

REVIEW ARTICLE

Exploring the New Perspectives of Doping in Sports

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How to cite this article:

Joshi S., Dubey A., Sharma S. Exploring the New Perspectives of Doping in Sports. Indian J Forensic Med Pathol. 2025; 18(2): 321-328.

ABSTRACT

Doping is appearing as one of the major problems in the world. It can be a serious problem in the world, it can be defined based on various perspectives. Doping is related to abuse of drugs in sports. Doping along with performance enhancing substances is a current problem being dealt internationally. WADA (World Anti-Doping Agency) has banned doping. Although, it is almost universally present among athletes aiming to win without any proper efforts in the right direction. Among the cases of doping reported it becomes difficult for identifying the intent if present behind it. Besides, lack of awareness on the ill effects of doping on the health also continues to be an ignored issue. There are some athletes who feel incapable of achieving needed natural abilities including speed, strength and stamina unless intake of illicit substances are done. In some cases, the evidences were not contested and athletes admitted the use of illicit substances. However, in other cases, athletes refused the use of doping to enhance performance and claimed to have involuntarily or passively absorbed the drug. The purpose of this review is to evaluate the in and outs of doping which includes its adverse effects, causes, etc. Previous studies on this topic discussed many cases, on which it was revealed that diagnosis of doping can take too much time or less (hours or days) depending upon the type of doping. After doping several signs and symptoms can be seen; such as high blood pressure, acne on oily skin, aggressive behavior, insomnia, agitation, dizziness, headache etc. Articles referenced in this review were of great help in understanding various aspects of doping.

KEYWORDS

• WADA • Doping • Masking Agents • Narcotics • VO2 Max • TUE • NADA

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➤ **Received:** 29-06-2024 ➤ **Accepted:** 11-06-2025



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INTRODUCTION

Doping: An Overview

The origin of the term 'Doping' from the Dutch word 'Dop' comes from the Kaffir dialect of South Africa. It referred to the use of stimulating liquor by tribe members during religious ceremonies.¹

Doping for the reason of enhancing sports performance has a long history. Within the early era of modern sport, it was for the most part related to professional cycling. In spite of the fact that after ward within the late of 19th century, a few cyclists passed away from the intake of strong stimulants and in the early portion of the twentieth century, sports authorities remained unreceptive. It was not until a Danish cyclist met his end in 1960 amid a road race at the Olympic Games in Rome, that deed was taken. Then the Union Cycliste Internationale (UCI) started developing a protocol and in 1967, the International Olympic Committee (IOC) formed a 'Medical Commission' (IOC-MC) to tackle the misuse of drugs in Olympic sports.²

Drugs banned by the International Olympic Committee - Medical Commission, 1968:

- a. **Psychomotor stimulant drugs:** e.g., amphetamine, benzphetamine, cocaine, diethylpropion, dimethylamphetamine, ethylamphetamine, fencamfamin, methylamphetamine, methylphenidate, norpseudoephedrine, phendimetrazine, prolintane, and related compounds.
- b. **Miscellaneous central nervous system stimulants:** e.g., amiphenazole, bemegride, leptazol, nikethamide, strychnine, and related compounds.
- c. **Sympathomimetic amines:** e.g., methylephedrine, ephedrine, and related compounds.
- d. **Narcotic analgesics:** e.g., heroin, morphine, methadone, dexamoramide, dipipanone, pethidine, and related compounds.³

These days, doping is not only concerned with wellbeing-related matters but, moreover, with moral values as well. The act of utilizing specific drugs to improve performance in sports is referred to as "doping". It is broadly practiced by sportspeople in an endeavor to improve their performance without any fright

or ignorance associated with their potential consequences or side effects. These honours not only diminish the integrity of sports but may be considered a form of corruption in sports, in this way undermining sportsmanship.⁴

Historical Background of Doping:

Doping then:

First use of doping started from 1963 and the official definition of it was proposed by the European Committee Council: "Doping represents the use of substances or physiological mediators, which are not usually present in the person's body, introduced as an outer aid to boost the athletes performance during a competition."⁵

The use of performance-improving drugs has certainly happened since the time of the beginning of the Olympic Games. The root of the word doping is accredited to the Dutch word 'doop' which is a thick opium juice. Throughout history, there have been several examples of athletes resorting to special mixtures to gain an extra edge, facilitating victory and aiding them in various circumstances. In around 300 B.C., the Indian physician Susruta suggested consuming testicles to enhance virility. Similarly, before battles, the Huns consumed testicles, presumably with the same goal, as mentioned by Chinery (1983). Afterward, cyclists and other competitors frequently utilized strychnine, caffeine, cocaine, and liquor either individually or in combination. One of the concoctions that purported to enhance performance was 'Mariani wine', initially created and patented in 1863 by Angelo Mariani. This wine was crafted from Bordeaux wine and coca extracts.⁶

Enhancing performance through unlawful means has been a concern since the beginning of the ancient Olympic Games in Greece. The substances employed included unique mushrooms, alcoholic beverages, bull's blood, and bull's gonads.⁷

In the ancient games, many athletes sought to improve their performance by various means such as studying their sports techniques and adjusting their diets. Early stimulants often came from plants; for instance, Norse Berserkers allegedly used bufotein from fly-agaric mushrooms (*Amantia muscaria*) to amplify their fighting strength twelvefold.⁸

Between the late nineteenth and the latter half of the twentieth century, the initial definitions

and rules against doping in sports began to emerge. The International Athletic Federation (IAAF) was the pioneer of prohibiting the use of performance-enhancing substances in sport, although enforcement remained futile until testing methods became obtainable.⁹

Doping Now:

German doping expert Mario Thevis has identified more than 100 specific performance-improving drugs that are undetectable. He highlighted that these substances pose significant challenges for detection due to their structural properties. Developing tests to identify these drugs is exceptionally arduous. In modern era, players are utilizing a variety of techniques and drugs, posing a significant challenge for experts to detect and combat in the ongoing battle against doping.⁴

At present, doping procedures in sports are evolving to synergize their effects across multiple organs and systems simultaneously, targeting numerous body complexes simultaneously. As a result, there has been a broadening of the body systems implicated in doping, now encompassing the endocrine, nervous, muscular, and circulatory systems.²

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Types or Forms of Doping:

Doping has been classified in the following on the basis of its practice or by the method it's done:

Blood Doping:

Blood doping entails the infusion of blood into an athlete's system to enhance their capacity to carry oxygen. It is prohibited by WADA since 2006 Winter Olympics. In this, red cell transfusion is done. The blood doping is not always "autologous" it can be done by "homologous" means as well.¹⁰

Gene Doping:

It refers to the utilization of genes, genetic components, or cells to improve athletic performance for non-therapeutic purposes. In order to protect the health of athletes and to ensure the integrity of sports, WADA has banned Gene doping.¹¹

Hormonal doping:

Growth hormone usage to mean to improve sports performance is thought to be prevalent among both seasoned professional athletes

and newcomers to sports. GH are prohibited by WADA due to the malpractices of doping. Growth hormone in general are secreted by pituitary gland but due to its anabolic and growth promoting activity, the usage of GH in sports is common.¹²

Use of artificial Oxygen carrier:

This practice resembles blood doping and entails the utilization of synthetic oxygen carriers, namely HBOCs and PFCs, which are chemical compounds or purified proteins capable of carrying oxygen. The use of these as performance enhancing drug is prevalent.⁴

Masking Agents:

Masking agents, like diuretics, are employed to manipulate doping test results and to conceal doping. Consequently, such substances are listed as prohibited by WADA. In sports, athletes or individual use these to avoid detection of doping during anti-doping tests.¹³

Types of Masking Agents:

Some common types of masking agents are following:

A. *Diuretics:* Diuretics are drugs that increase urine production and promote the elimination of sodium, regulating body fluid volume and composition. These drugs includes various categories with diverse structures, properties, effects on urine composition, and mechanisms of action. Athletes frequently misuse diuretics to rapidly shed weight and conceal other banned substances. Consequently, they have been designated as banned substances by the WADA, with usage banned during both competitive and non-competitive periods. Anti-doping laboratories routinely conduct screenings for diuretics to uphold fair play in sports.¹⁴

e.g. Hydrochlorothiazide, furosemide.

B. *Adulterants:* These are the substances added directly to urine samples to interfere with drug testing. They may alter the pH, specific gravity, or other characteristics of the sample.

*e.g. Bleach, detergents, nitrites etc.*¹⁵

Table 1: Drug Classes Routinely Monitored in medico-legal Drug-Testing program¹⁵

Drug rank	Analytes observed in urine
Amphetamine and its derivatives	Amphetamines Methamphetamines Methylenedioxymethamphetamine (MDMA) Methylenedioxyamphetamine (MDA)
Cannabis	11-Nor-9-carboxy-tetrahydrocannabinol (THC-COOH)
Opiates	Morphine 6- monoacetylmorphine (6-MAM) Codeine
Cocaine	Ecgonine methyl ester (EME) Benzoyllecgonine (BZP)

C. *Urine pH Modifiers:* These are agents that amplifies urine's pH. By doing so, these substances render the urine further basic, aiding in the impediment in formation of kidney stone. Additionally, this alkaline environment assists the kidneys in eliminating toxic substances.

*e.g. Baking Soda, Sodium Carbonate etc.*¹⁶

D. *Creatinine adulterants:* Creatinine adulteration refers to the act of tampering with a urine sample using chemical adulterants to generate a misleading negative test outcome. This problem is compounded by the availability of a multitude of easily obtained chemicals that can effectively adulterate a urine specimen.¹⁵

e.g. Adulterants containing creatinine.

Doping in India:

In India, the attentiveness concerned with doping increasing at International as well as National level sports.¹⁷

Doping remains a pervasive issue in Indian sports. Since 2009, NADA has conducted tests on over 40,000 athletes for Anti-Doping Rule Violations (ADRVs), resulting in 1206 athletes being found in violation of NADA Rules. India consistently ranks among the top violators in the report on Anti-Doping Rule Violation (ADRV) released by WADA. For instance, in 2018, Russia (144 ADRV), Italy (132 ADRV), and France (114 ADRV) topped the list of doping violations, with India closely following in fourth place with 107 ADRV. Similarly, in 2017, India ranked fourth in the number of ADRV reported, and for the three preceding

years (2015-2017), India held the third highest number of ADRV consecutively.¹⁸

NADA disclosed that out of 27 tested cricketers, 13 applied for Therapeutic Use Exemption (TUE). According to a report by WADA, India has been ranked as the second worst country in a global study of positive doping cases involving minors.¹⁹

The Anti- Doping Agenda:

As long as there is competition in sports, there will always be individuals tempted to cheat for an unjust advantage. Conversely, there will also be diligent individuals and organizations committed to maintaining fairness and safety in sports by ensuring a level playing field.⁸

The fight against doping in sport as we are aware today, commenced by the creation of the International Olympic Committee (IOC) Medical Commission in 1961 after the death of a Danish cyclist during the Rome Olympic Games the year before.²⁰

In light of this drab evaluation, it's unsurprising to find that anti-doping initiatives have experienced notable transformations in recent times. For instance, a wave of research grounded in social science proposed that prioritizing avoidance over detection could be the optimal approach for eradicating drug use in sports. Nonetheless, it's important to emphasize that the emphasis seems to be reverting back to detection-centered strategies, with collaborative investigations involving anti-doping authorities and law enforcement agencies being perceived as the path forward.²¹

World Anti-Doping Agency (WADA):

Reports of athletes seeking to enhance their physical capabilities can be traced back to third century BCE. Endeavoring to address the growing problem of doping in sport, WADA was formed in 1999.²²

WADA emerged in 1999 amidst a climate characterized by both frustration due to perceived lack of effective anti-doping stewardship from the International Olympic Committee and anticipation that clean athletes would finally find safeguarding against the influence of corrupt sports entities, athletes, coaches, and medical personnel. The establishment of WADA occurred against a backdrop marked by mutual suspicion between governments and international sports bodies.²³

The establishment of the WADA stemmed from four primary reasons. Firstly, there existed a lack of synchronization in anti-doping regulations. Various International Federations and National anti-doping organizations (NADOs) operated under disparate regulations, leading to an escalating doping cases being disputed in civil courts. Several factors drove the need for harmonization of anti-doping regulations. Secondly, the misuse of doping substances, such as, AAS extended further than the realm of sports and began to manifest as a civil health concern. The consumption of AAS poses serious undesirable effects on both an entity and civilization as a whole. Thirdly, there was a necessity to conduct ongoing research to keep pace with advancements in the pharmaceutical production, specifically, in developing analytical techniques for new substances and methodologies entering the market. Fourthly, it was crucial to advocate for anti-doping efforts at both national and international levels, with oversight from a central governing body.²

Since its inception, WADA has pursued a significantly additional rigorous anti-doping approach compared to previous efforts by the IOC's. Particularly in sports like cycling, WADA seems to have achieved greater success in detecting solo athletes who have tested positive for banned substances. However, while WADA has had some success in this area, the most noteworthy advancements emerge to have stemmed not from sporting organizations' activities but from administration agencies' interventions, such as the law enforcement and customs. Consequently, while individual athletes have occasionally tested positive in drug screenings carried by WADA and other sports bodies, administration agencies like the law and customs have uncovered not just solo drug user but also extensive networks, occasionally involving hundreds of individuals engaged in doping practices in sports. This was evident in cases like Operación Puerto in Spain in 2006 and recent police operations in Italy (Waddington and Smith, forthcoming).¹³

In year 2004, the WADA took over The List from the IOC-MC. Presently, WADA employs three criteria to determine the prohibition of a substance: if it boosts athletic performance, if its absence could endanger health, or if its usage contradicts the principles of fair play in sports.²⁴

WADA proposed a list of prohibited substances that falls under these categories:

S0. Non Approved Substances

S1. Anabolic Agents

S2. Peptide Hormones, Growth Factors, Related Substances and Mimetics

S3. Beta-2 Agonists

S4. Hormone And Metabolic Modulators

S5. Diuretics And Masking Agents

M1. Manipulation of Blood, and Blood Components

M2. Chemical and Physical Manipulation

M3. Gene and Cell Doping

S6. Stimulants

S7. Narcotics

S8. Cannabinoids

S9. Glucocorticoids

P1. Beta Blockers 25

National Anti-Doping Agency (NADA):

At the national level, nearly every country has its own anti-doping agency responsible for overseeing anti-doping efforts. India has a body named NADA for the similar purpose. NADA had approved World Anti-Doping Code in the year of 2008. The Code was implemented with a commitment to support NADA's efforts to end doping in India. Major aim of NADA is to device and adapt anti-doping programs and create awareness of issues related to doping. The NADA is specifically designed to assure prevention from doping in India. Main objective of NADA is to encourage drug-free sports. In addition to educating athletes at the national level, NADA also works to raise awareness in state-level tournaments, colleges, and schools. To discourage future infractions of doping restrictions, young athletes in schools and colleges receive instruction on doping and its consequences. NADA maintains a zero-tolerance policy on doping. The committee members have the power to impose lifetime or multiple-year bans on athletes who are found guilty of taking illegal substances to improve their performance. Every athlete is given comprehensive doping rules and regulations, with the expectation of absolute compliance. In addition, those found guilty of doping infractions face harsh penalties. Before an athlete may compete in the Olympic

or Commonwealth Games, they are required to submit to drug tests conducted by NADA. Athletes are allowed to compete in the event after obtaining approval from the agency. Subsequent investigations are carried out, and those who fail these exams are not eligible to participate. Any athlete found to have violated the rules and regulations of NADA are subject to appropriate penalties.¹⁷

The adverse effects of Doping

The lack of focus on the health hazards associated with doping substances within scientific literature has led to a widespread belief among athletes that the only negative result of doping is the risk of detection. As per the earlier reports, when an athlete is questioned about the willingness to abuse performance enhancement drugs without the risk of getting caught to win an Olympic medal the percentage of athletes who said yes to it was 98%. Surprisingly 50% of athlete accepted to be willing to take drugs even if it may have toxic effects leading to death in exchange of assured victory for 5 years. Reasons for abusing drugs range from financial gain, success in the field, remedy for injury and notion of peer influence. Doping has many side effects based on the method of conduct. The current review highlights and summarizes major drugs used in doping and their toxic effects on the athletes.

Adverse effects of Anabolic Androgenic Steroids

Athletes often use anabolic androgenic steroids (AAS) to enhance exercise performance or modify their body shape. Combination of these steroids with various substances increased the anabolic or performance enhancement effects. AAS in higher doses are associated with cardiovascular complications. Among the AAS users 35% have shown alterations in the structure of heart and its functioning in long-term. Some of the common results also has changed patterns in cardiac relaxation and decrease in heart rate, distended heart chambers, increased thickness in heart muscle, cell damage and scarring.²⁶

Adverse effects of Growth Hormone Doping

In another study, around 40% to 80% adults were administered Growth Hormone (GH) experienced adverse effects. Immediate side effects that surfaced included tingling sensations, carpal tunnel syndrome and joint pain. Other side effects include fatigue,

dizziness, hyperglycemia and fatigue. Doping using GH has also shown increased fatigue, lower level of concentration, muscle distress and positive effects in GH replacement therapy. Extreme GH intake may lead to decrease in quality of life. There can be seen many other side effects such as; cardiovascular effects, endocrinal effects, liver damage, risk of cancer, psychological effects, reproductive system effects etc.

Adverse effects of Gene Doping

Prolonged exposure of gene doping carries significant risk of unnecessary adverse effects, such as systolic dysfunction, cardiac hypertrophy and development of cancer.

Gene therapy poses significant health risks, including the possibility of tumor formation, liver damage, or the onset of autoimmune disorders. These risks arise from potential immune reactions triggered by both the viral vectors used in gene delivery and the therapeutic proteins themselves. For instance, when non-human primates are administered the Epo gene intramuscularly, they develop severe autoimmune anemia.²⁷ Unnaturally rising the levels of EPO will lead to the increase of RBCs which in turn will most likely cause many health effects such as heart attack, paralysis and insertional mutagenesis

Adverse effects of Blood Doping

Blood infusions can escort to adverse reactions, which can be divided into immune-moderated and non-immune-moderated types. Among these, the most severe reactions typically stem from immune-mediated responses, often due to errors in blood typing. ABO incompatibility reactions happen when type B or A blood is mistakenly administered to a recipient with a different blood type, causing a rapid and severe breakdown of RBCs that can lead to organ failure and mortality. Arguably, the major transfusion-transmitted infection (TTI) is HIV, which leads to Acquired Immunodeficiency Syndrome (AIDS). The significance of thorough screening and testing of blood is exemplified by the widespread transmission of HIV through tainted blood products within the hemophiliac community. Between 1979 and 1986, prior to the availability of a dependable HIV antibody test, 1227 individuals with hemophilia contracted HIV-1.¹⁰ There can be seen many other side effects of blood doping; such as myocardial

infarction, stroke, embolism, infections and certain allergic reactions.

DISCUSSION

The intention of this study was to explore new perspectives on doping, which includes compiling research articles, refining our knowledge of doping, and understanding its various aspects. It was discovered after reading a number of research and review papers that doping in sports is a major problem that needs more attention. Doping is an extensive topic that encompasses multiple approaches, including gene doping, hormone doping, blood doping, and so forth. Because they are competitive and want to win, athletes have been misusing drugs and adopting various doping methods. Athletes still abuse performance-enhancing pharmaceuticals even after doping and its methods were banned by the WADA and NADA decades ago. It became clear from researching the history of doping over the ages that the Olympics and rising levels of competition in sports were the primary causes of the use of performance enhancing drugs in sports. Apart from this, the utilization of masking agents to prevent the detection of doping also become rampant. Masking agents, like diuretics, have properties that amplify the flow of urine, which aids in preventing its detection. Hence, the utilization of masking agents in doping is a matter of concern. As per the data of NADA 142 Indian athletes have been associated with doping related activities from April 2022 to March 2023. Also, NADA has reported 27 tested cricketers, 13 applied for Therapeutic Use Exemption (TUE). As per a report of WADA, India has been ranked at second in the list of worst country in global study of positive cases in minors. According to a report by WADA, India has been ranked as the second worst country in a global study of positive doping cases involving minors. Substance of abuse being used in sports and use of masking agents also leads different health issues. These drugs used for enhancing performance have many harmful properties. The major reason for anti-doping agencies to ban doping.

CONCLUSION

After studying various research and review articles on doping, it became evident that doping in sports is still very concerning issue.

As athletes are using complicated ways of performing doping such as; blood doping, EPO doping, gene doping and these poses various adverse effects on their systems and the main concern is WADA alone can't control it the need of legal agents is required. From the beginning of 20th century doping in India became prevalent and due to that India has become 2nd worst country with positive doping cases which is very concerning on its own. Hence the requirement of more steps in opposition to doping is necessary and more wakefulness towards the adverse effects of doping on wellbeing in athletes should be considered.

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