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## A Comprehensive Review on Ethical and Medicinal Application of Steroidal Medicines

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**Abstract** Since their discovery about 80 years ago, steroids have been widely used in the treatment of many medical conditions. The therapeutic functions of steroids are mostly associated with their strong anti-inflammatory and immune-modulating capabilities. This study provides a concise overview of the fundamental pharmacology, potential problems, and practical considerations related to the use of steroids. The steroid system has been widely utilized as a privileged scaffold that possesses a wide range of medicinal qualities in the process of drug discovery and development. Steroidal molecules are favored for their rigidity and high capacity to permeate biological membranes. Steroids are synthetic compounds that mimic the naturally occurring hormones produced in the human body. Modifying the fundamental ring structure leads to the creation of steroidal derivatives that possess a diverse array of medicinal properties. Conjugating steroids with different physiologically active moieties enhances their lipophilicity, stability, and target selectivity while reducing side effects. Therefore, the steroid nucleus effectively functions as a biological transporter for tiny substances. Steroid bioconjugates have several benefits, including enhanced effectiveness in combination with lower dosage and targeted treatment, resulting in fewer adverse effects. Steroidal bioconjugates have been extensively studied for their efficacy in treating various disorders. They have demonstrated significant effectiveness as anticancer, anti-inflammatory, anticoagulant, antimicrobial, insecticidal/pesticidal, antioxidant, and antiviral agents, among other miscellaneous activities. This study offers a thorough examination of the therapeutic development of steroidal bioconjugates as biologically active compounds. The paper discusses the possible uses of steroidal bioconjugates in biology and might be helpful to scientists in their efforts to identify new drugs.

**Keywords** steroidal drugs, steroids misuses, steroids, corticoids, anti-inflammatory drugs

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### Introduction

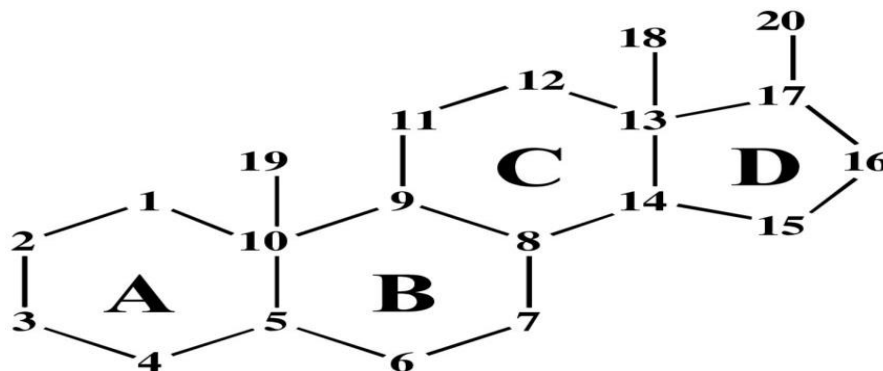
#### What are steroid

A steroid is a bioactive organic molecule consisting of four rings organized in a certain molecular structure. Steroids have two primary biological roles: they operate as crucial constituents of cell membranes, modifying their fluidity, and they act as signaling molecules. Plants, animals, and fungus contain many steroids. All steroids are produced by manufacturing processes.

The cells contain either lanosterol (found in opisthokonts) or cycloartenol (found in plants). Lanosterol and cycloartenol are produced by the process of cyclization of the triterpene squalene. [1] Anabolic steroid. These chemicals are known as steroids, which may be either natural or manufactured. They have a molecular structure



consisting of 17 carbon atoms arranged in four rings in a specific three-dimensional pattern. Different steroids may be distinguished based on the configuration of their nucleus, the type of the groups linked to it, and their locations. Many steroids have been discovered in plants and animals, and a large number of additional steroids have been created by synthesis or by altering existing natural steroids. Steroids have a crucial role in the fields of biology, chemistry, and medicine. Examples encompass a wide range of substances such as various hormones (including sex hormones), bile acids, sterols (including cholesterol), and oral contraceptives. Digitalis was the initial steroid that gained widespread usage in Western medicine. Corticosteroids and their synthetic counterparts are utilized for the treatment of rheumatism and other inflammatory conditions. Additionally, please refer to the term "anabolic steroid." [2]



### Type of steroid

#### 1. Corticosteroids:

- Glucocorticoids
- Mineralocorticoids

#### 2. Sex steroids:

- Progestogens
- Androgens
- Estrogens

### Uses

#### How are anabolic steroids used?

Anabolic steroids are primarily utilized in cycles lasting from 6 to 18 weeks. The unverified justification for this method is to increase muscular mass and strength during a cycle, enabling the body to recuperate between cycles. The ingredients, dosage, and length of the cycles are mostly determined by guidance from self-proclaimed authorities and are grounded in unverified convictions and individual encounters. Given that muscle growth and strength decrease after stopping the use of AAS, it is considered necessary to undergo repeated cycles or ongoing usage in order to preserve or enhance the muscle mass that has been obtained. In our cohort research, the average weekly estimated androgen dosage was around 1000 mg, with a range of 250 to 3300 mg. [3]

### Medical uses

Pharmaceutical medications that mimic the effects of corticosteroids are utilized to treat a wide range of disorders, including hematological neoplasms, brain tumors, and skin ailments. Dexamethasone and its derivatives have mostly glucocorticoid activity, whereas prednisone and its derivatives possess both glucocorticoid and mineralocorticoid effects. Fludrocortisone, often known as Florinef, is an artificial mineralocorticoid. Hydrocortisone, often known as cortisol, is commonly administered as a replacement treatment for conditions such as adrenal insufficiency and congenital adrenal hyperplasia.



## Classification of steroid

The major classes of steroid hormones, with prominent members and examples of related functions, are:

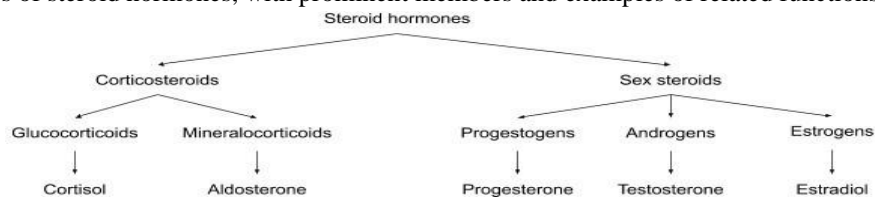


Figure 1: Classification of steroid

### Corticosteroids:

Glucocorticoids: (Prednisone, Prednisolone, Triamcinolone, Methylprednisolone, Dexamethasone)

Glucocorticoids, also known as glucocorticosteroids, belong to the class of corticosteroids, which are a kind of steroid hormones. Glucocorticoids are a kind of corticosteroids that specifically attach to the glucocorticoid receptor, which is found in nearly all cells of vertebrate animals. The term "glucocorticoid" is a combination of the words "glucose," "cortex," and "steroid," reflecting its function in regulating glucose metabolism and its production in the adrenal cortex. [4]

Mineralocorticoids: (Aldosterone)

Mineralocorticoids belong to the category of corticosteroids, which are a type of steroid hormones. Mineralocorticoids are synthesized in the adrenal cortex and have an impact on the equilibrium of salt and water, namely the balance of electrolytes and fluids. Aldosterone is the main mineralocorticoid. The term "mineralocorticoid" originated from first discoveries indicating the involvement of these hormones in the retention of sodium, a mineral. Aldosterone is the main natural mineralocorticoid, however several other natural hormones such as progesterone and deoxycorticosterone also exhibit mineralocorticoid activity.

Sex steroids:

Progestogens: (Medroxyprogesterone acetate, Norgestrel acetate, Norethindrone, Levonorgestrel, Gestodene)

Progestogens, sometimes referred to as progestogens or gestagens, are a group of steroid hormones, either naturally occurring or artificially produced, that attach to and stimulate the progesterone receptors (PR). Progesterone is the primary and most significant progestogen in the human body. The progestogens are called for their role in sustaining pregnancy (i.e., progestational), but they are also present at other stages of the oestrous and menstrual cycles. [5]

Androgens: (Dehydroepiandrosterone-DHEA, DHEA sulphate)

An androgen is a kind of steroid hormone, either natural or synthetic, that controls the growth and upkeep of masculine traits in vertebrates by attaching to androgen receptors. This encompasses the process of embryological development of the major male reproductive organs, as well as the development of male secondary sexual traits throughout puberty. Androgens are produced in the testes, ovaries, and adrenal glands.

Estrogens: (Estrone, Estradiol, Estriol)

Estrogen, often known as oestrogen, is a kind of sex hormone that plays a crucial role in the development and control of the female reproductive system and the traits associated with it. There are three primary endogenous Estrogens that exhibit estrogenic hormonal activity: estrone (E1), Estradiol (E2), and estriol (E3). Estradiol, a compound belonging to the estrane class, is both very powerful and widely distributed. Estetrol (E4), another kind of estrogen, is only created during pregnancy.

### Steroid abuse

Why athlete abuse steroid

Uninformed or misinformed athletes, sometimes influenced by coaches or parents, take anabolic steroids with the belief that it can enhance their competitiveness and performance. They use these chemicals to increase lean muscle mass, stimulate aggression, and gain body weight. [6]



### Side effect of steroid abuse

Misuse of anabolic steroids can lead to a range of negative effects, varying from moderate to severe, and in some cases, even life-threatening. The majority of these effects may be reversed if the person discontinues drug consumption. However, some may be enduring or semi-permanent.

The majority of information about the lasting impacts of anabolic steroids in humans is derived from individual case reports rather than rigorous epidemiological research. Severe and perhaps fatal side effects could be inaccurately recorded, particularly considering their potential occurrence several years after. A research identified 19 fatalities in published case reports associated with the use of anabolic steroids from 1990 to 2020. However, since many individuals who used steroids also used other substances, it is challenging to establish a direct causal link between anabolic steroid usage and these deaths.

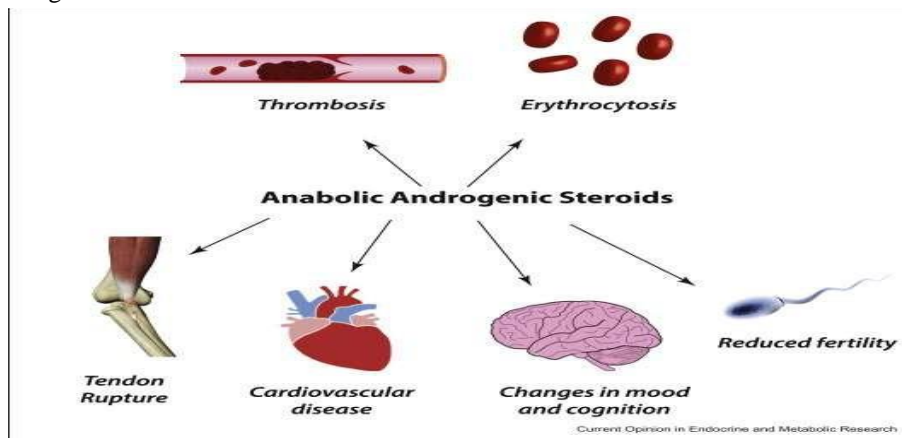


Figure 2: Side effect of steroid abuse

### Impact of anabolic steroid abuse in athletes and bodybuilding

Doping is a grave matter, and its repercussions have wide-ranging effects. It has the potential to irreversibly harm your reputation, well-being, and opportunities both within and outside of the realm of sports. Individuals who have enrolled in a sporting organization that adheres to the sporting Anti-Doping Rules may face penalties for engaging in doping. There are a total of 11 rules, all of which are applicable to athletes, while seven of them specifically apply to coaches and support people. [7]

#### Career

A punishment has the potential to terminate your professional ambitions. The detriment to your reputation may impede your ability to secure a position on a team or possibilities for coaching.

#### Relationships

Imposing a suspension can exert a detrimental influence on your relationships with colleagues, classmates, and close whanau. Experiencing an inability to participate in sports might lead to feelings of social isolation.

#### Finances

Failure to comply may result in the loss of sponsorship opportunities, contracts, or other forms of support, as well as potential financial consequences.

#### Health

Using performance-enhancing drugs can have severe and permanent health repercussions.



**Steroid and social media**

Previous research has found that the connections between social media use and body dissatisfaction, as well as associated factors, among women and girls also apply to sexual minority males. Social media sites that place a higher emphasis on images may be more worrisome than platforms that focus mostly on text. Further investigation including sexual minority men is necessary to clarify the differences between beneficial and harmful utilization of social media in relation to body dissatisfaction, eating disorders, and anabolic steroid usage.

**Steroid in Bollywood**

The utilization of steroids by Bollywood stars has garnered attention in several newspaper and web articles, as actors and models who previously had slender physiques have rapidly transformed into strong bodies.

**Steroid-induced osteoporosis**

Steroid-induced osteoporosis is osteoporosis arising from the use of glucocorticoids (a class of steroid hormones) analogous to Cushing's syndrome but involving mainly the axial skeleton. The synthetic glucocorticoid prescription drug prednisone is a main candidate after prolonged intake. Bisphosphonates are beneficial in reducing the risk of vertebral fractures [8].

**Steroid cause acne**

Steroid acne refers to a skin condition resembling acne that develops in individuals with elevated amounts of corticosteroids in their bloodstream. They may be afflicted with Cushing's disease or they may be receiving therapy with systemic corticosteroid drugs. Steroid acne primarily manifests on the chest, however it can also emerge on the face, neck, back, and arms.

**Medical and Ethical use of steroid**

**What are The Parameters of Proper Use of Topical Corticosteroids?** Correct use of TCs is predicated on the fulfilling of the following conditions:

**The right diagnosis:**

There are only a limited number of situations where there is substantial data supporting the effectiveness of TCs. The most well-established indications for localized forms of various skin conditions such as eczemas, psoriasis, lichen planus, immunoblot disorders, lupus erythematosus, or dermatomycosis's are cutaneous manifestations of collagen vascular diseases. There are specific situations when it may be necessary to utilize medication for a short period of time. These include superficial fungal or bacterial infections that cause a lot of inflammation, localized itchiness from any cause, and certain unknown illnesses that cause inflammation of the skin, such as superficial forms of pyoderma gangrenous. [9]

**The right molecule and delivery system:**

Since their first introduction in the early 1950s, TCs have had significant growth as a category. Currently, there are over 20 distinct compounds with differing levels of strength accessible globally, ranging from moderate to highly powerful. Furthermore, there is a range of different doses and modes of dosing available, including creams, gels, lotions, ointments, foams, muco-adherent gels, aerosols, and tapes. It is crucial for the prescriber to have knowledge of several compounds, ideally with varying potencies.

**The right patient:**

The patient's age, gender, and profession significantly influence the decision to utilize TC. Both pediatric and geriatric individuals have compromised epidermal barrier function and comparatively thinner skin. Furthermore, newborns possess a significantly elevated surface area to weight ratio, which might result in a disproportionately heightened systemic absorption when applying substances topically.



Frequent wet-dry cycling typically leads to damaged skin in women who regularly engage in housekeeping. This necessitates more regular application, as do certain vocations that involve physical labor. The appropriate formulation is determined by other parameters such as the anatomical location and degree of the illness. Delicate parts of skin such as the eyelids, cheeks, and scrotum require gentler treatments compared to the back, palms, and soles. Prevalent skin conditions require dose formulations that can be easily dispersed and have lower strengths to prevent unwanted absorption into the body.

When applying TCs to the face or other exposed areas, it is important to prioritize cosmetic factors. Creams, gels, and lotions are the ideal options in these cases because of their elegant appearance. Intertriginous regions are very vulnerable to a more intense impact than anticipated because of the skin's occlusion and maceration. Therefore, it is advisable to exercise caution while determining the potency of treatments for these areas. [10]

### **The right amount, frequency and duration**

One of the most frequent oversights in a TC prescription is the lack of guidance on the appropriate dosage to be used in a certain circumstance. The Fingertip Unit (FTU) developed by Long and Finlay is a straightforward method to instruct the patient on the appropriate amount of topical corticosteroid (TC) to apply. An FTU refers to the volume of ointment that fills the gap between the fingertip and the first skin wrinkle when it is extruded via a nozzle with a diameter of 5 mm. The determined quantity was 0.5 grams, which is suitable for hands of typical adult size. This quantity is sufficient to cover a small area on the skin, approximately the size of a palm, when using creams. However, ointments have a greater capacity to spread, thus they may cover around 20% more area than creams. Guidelines have been established to determine the number of FTUs needed to cover specific anatomical regions. The importance of this information should be well communicated to the patient to avoid excessive or insufficient utilization. [11]

### **The right “exit strategy”:**

Having a well-defined strategy for gradually reducing and discontinuing the usage of TC (therapeutic medication) after achieving sufficient control or remission is of utmost significance. With the exception of circumstances that naturally resolve on their own, TC Extended periods of usage, exceeding the suggested safe lengths, are frequently required. This can be accomplished safely by gradually reducing the dosage to less strong forms or implementing a treatment schedule that involves taking medication every other day or just on weekends. Emollients and/or calcineurin inhibitors, which are medications that can reduce the need for steroids, are provided during days when topical corticosteroids are not used.

### **Being aware of corticosteroid allergy:**

Oftentimes, we encounter patients who fail to exhibit the intended progress despite the utilization of proper therapeutic care. Occasionally, control is attained, but this subsequently results in periods of heightened disease activity that necessitate the use of more potent corticosteroids. During such circumstances, it is important to acknowledge the potential occurrence of contact dermatitis in response to the use of topical corticosteroids. This can occur as a result of either the preservatives, additional excipients, or the active molecule itself. For these situations, it is necessary to do suitable patch testing and then prescribe an allergen-free product.

### **Control of steroid abuse and committee World Antidoping agencies (WADA)**

The main function of WADA is to formulate, standardize, and synchronize anti-doping regulations and policies across all sports and nations.

The main tasks involve overseeing and supervising the proper execution of the World Anti-Doping Code and its associated International Standards. This includes conducting scientific and social science research, providing education on the subject, gathering intelligence and conducting investigations, as well as assisting in the development of anti-doping capabilities in organizations around the world.



**International Paralympic committee (IPC)**

The International Paralympic Committee (IPC) serves as a comprehensive governing body, encompassing various sports and disabilities. In contrast, other international sports organizations for athletes with disabilities primarily focus on a single sport or disability. Similarly, the International Olympic Committee relies on individual member sanctioning bodies to represent each Olympic sport. [12]

**National institute of drug abuse (NIDA)**

The primary objective of the National Institute on Drug Abuse (NIDA) is to promote scientific research on the origins and effects of drug use and addiction, and to utilize this information to enhance the well-being of individuals and the general population.

**National Antidoping organisation (NADO)**

National Anti-Doping Organizations (NADOs) are organizations that have been officially recognized by their respective countries or governments as the major governing bodies responsible for implementing and overseeing anti-doping programs at the national level. The following items are included: Enacting and enforcing regulations on the use of performance-enhancing drugs Developing and executing anti-doping educational programs Supervising the gathering of samples, which involves overseeing the staff responsible for collecting training samples. Performing inquiries Test result management Performing outcome administration on a nationwide scale.

**Steroid Case studies****Tyson Gay, Track and Field**

Gay was a prominent figure in the world of sprinting until he was found to have used a prohibited drug in 2013. Gay had previously achieved a silver medal at the 2012 Summer Olympics and had the second-quickest time in the 100-meter dash with a 9.69-second sprint in 2009 at the Shanghai Golden Grand Prix. Following his confirmed positive test, Gay was subsequently issued a one-year suspension from the sport and had his silver Olympic medal revoked.

**Rafael Palmeiro, Baseball**

Palmeiro has a lengthy and fruitful tenure in Major League Baseball; nevertheless, his accomplishments have been subject to scrutiny due to allegations of performance-enhancing drug (P.E.D.) usage. In his 2005 publication, "Juiced: Wild Times, Rampant 'Roids, Smash Hits & How Baseball Got Big," José Canseco made allegations against Palmeiro regarding his usage of steroids. However, later that same year, Palmeiro testified before Congress, stating unequivocally that he had "never used steroids, period."

Palmeiro was then suspended after testing positive for an anabolic steroid, despite his assertion that he had taken it without being aware of its presence. Palmeiro is among a select group of just five players in the annals of baseball who have achieved the impressive feat of accumulating a minimum of 500 home runs and 3,000 hits during their careers. However, his association with performance-enhancing drugs has cast a shadow over his accomplishments in the eyes of several fans.

**Rashid Ramzi, Track and Field**

Ramzi demonstrated his exceptional athletic abilities by emerging victorious in the 800- and 1500-meter races at the 2005 World Championships. This remarkable achievement made him the first male athlete to triumph in both events in the championship. Subsequently, a few years later, he achieved the remarkable feat of winning a gold medal in the 2008 Summer Olympics in Beijing, which was a historic first for the nation of Bahrain. However, this achievement was short-lived as Ramzi's victory was invalidated due to his positive test for the prohibited blood-boosting chemical known as CERA, resulting in the revocation of his medal.



### **Floyd Landis, Cycling**

The prominent figure in the cycling world associated with performance-enhancing substances is widely recognized as Lance Armstrong. However, it is worth noting that Floyd Landis also had a role in engaging in doping practices. Landis was initially detected in 2006 when one of his tests showed a high testosterone ratio following a remarkable performance on a stage of the Tour de France that raised suspicions. Subsequently, the rider was banned from the sport and, in a highly dramatic act of severing ties with the public, openly accused Armstrong of engaging in doping as well.

### **Ben Johnson, Track and Field**

In the 100-meter dash at the 1988 Summer Olympics, the Canadian sprinter emerged victorious over his adversary Carl Lewis, achieving a remarkable performance of 9.79 seconds and securing the gold medal. Johnson had already achieved two gold at the 1984 Olympics and established a record with his time in 1988—nevertheless, his triumph was exceedingly brief. Shortly after achieving the gold medal, it was revealed that Johnson had tested positive for an anabolic steroid, resulting in the revocation of his medal.

### **Results**

Frequently seen and troublesome, steroids often cause clinically significant adverse effects. Side effects may manifest throughout a broad spectrum of dosages and might differ based on the method of delivery. Patients at modest dosages may experience the complete range of adverse effects.

Administration of glucocorticoids can also result in psychological side effects such as mood disorders, anxiety, delirium, and panic disorder. Psychotropic medicine may be necessary to manage these symptoms, although the outlook is positive after the glucocorticoids are decreased or stopped. Adverse effects are experienced by as many as 90% of patients who take glucocorticoids for more than 60 days. Even individuals receiving low amounts ( $\leq 7.5$  mg/d) experience same adverse effects, including more severe fractures and cataracts.

Topical corticosteroids, such as 2.5% ointment, triamcinolone 0.1% ointment, and clobetasol propionate 0.05% foam, are more efficient in reaching higher concentrations in the skin compared to oral administration.

Topical administration of corticosteroids can lead to side effects such as skin thinning, color change, and systemic effects. These side effects tend to grow in severity as the dose of corticosteroids increases. Inhaled corticosteroids have become a fundamental component of treatment for those with moderate to severe asthma. The effectiveness and systemic bioavailability of corticosteroid molecules and dosages differ, but overall, judicious administration minimizes systemic effects. Typical adverse effects of inhaled corticosteroids include gum inflammation and oral fungal infection, in addition to the several general symptoms linked to corticosteroid use. [13-14]

### **Conclusion**

In conclusion Professional athletes should abstain from using anabolic steroids. Athletes that employ these substances are compromising the integrity of the game. This situation is unjust for other sportsmen, the leagues, and the fans of the game. The utilization of steroids is likewise morally wrong. Anabolic drugs pose significant physical and psychological risks to sportsmen. If professional leagues endorse the utilization of anabolic steroids inside their organizations, they are demonstrating a disregard for the well-being of their athletes. Presently, sports professions around the country are implementing more stringent measures to combat the use of anabolic steroids in sports organizations. Professional leagues are resolutely maintaining their stance that the use of performance enhancing chemicals will continue to be prohibited in professional sports. Upon thorough analysis of all facets of performance-enhancing drug utilization, our team has reached the definitive conclusion that doping has a detrimental impact on sports. Performance-enhancing medications have detrimental effects for several causes. Athletes experience severe adverse consequences and sustain long-term damage to their bodies. In our perspective, providing players with such advantages in sports is considered a sort of cheating. In addition, they foster a mindset of doing whatever it takes to succeed and a belief that attaining a "ideal" physique is not possible without dedication and exertion. Significantly, this subject is emerging as a societal concern due to its widespread occurrence and the impact it is having on our





younger generation and adolescents. Athletes who engage in drug usage are inadvertently promoting the use of these substances among young individuals, who perceive them as influential figures, in order to enhance their athletic performance and physical appearance.

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