High Performing Athletes

Does Cannabis Use Enhance Performance?

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June 19th, 2021

This was the day that Sha’Carri Richardson’s dream of going to the 2021 Olympics was crushed. Sha’Carri Richardson was predicted to be the big gun in the women’s 100-meter race after winning with a time of 10.86 seconds in the U.S. Olympic Track and Field Trials. A turn of events occurred when Richardson tested positive for cannabis as a result of the psychoactive component, THC. Cannabis use, one of the numerous banned substances under the United States Anti-Doping Agency (USADA), results in a three-month suspension if the athlete can confirm that the substance use did not occur within the competition period and had no relation to their sports performance. Additionally, athletes can reduce their suspension to one month if they complete a substance abuse treatment program with approval from the USADA [1]. Inasmuch as the Track and Field Trials took place a mere month before the start of the 2021 Olympics, Richardson had the opportunity taken away from her to represent the USA. Richardson completed the counseling program as a result of her cannabis use in response to cope with the tragic news of her biological mother dying just weeks before the start of the competition [2]. Athletes across the board have been in situations like this, but as laws are changing and research is being conducted, the rules remain the same for cannabis use in athletics. Why is this the case?

Brief History Lesson

Cannabis has been present in this world since 4,000 B.C.E originating in China. Its original use was to treat ailments such as gastrointestinal illnesses, seizures, malaria, and pain associated with childbirth. From that time, it made its way through Asia, the Middle East, and Africa. It did not appear in America until 1545, though, when the Spaniards brought the hemp plant in hopes to make good rope for the ships they were building. Fast forward to the 19th century, cannabis became more popular and used for recreational purposes. Cannabis began being used for numerous illnesses, plus drug companies began constructing cannabis tinctures. Subsequently, the Pure Food and Drug Act of 1906 and the Harrison Narcotic Act of 1914 imposed restrictions on alcohol which indirectly increased recreational use of cannabis. Harry Anslinger, who was the first commissioner of the Federal Narcotic Bureau in 1930, attempted to eliminate cannabis which led to the Marijuana Tax Act of 1937 [3]. This tax act ensured that possession of cannabis would result in legal penalties which increased with the implementation of the Boggs Act of 1951 and the Narcotics Control Act of 1956 [4]. Imposing a tax on cannabis was declared illegal by the Supreme Court in 1969 because imposing a tax on someone who wants to possess an illegal substance is considered a form of self-incrimination. It was not until 1970 though when the Federal
Drug Enforcement Agency (FDEA) specified cannabis as a Schedule 1 drug, making medical and recreational use illegal [5]. As a schedule 1 controlled substance, cannabis has no accepted medicinal use, high abuse potential, concerns for dependence, and a lack of accepted safety for use under medical supervision [4]. Despite this, in 1996 California enacted the Compassionate Use Act, which permits legal access to and use of botanical cannabis for medicinal purposes under physician supervision. This created a ripple effect in that 18 states have legalized cannabis for recreational use, 38 states have legalized cannabis for medical use, and 32 states have decriminalized cannabis and eliminated prohibition for the possession of small amounts [6].

**Protect and Serve**

The justice system in the United States was created to “protect and serve” its citizens, but it does not do so equally. The “war on drugs”, started by Richard Nixon in 1968, was created to reduce the illegal drug trade in the United States. Following this, our jails, prisons, and courts experienced a monstrous wave of rules and regulations while doing very little to decrease the actual use of drugs in communities. The United States has seen a five-time increase in incarcerations as compared to 1972, but there is no equivalent decrease in drug use. Moreover, discrepancies are found concerning the population that serves in prison versus the rate and prevalence of drug use in the general population. Rates of illicit drug use are quite similar between Blacks and Whites, with some lower numbers seen for Hispanics. Reporting of drug use is commonly found in communities of suburban, middle-class areas across the country. Whites were 5 times more likely to use cannabis than their Black counterparts, but Black men are 13 times more likely to be admitted to prison with similar drug charges to White men and thus make up 60% of the prison population. In some cases, there is a 26 to 27-fold increase with this discrepancy. This is not saying that Black men are more likely to do drugs, just that they are more likely to be arrested and convicted. As a result of these incarcerations, Blacks have more difficulty finding work as bosses are less likely to hire people with previous track records. Additionally, their social networks, relationships, and families have all suffered significantly. As demonstrated, the history of cannabis is not only rooted in a plethora of laws and regulations, but also a severe discrepancy that disadvantages Blacks and Hispanics in an already unequal society [7].

**What is Cannabis?**

Cannabis is a cannabinoid that contains the psychoactive compound delta-9-tetrahydrocannabinol (THC) and non-psychoactive cannabidiol (CBD). The THC in cannabis primarily acts on the brain through the first cannabinoid receptor (CB1) and the second cannabinoid receptor (CB2). Each of these receptors is a G-protein coupled receptors (GPCRs) which are a large number of receptors that respond to various external stimuli. Activating GPCRs causes the release of an intracellular protein, known as a G protein, which controls the activation of an enzyme within the postsynaptic neuron. This activation then communicates with the second messenger, allowing the receptor channel to open and potentially affect additional processes in other parts of the cell. CB1 receptors have a high concentration in the central nervous system (CNS) and are the most common GPCRs in the CNS [3]. CB2 receptors are primarily found in the tissues of the immune system as well as the heart. In 1964, the structure of the main psychoactive compound, now known as THC, was discovered by Mechoulam and Gaoni [8]. Thus, this discovery allowed
researchers to delve more deeply into the world of cannabis.

The Ins and Outs of THC

There are numerous neurotransmitters involved in the mechanism of action for cannabis. As illustrated in Figure 1, upon inhaling a puff of cannabis containing THC, the CB1 receptors are primarily activated. This activation is dependent on two of the endogenous cannabinoids found in the body which are anandamide (AEA) and 2-arachidonoylglycerol (2-AG). The cannabinoids inhibit the Ca²⁺ channels which in turn activate the K⁺ channels, making the cell less likely to release neurotransmitters. As a result, there is an inhibitory effect on the neurotransmitter release of norepinephrine (NE), dopamine (DA), gamma-aminobutyric acid (GABA), acetylcholine (Ach), and glutamate (Glu). CB1 activation has been found to increase DA in the prefrontal cortex (PFC), though, which is responsible for high cognitive functioning, planning, and problem-solving. As can be seen in Figure 2, there is a disinhibition of pyramidal Glu neurons. The normal GABA release onto these pyramidal Glu neurons is now suppressed, allowing Glu to be released onto the ventral tegmental area (VTA) which plays a role in drug addiction, behavioral disorders, cognition, motivation, and locomotor activity. The VTA then projects onto the Nucleus Accumbens which then projects onto the PFC and increases dopamine in that region.

THC vs. CBD

CBD was first isolated from cannabis in 1940 and its structure was later reported in 1963. Unlike THC, the most notable difference for CBD is the fact that it is not a psychoactive compound. In other words, CBD has similar pharmacological effects to THC but does not produce the high that you experience when consuming THC. CBD does not have any impact on the CB1 and CB2 receptors which typically produces the psychoactive aspect, or high. CBD has increased in popularity and is more heavily studied with its possible health benefits for the central nervous system such as assisting with generalized anxiety, obsessive-compulsive disorder, panic disorder, and psychosis [9]. Additionally, CBD has been found to have possible use as an antipsychotic, anti-inflammatory, antiepileptic, as well as for some neuroprotective effects. Furthermore, some applications of CBD for medicinal use have emerged such as in treating pain (chronic and neuropathic), diabetes, cancer, and neurodegenerative diseases such as Huntington’s disease [4].

Pharmacological effects and Time Course

Cannabis is known to have psychotropic effects as well as somatic effects such as analgesia, antinociception (pain-blocking), and orexigenia (appetite stimulant). When taken in low to moderate doses, pleasant side effects can be seen such as euphoria, elation, exhilaration, disinhibition, hyperactivity, and an increase in hunger. Additionally, users have reported subjective effects includ-
ing feeling calm, relaxed, and in a dream-like state. To boot, cannabis is known to have anxiolytic effects, so individuals may use it to aid in relieving their stress and anxiety [10]. On the contrary, when taken in high doses, cannabis can induce adverse effects such as anxiety, tachycardia, and hypertension.

Cannabis has multiple routes of administration but its most effective and well-known is smoking. When smoked cannabis typically has peak plasma concentrations attained within 3-10 minutes [11]. Inhalation of cannabinoids bypasses the first-pass metabolism that usually takes place when orally ingesting compounds. First-pass metabolism occurs when enzymes in the GI tract or liver can significantly reduce the concentration of a drug that reaches the bloodstream [3]. Cannabis rapidly distributes into organs containing high amounts of blood vessels and then evening out into less vascularized tissue. Much of the THC absorbed is stored in body fat where it is slowly released from. Metabolism of THC takes place by hepatic cytochrome P450 enzymes. In metabolizing THC, its metabolites 11-hydroxy-THC (11-OH-THC) and 11-carboxy-THC (11-COOH-THC) go through the process of glucuronidation which is excreted in feces and urine [11]. When identifying THC in urine samples, the focus lies on identifying its inactive metabolite, 11-carboxy-THC. In compliance with the World Anti-Doping Agency, testing positive for cannabis is found when the test detects 11-carboxy-THC concentrations greater than 15 µg/L [13].

The amount of time it takes for the plasma levels of THC to fall to 50%, also known as a drug’s half-life, varies depending on an individual’s frequency of usage but is typically around 20-30 hours. Heavy users typically have a longer half-life as a result of the slow redistribution from fatty tissues. In light users, who are individuals that consume cannabis less than twice per week, a positive urine sample will occur for 1 to 3 days after ceasing smoking. In regular smokers, who are individuals that consume cannabis several times per week, a positive urine sample will occur for 7 to 21 days after ceasing smoking. In chronic smokers, who are individuals that smoke daily for extended periods, a positive urine sample can occur for 30 days or longer upon ceasing smoking. Consequently, testing positive does not technically mean that an individual has recently smoked cannabis. There is little to no correlation between the presence of 11-carboxy-THC in urine samples and the presence of significant concentrations of THC in the blood [3].

Do you use it too?

Cannabis is considered to be the most commonly used federally illicit drug in the United States, with about 18% of Americans using it in 2019. Adolescent cannabis use has varied since 1979 from 50% to an all-time low of 22% and now hovering around 36%. There also appears to be a gender difference among adolescents in which males have a higher prevalence of daily use of cannabis as compared to females. Furthermore, daily use is higher among Black and Hispanic adolescents as compared to their White counterparts which elucidates the racial stereotypes associated with cannabis use in the United States. These statistics are found to be true for both adolescents and adults.

When looking at the young adult
age group, there were significantly higher rates of increased past-year cannabis use as compared to those in the older age groups. Contrary to the adolescent age group, cannabis use declined among men in the adult age group while the use in women remained fairly constant. This decline is consistent with the narrowing of the gender gap in the frequency of heavy drinking and alcohol problems. In addition to the racial and ethnic disparities, an individual's income also plays a role in cannabis use across the United States. Individuals with the lowest incomes had the highest risk and substantial rates of increase in past-year cannabis use as well as cannabis use disorder. Moreover, men in adult households making less than $50,000 have increased prevalence than women in the same situation.

As it happens, cannabis use among pregnant women is more common than we would like to admit. Past-month cannabis use increased to 62% among pregnant women and 47% among non-pregnant reproductive-age women [5]. Thus, we can see that cannabis use is prevalent across all age groups, genders, ethnicities, socioeconomic backgrounds, and reproductive statuses.

Do athletes use it too?

A recent study conducted in 2019 found that cannabis use runs in second place following alcohol use among athletes. A study conducted in 2011 found that one-third of male and one-quarter of female student-athletes in their NCAA Division 1 school reported using cannabis in the past year but the scientists who conducted this study believe this number may be underrepresented of the actual number since they relied on athletes self-reporting their use. These numbers are slightly lower than we see in students who don’t participate in athletics, but it is also thought to believe that student-athletes underreport their cannabis use [10].

Does Cannabis use show evidence for enhancing performance?

Now that we’ve got the nitty-gritty information out of the way, we can talk about what we came to talk about: does cannabis use show evidence for enhancing performance? Studies upon studies are conducted, indicating how exercise is essential for remaining healthy in life. As cannabis becomes increasingly popular and laws are changing around its use, scientists have begun studying cannabis use and its effects on physical exercise performance. There is a lack of strong evidence showing that there is a relationship between cannabis use and athletic performance. Conversely, there are proven to be adverse effects from short-term and long-term cannabis use. On the short-term side, cannabis use has been found to result in impaired short-term memory, impaired motor coordination, altered judgment, and paranoia or psychosis in high doses. On the long-term side, significantly heavy cannabis use has been found to result in chronic bronchitis and increased risk of chronic psychosis-related health illnesses such as schizophrenia, myocardial infarction stroke, and transient ischemic attack [4]. Moreover, research has found that long-term effects may result in immunosuppression, bronchial irritation and inflammation, and even reducing sperm count and viability in men.

Additionally, a review study conducted in 2018 found that there are results that indicate cannabis use negatively affects an athlete’s performance. Thus, cannabis is considered an ergo-
lytic substance as opposed to an ergogenic one. That is, cannabis is a substance that impairs exercise capacity and athletic performance instead of enhancing it [10]. Although there is no evidence on physical performance enhancement, there is some evidence that may suggest that athletes use cannabis due to the euphoric subjective experience. As mentioned earlier, THC has anxiolytic effects at low doses which is why some athletes may depend on the substance to relieve any anxiety before competitions. Additionally, athletes have reported other psychological improvements such as an increase in relaxation, pleasure, and an improvement in sleep. These factors do not directly affect performance, but there is the chance that they can positively impact an athlete’s mindset, therefore indirectly affecting their performance. One thing to note though is that these psychological factors have all been subjective self-reports. There is no concrete evidence that shows a direct relationship between cannabis use and its influences on the mental state of an athlete concerning the management of their anxiety [10, 12].

Throughout the sporting world, there are no consistent penalties found when testing positive for THC. The NFL and National Basketball Association have clearly defined penalties, but the National Hockey League has minimal penalties for athletes testing positive. Moreover, there is no consistency in an acceptable level of THC. The NCAA will not permit THC levels at a threshold greater than 1.5 µg/l while the World Anti-Doping Agency (WADA) will permit THC levels at a threshold of 15 µg/l. On top of this, the NCAA does not allow cannabis use at any point of the season, while the WADA only bans the substance at the time of competition.

With all the aforementioned evidence, my question then is, why does our society continue to view cannabis as an illicit substance with no accepted medical use? Why are there numerous discrepancies between levels of accepted concentrations or times at which cannabis use may be appropriate? As Bob Marley once said concerning cannabis use, “Herb. Herb is a plant. Herb so good for everything. Why, these people who want to do so much good for everyone – who call themselves governments and this and that – why them say you must not use the herb?” [14]
References


