most sports organizations will not allow THC use in their sports. THC is highly detected among drug tests for athletes because it is so commonly used. There hasn't been any concrete and scientific evidence on ergogenic or performance enhancing effects of marijuana use. However, some researchers claimed that cannabis is ergogenic for helping reduce fear feelings, healing from a traumatic event and preventing learned adverse behaviors. It has also been suggested that cannabis smoking reduces anxiety, allowing athletes to better perform under pressure and to alleviate stress experienced before and during competition [6].

Using cannabis for sports training can be performance-enhancing in some specific circumstances; however, it is generally found to have hindering effects on performance [4] because it decreases coordination, distorts spatial perception and alters perception and awareness of passage of time. Cannabis can only indirectly improve performance by giving the euphjoric effect to reduce anxiety and relaxing after workouts or competition. The anti-doping perspective advocates can suggest that this effect is evidence that cannabis is doping; however it harms performance and motivation with regular use [21]. It has reported that cannabis has positive effects for improving vision for goalkeepers [6]. Saugy et al. Stated that occasional consumption of cannabis can lead to mild intoxication, slower reaction times, memory problems and drowsiness [21]. Because of the psychomotor repercussions and regressions associated with cannabis intake such as heaviness feeling and fatigue in limbs, they argue that only acceptable beneficial reason for smoking cannabis as an athlete is to relax, escape from social pressures and helping get a good sleep by consuming before bed [21]. Some other indirect risks of cannabis use of athletes can be stated as;

* Potentially altering the perception of risk which can lead to poor decision making [6].

Sport-related effects	Effect
General	Increased pain threshold, decreased focus, worse reaction time, no direct cause for muscle gain or fat loss
Muscle Gain	Can increase appetite, can improve recovery, better perspective during workout
Fat Loss	Can make exercise more enjoyable, obesity rates lower among users, junk food tendency

Table 4.1: Generalized effects of cannabis in sports-related effects.

Buchowski et al. examined the effects of aerobic exercise on cannabis craving. They found that exercise reduces the craving and the feeling of snacking behavior. However, they treat this experiment as a pilot study and more trials and tests are needed on this subject [34]. From this experiment, it can be argued that athletes are less prone

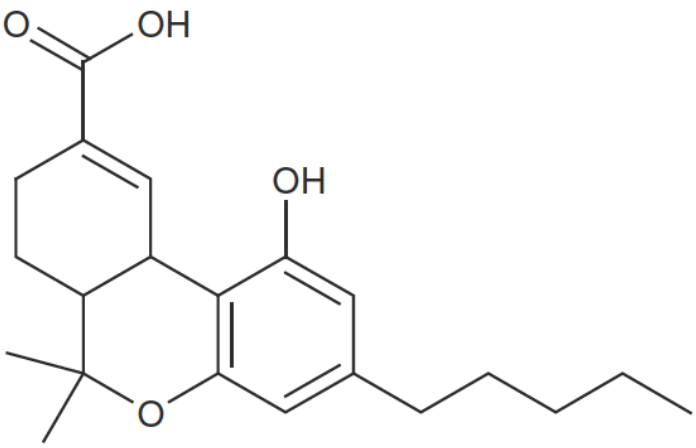
to the effects of craving and poor eating habits developed by „munchies“ because they are exercising frequently.

Marijuana is banned in the highest level of sport such as the NFL, NBA and Olympics. WADA laboratory results show that cannabis is the most frequently detected substance in positive tests [97]. On the other hand, some other leagues have more relaxed rules about it. The CFL doesn't test for marijuana and NHL players do not get punishment for positive tests [7]. There are arguments for legalization of marijuana in the NFL. The pro-marijuana advocates state that legalization of marijuana in sports will improve athletes' overall health by decreasing prescription drug abuse and being a preventive measure for concussions in football players [9]. In theory, it is possible to apply for a medical exemption if the player has a medical condition that can be treated by smoking marijuana. However, while some other drugs and substances can be subject to an exempt, THC almost never gets permission even in a situation like this.

A study done by researchers at Washington University has revealed some chilling results. According to this study, retired NFL players misused pain medications more than four times than someone from general population. Furthermore, %71 of players who used painkillers during their careers confessed to abusing or overusing them [9]. To add to this study, %66 of active NFL players said that allowing marijuana use in the league will decrease chemical painkiller usage throughout the league [9].

Cannabis is banned by the IOC in 1989. WADA has banned cannabis for all sports competition in 2004. [29]. The test for cannabis use is done in-competition season.

THC is metabolized in the body to multiple forms of alcohols and acids but THC-COOH (11-nor-9-carboxy-Δ9 -THC) was selected as the molecules to monitor in almost all of the drug-testing programmes because it is the most abundant cannabis related molecule found in urine samples [6]. With the limit for a positive test at >15 ng/mL, a urine sample with THCCOOH amount greater than 15 ng/mL is reported by WADA-accredited laboratories as an adverse analytical finding (AAF) [6]. However, it should be pointed out that recently Brenneisen et al. suggested that THC, 11-nor-9-carboxy-Δ9 -THC and 11-hydroxy-Δ9 -THC all should be considered as target analytes for cannabis doping [4].



THCCOOH

Figure 4.3 : THCCOOH chemical structure. THCCOOH is the target molecule in drug tests done with urine samples.

Table II. Adverse analytical findings (AAFs) for cannabinoids from 1998 to 2009 from the International Olympic Committee (1998–2002) and the World Anti-Doping Agency (2003–9)

Year	Specimens (n)	Total AAFs (n)	AAFs for cannabinoids (n)	AAFs for cannabinoids (%)
2009	277 771	4567	352	7.7
2008	274 615	5523	496	9.0
2007	223 888	4850	576	11.9
2006	198 143	4332	553	12.8
2005	183 337	4298	503	11.7
2004	169 187	3305	518	15.7
2003	151 210	2716	378	13.9
2002	131 373	2371	347	14.6
2001	125 701	2075	298	14.3
2000	117 314	2228	295	13.2
1999	118 259	2341	312	13.3
1998	105 250	1926	233	12.1

Figure 4.4: Percentage of positive tests caused by cannabis in WADA laboratories [6].

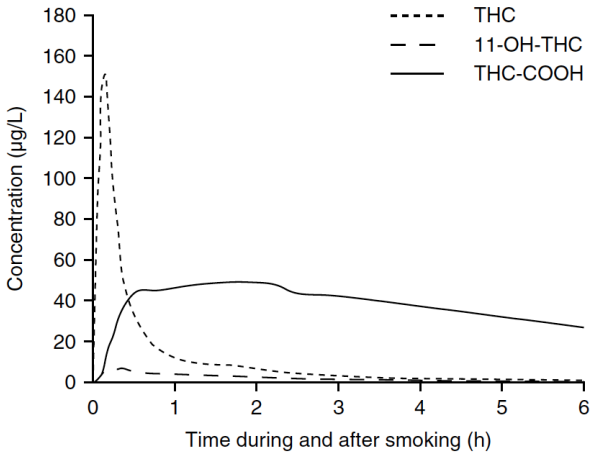


Fig. 5. Mean plasma concentrations of Δ^9-tetrahydrocannabinol (THC), 11-hydroxy-THC (11-OH-THC) and 11-nor-9-carboxy-THC (THC-COOH) of six subjects during and after smoking a cannabis cigarette containing about 34mg of THC.[35]

Figure 4.5: concentrations of THC, THCCOOH and 11-OH-TC in plasma concentration after some time has passed from smoking [13].

In infrequent users, a positive urine cannabinoid test would likely be positive 4 days after smoking. Daily and extended using results in positive tests for up to 4 weeks[6]. Groenthermen stated that a single dose of THC may be detectable in urine for up to 12 days [13]. For the urine to be cleared from THC, it took 8.5 days on average for infrequent users and 19.1 days for daily users [13].

The adverse effects of cannabis on psychomotor performance and overall physical exercise performance is well-documented. As cannabis smoking impairs exercise and psychomotor performance (such as sedative effect, slower reaction times and other psychomotor effects), its ability to serve as an ergogenic aid has been questioned, and is generally considered to be an ergolytic drug [4][97]. Even with its detrimental properties, it is paramount to identifying the reasoning behind its popularity.

Prohibition of cannabis in sports competitions was a hotly discussed subject in World Conference on Doping in Sport in Copenhagen in 2003. Some of the delegates vehemently disagreed with the inclusion on cannabis on Prohibited List, stating that cannabis is not a PES, while some of the other delegates defended that cannabis is indeed a PES. Another argument for inclusion of cannabis in the list is that because of the fact that it is an illegal substance in most countries, athletes shouldn't be allowed to consume cannabinoids due to athletes being seen as role models in societies [6].

The international anti-doping community defend that athletes are role models in today's society and should be held in higher standards. Use of a substance that is portrayed as an illicit drug which is illegal in many countries, and advertised as harmful and addicting is not consistent with an athlete that should be a role model to the youth.

A questionnaire was prepared to gauge the knowledge and perception of cannabis on sportspeople. Privacy was an important aspect and no name and age was taken. The questionnaire participation happened via Google Forms. The main goal was to try to find answers and trends among different levels of athletes and also some people who play sports or exercise as a recreational activity. With the author of the thesis being a former American Football player who played in Turkey as well as in Czechia in Prague Black Panthers, majority of the responders were current and former American Football players. The questions and answers are analyzed and commented below [35].

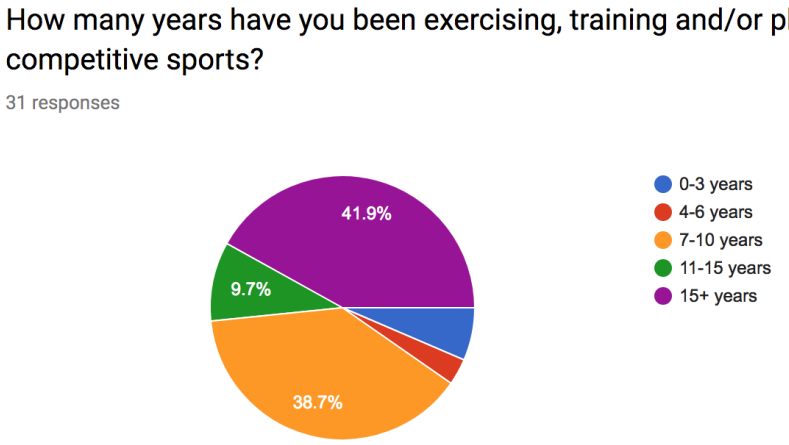


Figure 4.6: Different levels of sports experience is observed in participants.

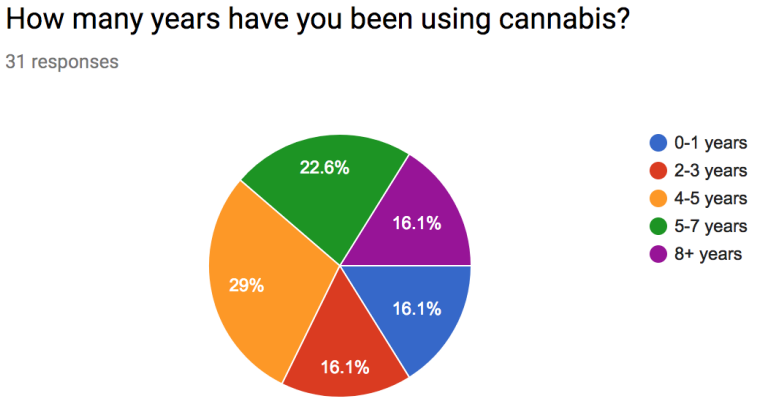


Figure 4.7: Experience of cannabis use of participants.

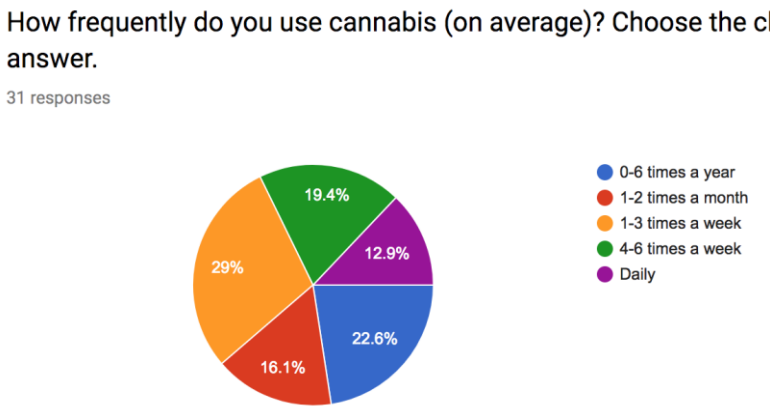


Figure 4.8: %61.3 of participants are regular smokers defined as more than once per week.

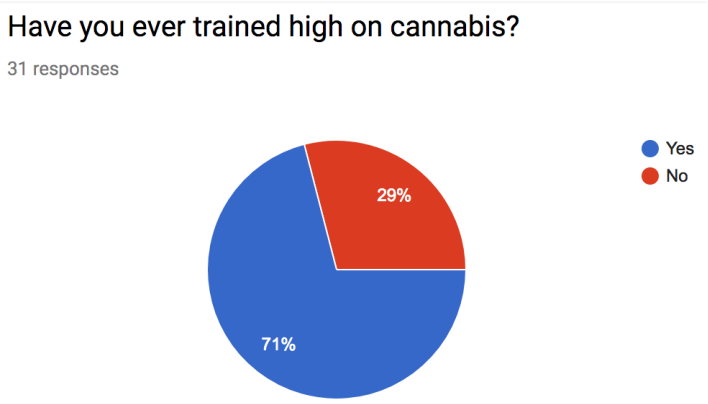


Figure 4.9: Majority of participants trained under the influence of cannabis.

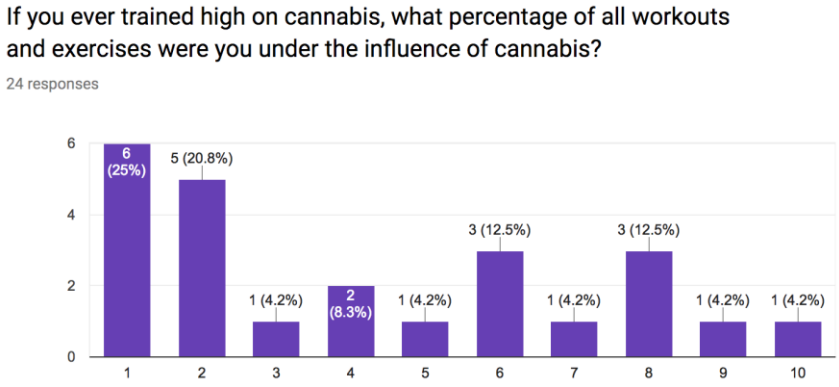


Figure 4.10: 1 being 0-10 percent and 10 100 percent.

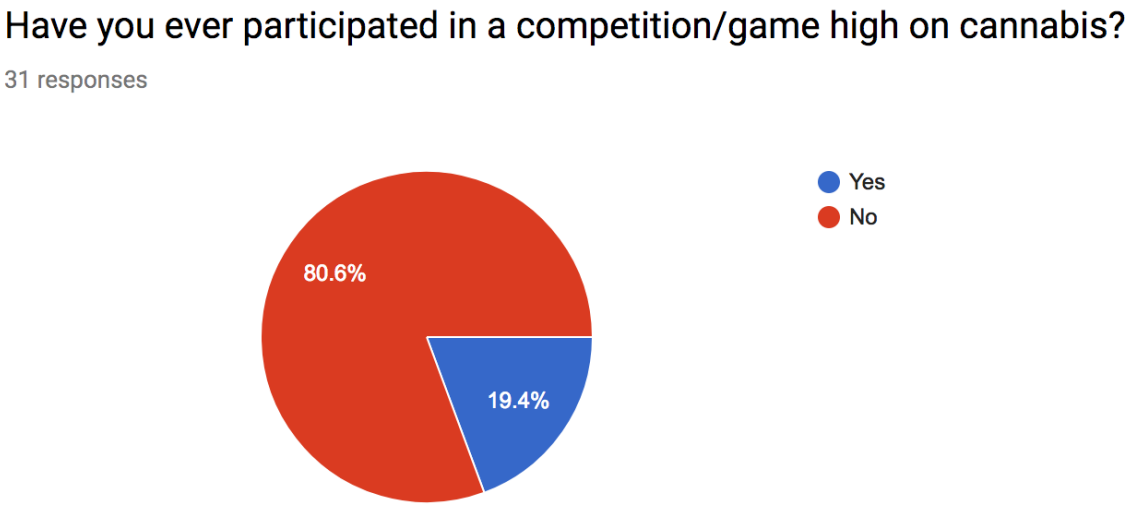


Figure 4.11: While %71 trained high on cannabis, only %19.4 participated in sporting event while high.

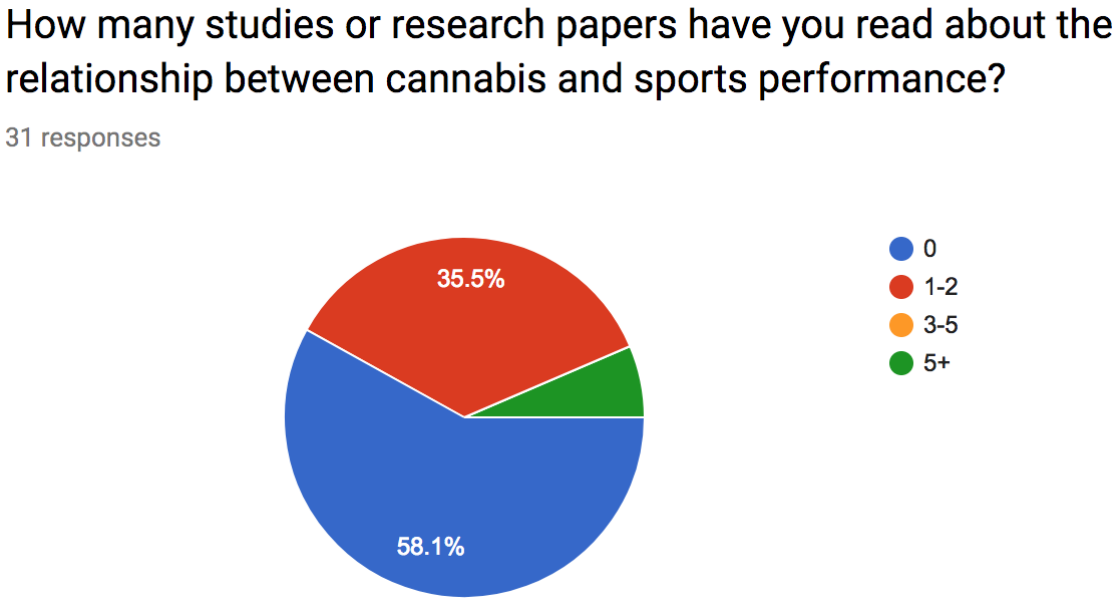


Figure 4.12: Over %90 of participants researched minimally to non-existent on this subject.

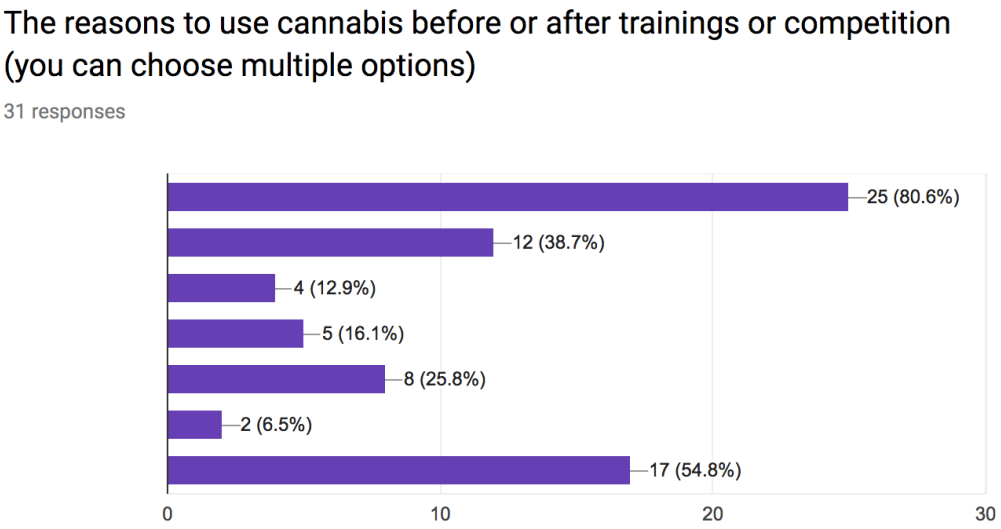


Figure 4.13: *Improved sleep %80.6

* Relaxation improving mental awareness during a game or training %36.7

* Increased reflexed and concentration %12.9

* Relieve stress preparing for important sporting event %16.1

* To socialize with teammates %25.8

* Increased physical performance %6.5

* Better recovery and pain mediation %54.8

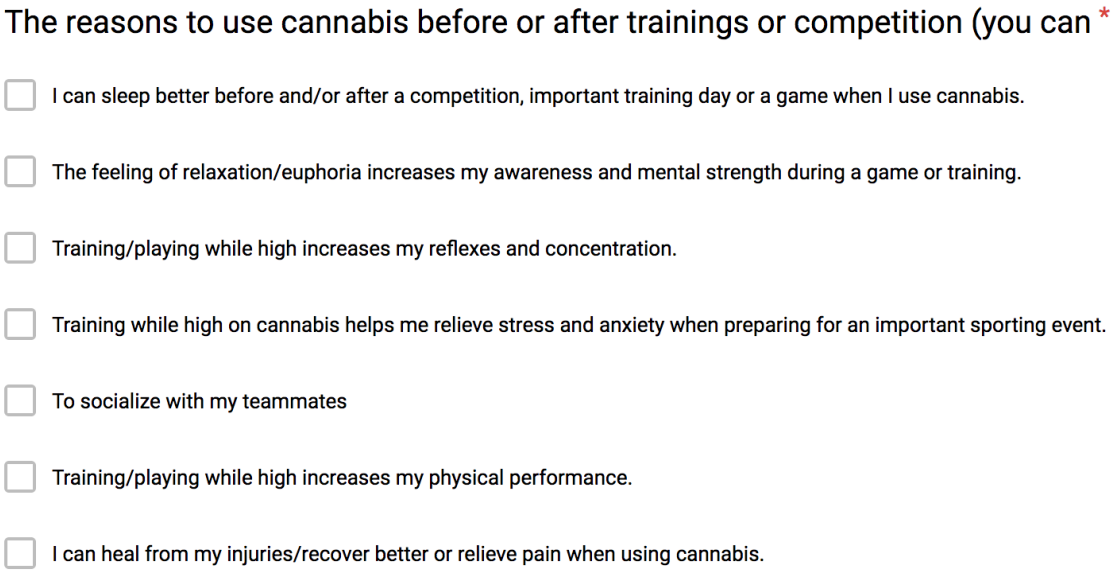


Figure 4.14: The answers given in Figure 4.13 are from this checkbox.

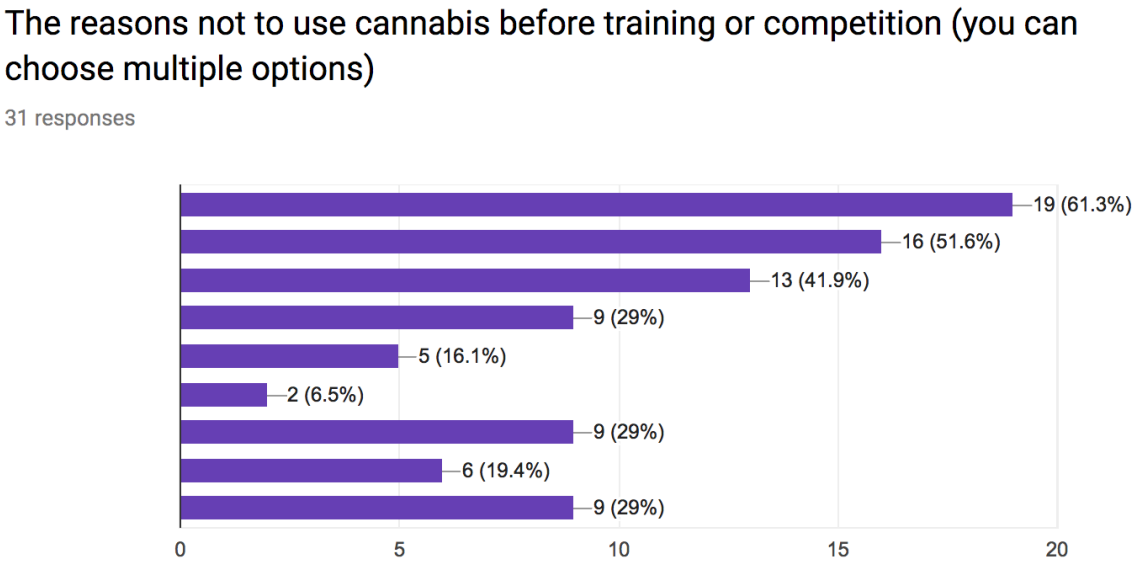


Figure 4.15: * Fatigued easier %61.3

* Submaximal physical performance %51.6* Decreased concentration and reflexes %41.9* Decrease in general performance %29* Irregular heartbeat %16.1* Slower healing and worse recovery %6.5 * Banned in sport and fear of sanctions %29 * Do not want to put illicit drug in systém %19.4 * Illegal in country %29

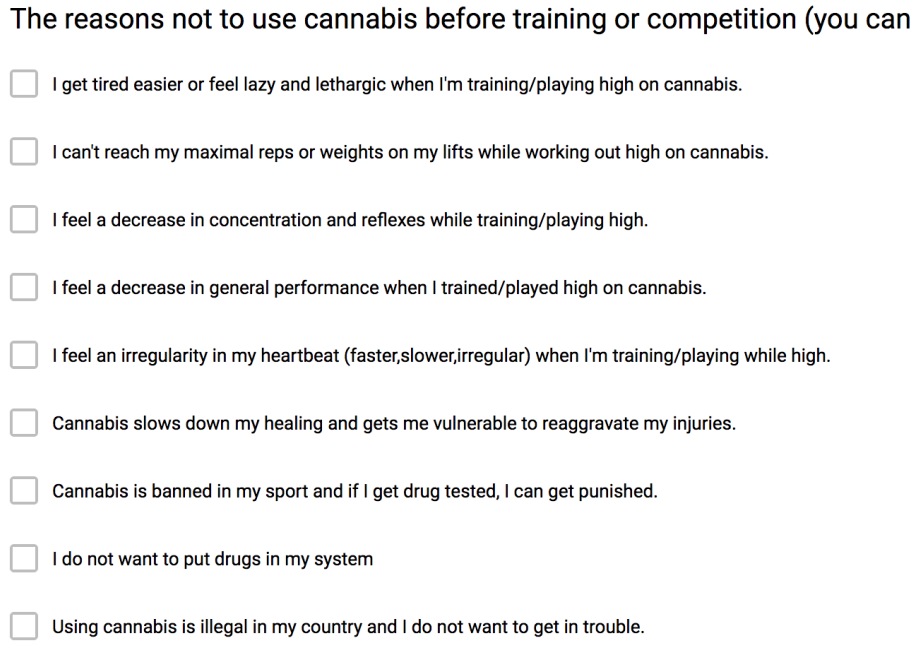


Figure 4.16: Answers of 4.15 selected from checkbox above.

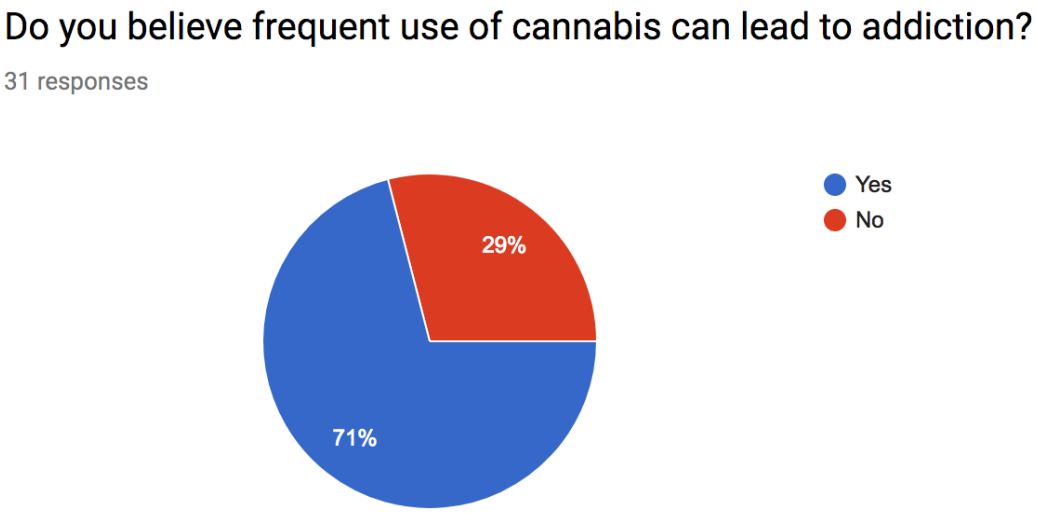


Figure 4.17: Majority don't believe cannabis can cause addiction.

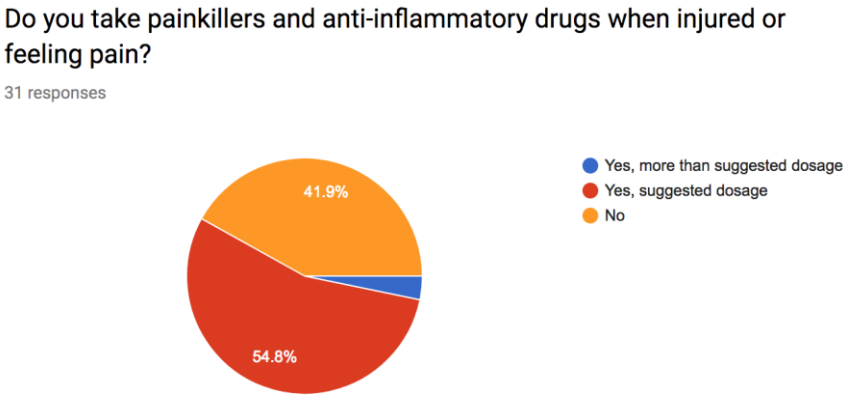


Figure 4.18: Vast majority of participants either don't use painkillers or don't abuse them

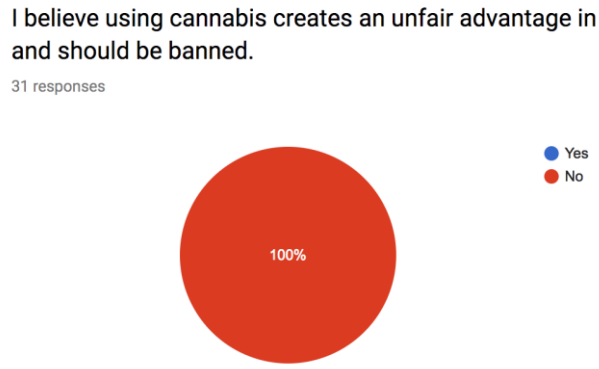


Figure 4.19: Unanimous decision about cannabis not being a performance enhancing drug and it shouldn't be banned from sport.

5. Cannabis Use of Athletes Throughout the Years

Figure 5.1: Classic photo of Arnold Schwarzenegger smoking what appears to be a marijuana joint in 1977.

A questionnaire conducted in elite Australian athletes from 8 national sporting organisations found that 21% of responders had used cannabis in the past at least once, but only 3.2% used cannabis within the past year. Also, while %33 of the athletes said they had an opportunity to use drugs, only %8 had done so [2]. One study found that an elite athlete is more likely to use illicit drugs if they are male, identify themselves as

full-time athletes, have been offered or had the opportunity to use drugs, knew other athletes who use drugs [36].

The nature of American football is very high-speed, high-contact and violent. Therefore, injuries are inevitable for a professional American football player. Moreover, playing American football brings serious risks of sustaining a head injury such as concussions and Chronic traumatic encephalopathy (CTE). Eben Britton played 6 seasons as an offensive lineman in one of the most competitive league in existence, the NFL (National Football League). He stated that cannabis helped his body in recovery phases and healing from injuries. He also suggests that a medicinal solution needs to be seeked for combatting concussions and other head injuries [37]. Britton added that potent painkillers like Vicodin and Percocet become widely used in the daily grueling grind of professional football. These pills gave him more stress and anxiety, sleeping difficulties and increased heart rate. These are the reasons he gravitated towards cannabis. Cannabis helped him with physical pain and physchological stress [38]. His post retirement goal is to convince the NFL to take a look at medical marijuana as a legitimate alternative. He finds smoking therapeutic and confessed that he played 3 NFL games while high on “weed”. He felt more concentrated and fluid. He defends that marijuana is not detrimental to athletic ability and can raise awareness of one's connectivity between mind and body. He concludes by saying that people deserve to know alternatives for painkillers and education is needed for how to take care of one's body [38]. There is a gradually increasing amount of support and movement from former and current NFL players for removing marijuana testing in the league, even from players who do not use the substance [47]. It is also necessary to point out that many players are opportunistic about using cannabis even though they are aware of the fact that they can randomly get tested during the season. Other retired NFL players who played in the more violent, less player-safety regulated years such as 1980s, state that retired players often abuse alcohol and other substances in abundance long after they retire to cope with the serious injuries and numerous concussions they endured during their careers and when they started using medical marijuana, it relieved and remedied their troubles [40].

Figure 5.2: Former NFL QB Jim McMahon smoking a medicinal marijuana joint. He battled with early onset dementia during his life [40].

Dr. Sue Sisley, who is a prominent name among medical marijuana research field, stated that she encountered many professional athlete patients who couldn't feel any relief from prescription painkillers and couldn't get back to playing until taking up medical marijuana as a form of treatment [41].

One of the most notorious marijuana users in professional sports is former NFL running back Ricky Williams. Williams is a standout player, former Heisman Trophy winner and was a first round (5th pick) by the New Orleans Saints. He prematurely retired in 2014 due to the fact that he was fined and suspended for repeated violations of the league's substance-abuse policy because he was smoking marijuana. He expressed his affinity for marijuana and applied spiritual practices combined with smoking to his life. He couldn't stay longer in the league because he refused to stop using the substance. Williams opened a new gym which will combine smoking cannabis with working out [42]. He stated that his aim is to remove the stigma that marijuana makes people lazy and hungry.

Figure 5.3: Ricky Williams in action as a member of Miami Dolphins.

An example of cannabis use combined with destructive behavior is recently reinstated NFL WR Josh Gordon. He led the NFL in receiving yards in 2013, but he received multiple suspensions for violating the league's substance abuse policy numerous times. He was banned from the league for close to 3 seasons before being reinstated in late 2017 season. In a short documentary in Uninterrupted series, Gordon elaborated on his surroundings growing up until he started getting suspensions [43]. He stated that not only he used marijuana for most of his life, he also abused alcohol and Xanax and occasionally used cocaine. He added that he grew up in very tough circumstances and that the ingestion of these types of substances were normal. He also admitted that he was enabled his whole life until he got to the NFL because he was an immensely talented football player. Whenever he got in trouble because of his drug use or unacceptable academic performance, he was helped by many higher level people to get away without facing any consequences [44]. While it cannot be strictly stated that his marijuana use was on track to derail his life and career nor that he was addicted to cannabis, it is true that he was aware of the NFL's substance abuse policy and that he deliberately continued his frequent cannabis use which parlays an irresponsible and reckless behavioral pattern. It can also be pointed out that his behavior cost him millions of dollars worth of salary and marketing opportunities.

Figure 5.4: Cleveland Browns WR Josh Gordon in action after reinstatement.

Cannabis can be useful for remedying many diseases or rare conditions which don't currently have effective mainstream treatment options or where the side effects of such treatments outweigh the benefits, for example, central sensitivity syndromes [11]. An assessment of current evidence in various indications is summarised Even though there is a study on marijuana decreasing Crohn's disease symptoms and other studies stating the benefits of THC and CBD in combating bowel diseases [8], NFL player Seantrel Henderson couldn't get an exemption from NFL to be allowed to use marijuana to treat his Crohn's disease. Henderson still smoked to alleviate symptoms, and therefore was suspended for 10 games [45]. NFL has lately taking some steps to softening their stance against marijuana, trying to work with NFLPA on a marijuana study and identifying benefits of cannabis related to concussions and other brain injuries [46].

Stephen Jackson is a retired NBA player who played 14 seasons in the league. He won a world championship in 2013 as a member of San Antonio Spurs. He admitted in a 2017 podcast with Michael Rapaport that he used marijuana during his career. He stated that he had smoked before games on a few occasions and had mixed results, saying that he played great on some games and was too excited and didn't start games well on other occasions. He clarified that he used cannabis for relaxing and recovering after games [17].

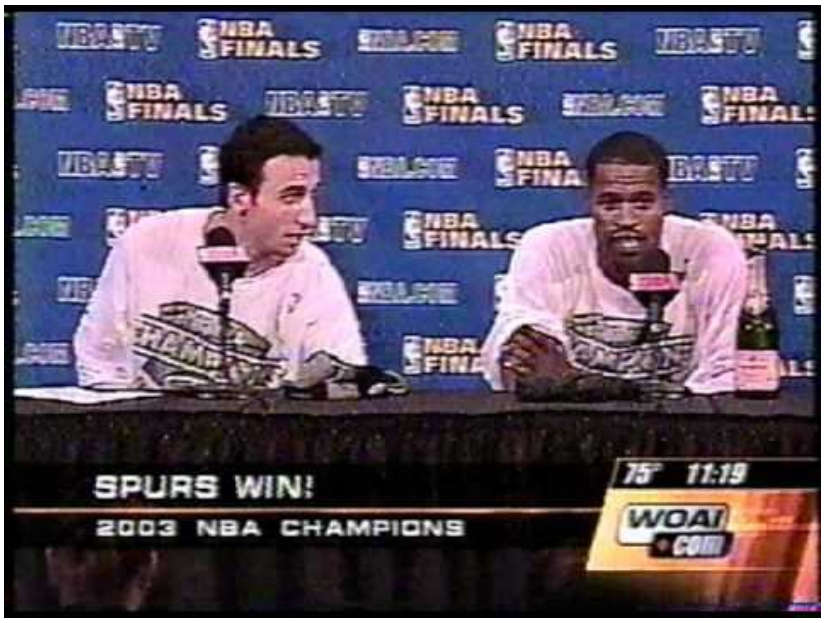


Figure 5.5: Stephen Jackson (right) post-game conference after becoming NBA champion as a member of San Antonio Spurs.

Figure 5.6: Olympics record gold medalist swimmer Michael Phelps was inhaling from a bong for what appears to be cannabis substance.

Doping in sports is a hot topic for medical, physiological and social science researches in recent years. Athletes have historically been reluctant to open up and discuss their opinions about doping in sports. This fact is also applicable to get sportspeople to talk openly about their use of cannabis.

6. Conclusion and Future Work

Cannabis has historically been used in medical applications with mainstream usage in Europe and North America between 1840 and 1940 [11]. In the last century it

became an unwanted and illegal substance mainly because of political and ideological reasons [11].

It can be stated that research about the relationship between cannabis and sport training is in inadequate quantity. While some research suggests that use of cannabis in different forms can be detrimental to making physique-related improvements, other papers may suggest the total opposite. None of the studies are very conclusive.

One thing that is proven with experiments is that the act of smoking is generally harmful to the lungs when done excessively. In this perspective, intake of cannabis via smoking-related methods can technically have a negative impact on exercise. There are also other drawbacks with smoking cannabis with respect to fitness goals, such as the tendency to ingest junk food which can be uncontrollable to some users and commonly associated feelng of laziness. On the other hand, while resistance training while under the influence of cannabis makes it less feasible to lift heavy or intensely, muscular contractions can be felt and experienced better than can oftentimes enhance the training experience.

As cannabis smoking impairs exercise and psychomotor performance(such as sedative effect, slower reaction times and other psychomotor effects), its ability to serve as an ergogenic aid has been questioned, and is generally considered to be an ergolytic. This is likely due to increase in heart rate and blood pressure, decline of cardiac output and reduced psychomotor activity.

Every data obtained in the effects of cannabis on humans and have to be carefully scrutinized in identifying its benefits and dangers on athletes without allowing cannabis abuse in sports. It is an undeniable truth that the effect of cannabis is varied from user to user. It can be dependent on experience, physical condition, mood, among many other things. Future studies should investigate the effects of exercise on cannabinoid receptor system and how this is modulated by marijuana use [4].

An argument for cannabis creating an unfair advantage in competition is that cannabis may reduce an athlete's stress and anxiety because of the soothing effect produced by consuming it. To add to that, cannabis has relaxing and sedative effects which can lead to relaxation and improved sleep.

An important aspect to consider is that athletes have to cope with a great deal of pain and are more inclined to ingest drugs and medication as tools for pain management. Prescription drugs are allowed in most leagues and because of this fact, players tend to abuse these painkillers and anti-inflammatory drugs. These drugs are

dangerous and potentially addictive. In the future, there is hope that cannabis can be seen as a safer alternative to these pharmaceutical drugs and opioids [7]. Banning marijuana from sports competitions doesn't hold sportspeople, and team doctors, from prescribing and applying other forms of medicinal treatment. The drugs and painkillers which are not on prohibited lists are used in abundance and more often than not, they are used in more than prescribed dosages for general population. The advocates for legalization of marijuana in the NFL state that, professional American football players abuse painkillers at an alarming rate. Worryingly, the strong medications and opioids have risks of dependency and retired football players are more prone to abusing prescription drugs than general population [9]. It is strongly stated that if NFL is serious about protecting the health of its players, they have to rethink their decision to include marijuana in their substance-abuse policy [47]. There is still negative perception and consequences for an athlete's image and sponsorship earnings when they are associated with cannabis, so the real number of marijuana supporters in professional sports would not be known in these circumstances.

It has to be kept in mind that negative effects of excessive cannabis use or abuse can lead to dependency and can affect emotions and memory functions [8][19]. In young athletes, the potentially harmful psychological effects may be more frequently observed. Negative behavioral changes and inconsistent performance and concentration are the possible symptoms. It's important to take close care of a player in a vulnerable condition such as long term injury [97].

After thorough research and analysis of findings of experiments, it could be determined that cannabis is not an ergogenic substance for sports training. The tradeoff between its beneficial attributes and decreased exercise performance because of increased heart rate and blood pressure results in cannabis being an ergolytic agent.

The emphasis on cannabis being classified as illegal in most of the world with sometimes severe penalties by the pro-marijuana-ban advocates suggest that its illicitness rather than performance-enhancing attributes contribute to cannabis being included in the prohibited lists. Strict stance against cannabis in the sports world can be attributed to its illicitness. As laws against cannabis are getting more lenient by the day, removing cannabis from the prohibited substance lists of different sports may also be a subject that could be considered in the future.

It has been argued that while the emphasis is on improving substance detection methods such as blood and urine tests, it would be more beneficial to instead focus on

striving to understand the psychosocial factors that lead to athletes deciding to use doping. Psychosocial factors may be attitudes, environment or beliefs that the professional athletes or recreational sportspeople see around them. Having a better grasp of psychosocial factors will also shed a better light of cannabis use in sports training environments, which is considered doping.

From the questionnaire prepared with participation of Turkish,Czech, Polish and American football players as well as recreational exercisers, it can be stated that most people don't believe cannabis should be banned from sport and that it is not a performance enhancing drug. While majority of participants trained while high at least once in their career, %80 of them didn't participate in a game or sporting event. Cannabis users a decline in general performance, easier fatigue and submaximal output while training. Also, they state the benefits as improved recovery and relaxation for better participation.

Only with extensive study of biomedical and psychosocial reasons of doping in sports can efficient prevention programmes be created if deemed necessary. The knowledge about doping in sports and side effects of performance enhancing substances are generally low. To add to that, there are few scientific studies about the effects of cannabis and sports training. A lack of questionnaires is observed regarding this subject. Interviews, questionnaires and further experiments should be conducted to get more concrete information about the effects of cannabis in sports training.

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8. List of figures and tables