

**Review Article****DOPING IN SPORTS- A REVIEW**Singh Deeksha<sup>1</sup>, Sharma Akarsh<sup>1</sup>, Dhawan R.K.<sup>1</sup>, Baghel U.S.<sup>1\*</sup><sup>1</sup>Khalsa College of Pharmacy, Khalsa University, Amritsar, India

Received 20 Jan. 2017; Accepted 15 Mar. 2017

**ABSTRACT**

The fight against doping in sports started as a result of the death of a Danish cyclist during the Rome Olympic Games in 1960 but progress was modest until the world's best male sprinter was found doped with anabolic steroids at the Olympic Games in Seoul in 1988. Further progress was made following the cessation of the cold war in 1989 and in 1999 public authorities around the world joined the Olympic Movement in a unique partnership by creating WADA – the 'World Anti-Doping Agency'. Despite intense efforts by sporting bodies and the medical professionals to eliminate the problem, drug taking to enhance sport performance remains widespread. No player should gain an unfair advantage over other players by using an unethical substance or method. The use of drugs may also be extremely dangerous to the health of players. Drug testing programs have been established by amateur and professional sports authorities to promote a safe and fair competitive environment. In the present review the various agents and the reasons why they are used is reviewed along with the history of doping.

**Keywords:** Doping, drug abuse, performance enhancement, sports.**1. Introduction**

Drug is defined as a substance that alters the physiological processes of the body which is used for the diagnosis, prevention and treatment of disease. Abuse denotes injudicious or irrational application. **Doping** is defined as the use by an athlete or player of prohibited substances or methods in order to enhance his/her sports performance. The use of performance-enhancing drugs is probably the major problem facing sports today [1]. Despite intense efforts by sporting bodies and the medical professionals to eliminate the problem, drug taking to enhance sport performance remains widespread. Doping is against "the spirit of the game".

The use of doping substances in many sports and on all continents has become a major public health issue. The global and universal characteristics of doping led to the formation in 1999 of the World Anti-Doping Agency (WADA), a unique collaboration between sports and governments. In 2003, the first anti-doping code was launched. WADA is financed by world governments and International Olympic Committee [2].

The Code now states that 'Doping is defined as the occurrence of one or more of the anti-doping rule violations set forth in Articles 2.1 through Article 2.10 of the Code', which includes [3]:

- (i) Presence of a prohibited substance or its metabolites or markers in an athlete's sample.
- (ii) Use or attempted use by an athlete of a prohibited substance or a prohibited method.
- (iii) Evading, refusing or failing to submit to sample collection.
- (iv) Violation of applicable requirements regarding athlete availability for testing.
- (v) Tampering or attempted tampering with any part of doping control.
- (vi) Possession of a prohibited substance or a prohibited method.
- (vii) Trafficking or attempted trafficking in any prohibited substance or prohibited method.
- (viii) Administration or attempted administration to any athlete in-competition of any prohibited substance or prohibited method, or administration or attempted administration to any athlete out-of-competition of any prohibited substance or any prohibited method that is prohibited out-of-competition.

(ix) Assisting, encouraging, aiding, abetting, conspiring, covering up or any other type of intentional complicity involving an anti-doping rule violation.

(x) Prohibited association.

### Why is doping prohibited?

Doping is prohibited because it is fundamentally contrary to the spirit of sport. No player should gain an unfair advantage over other players by using an unethical substance or method. The use of drugs may also be extremely dangerous to the health of players [3].

## 2. Historical Background

The use of drugs to enhance performance in sports has certainly occurred since the time of the original Olympic Games [from 776 to 393 BC]. The origin of the word 'doping' is attributed to the Dutch word 'doop,' which is a viscous opium juice, the drug of choice of the ancient Greeks [4].

- Ancient Greek athletes are known to have used special diets and stimulating potions to fortify themselves [5].
- Strychnine, caffeine, cocaine and alcohol were often used by cyclists and other endurance athletes in the 19<sup>th</sup> century [5].
- Reports of doping were common in the 19<sup>th</sup> century. The first reported drug-related death occurred in 1896 when an English cyclist died of an overdose of 'trimethyl' [6,7].
- Thomas Hicks ran to victory in the Olympic Marathon of 1904 in Saint Louis with the help of raw egg, injections of strychnine and doses of brandy administered to him during the race [5].
- Amphetamines were introduced to the US troops to help keep them awake at the battlefield. Following the war, some athletes began to use amphetamines [8].
- It was alleged that the Soviet athletes used anabolic steroids in 1952 Olympics in Helsinki [9].
- The use of anabolic steroids, especially by power athletes, became widespread in the late 1960 and 1970 [10].
- At the 1988 Seoul Olympics, the positive test results for anabolic steroid stanozolol on 100 m winner Ben Johnson focused world attention on the continuing problem of drug abuse in sports and resulted in renewed international attempts to stamp out the use of performance-enhancing drugs in sport [3].

## 3. Why Athletes Take Drugs?

Unfortunately, there has been little research into this question but there are a number of possible reasons [11,12]:

- Knowledge or belief that their competitors are taking drugs.
- A determination to do anything possible to attain success.
- Direct or indirect pressure from coaches, parents or peers.
- Pressure from government and/or authorities themselves.
- Lack of access to legal and natural methods to enhance performance (e.g. nutrition, psychology, recovery).
- Community attitudes and expectations regarding success and performance.
- Financial rewards.
- Influence from the media in facilitating these expectations and rewards.
- Increasing self-confidence and social recognition.
- Desire to be competitive.
- Increase their physical strength.
- Reduce pain and to relax.
- Cope with stress.

## 4. Prohibited substances and methods

The list is updated and released by WADA annually in which substances and methods are categorized in three parts as follows [3]:

1. Substances and Methods prohibited at all times (In- and Out-of-Competition)
2. Substances and Methods prohibited In-Competition
3. Substances prohibited in particular sports  
Substance or method which meets two of the following three criteria is included in the prohibited list:
  1. It can improve athletic performance.
  2. It poses a risk to health.
  3. Its use violates the principle of fairness in sport.

### 1. SUBSTANCES

#### (a) Anabolic agents

Anabolic agents are divided into two categories:

- (a) Androgenic anabolic steroids
- (b) Other anabolic agents

Androgenic anabolic steroids are synthetic version of the hormone testosterone. Testosterone is a male hormone found in large quantities in male and in some females. They have two categories (1) Exogenous steroids which are not produced by the body naturally and (2) Endogenous steroids which are produced by the body naturally.

#### **Why they are banned?**

They are prescribed for medical use only. Their use may enhance the athlete's performance giving them an unfair advantage. Another possibility is the serious medical side effects for the user.

#### **Why used?**

- To increase muscle size and strength.
- Reduce the time required to recover after exercise.
- To train harder and for a longer period of time.

#### **(b) Peptide hormones, growth factors and related substances**

Peptide hormones are the substances that are produced by the glands in the body and that after circulating through blood can affect other organs and tissues to change bodily functions.

#### **Why they are banned?**

They serve as messengers between different organs that stimulate various bodily functions such as growth, behaviour and sensitivity to pain.

#### **Why used?**

- To stimulate production of naturally occurring hormones.
- To build up muscles.
- To mend and improve body tissue.
- To improve body's ability to carry oxygen by increasing the production of red blood cells.

#### **(c) $\beta$ -2 agonists**

These are drugs commonly used to treat asthma by relaxing the muscles that surround the airway and opening up the air passages.

#### **Why they are banned?**

They can provide the same advantages of a stimulant or if administered into the bloodstream have anabolic effects.

#### **Why used?**

- To increase muscle size.

- To reduce body fat.
- For stimulatory effect.

#### **(d) Hormone and metabolic modulators**

These drugs impair the oestrogen effect/uptake at tissue level. They also oppose the negative feedback to the hypothalamus of oestrogen, increasing the release of GnRH.

#### **Why they are banned?**

They are used as masking agents. These substances are banned in males and females.

#### **Why used?**

- To lessen the side effects of anabolic steroids (e.g. gynaecomastia).
- Increase the endogenous production of testosterone.

#### **(e) Diuretics and other masking agents**

These are products that can potentially conceal the presence of a prohibited substance in urine or other samples.

#### **Why they are banned?**

They hide the presence of a banned substance in an athlete's urine or other samples, allowing them to cover up their use and gain unfair advantage.

#### **Why used?**

- To conceal the use of a prohibited substance in the testing process.
- To lose weight quickly in sports which have weight categories.

#### **(f) Stimulants**

These drugs boost alertness and physical activity by increasing heart and breathing rates and brain functions. By acting on the central nervous system, they can stimulate the body both mentally and physically.

#### **Why they are banned?**

They may artificially stimulate the body or mind therefore improves the athlete's performance and giving them unfair advantage.

#### **Why used?**

- To increase the ability to exercise at an optimal level.
- To combat tiredness.
- To suppress appetite.

### (g) Narcotics

These are painkillers that act on the brain and spinal cord to treat pain associated with painful stimuli.

#### Why they are banned?

Narcotics reduce or eliminate pain felt due to an injury and also help the athlete to train harder and for a longer period of time. The danger in this is that the drug is merely masking the pain. As a result the athlete continues training and it risks to health.

#### Why used?

- To reduce or eliminate the pain from an injury, allowing athlete to continue training.
- To reduce anxiety which enhances performance.

### (h) Cannabinoids

These are psychoactive substances derived from the *Cannabis* plant that cause a feeling of relaxation.

#### Why they are banned?

These are generally not considered performance enhancing. They are banned because their use is damaging to the image of sports. There are also safety factors as their use could weaken the ability of athlete to perform thereby compromising the safety of the athlete and other competitors.

#### Why used?

- To decrease the recovery time after exercise.
- Increase their heart rate.
- Reduce their inhibitions.
- To release tension.

### (i) Glucocorticoids

These are mainly used as anti-inflammatory drugs and to relieve pain. They are commonly used to treat asthma, hay fever, tissue inflammation and rheumatoid arthritis.

#### Why they are banned?

When administered systemically they can produce a feeling of euphoria, potentially giving the athlete unfair advantage.

#### Why used?

- To mask pain felt from an injury or illness.

### (j) Alcohol (Ethanol)

Alcohol is prohibited in-competition in the following sports:

1. Aeronautic
2. Archery
3. Automobile
4. Karate
5. Shooting
6. Modern pentathlon
7. Motorcycling
8. Ninepin and Tenpin bowling
9. Powerboating

Detection is done by analysis of breath, urine and/or blood.

#### Why they are banned?

Alcohol intoxication puts an athlete and others at risk especially travelling at high speeds.

#### Why used?

- To reduce stress prior to competition.
- To reduce anxiety.
- To reduce hand tremor.

### (k) $\beta$ -blockers

$\beta$ -blockers are prohibited in-competition in the following sports:

- (i) Aeronautic
- (ii) Archery (also prohibited out-of-competition)
- (iii) Automobile
- (iv) Billiards and Snooker
- (v) Bobsleigh
- (vi) Boules
- (vii) Bridge
- (viii) Curling
- (ix) Golf
- (x) Gymnastics
- (xi) Modern pentathlon
- (xii) Motorcycling
- (xiii) Ninepin and Tenpin bowling
- (xiv) Powerboating
- (xv) Sailing
- (xvi) Shooting (also prohibited out-of-competition)
- (xvii) Skiing
- (xviii) Snowboarding
- (xix) Wrestling

#### Why they are banned?

Potential toxic effects include aggravation of pre-existing asthma and in athletes with impaired cardiac function. They also give athletes an unfair advantage in precision events.

#### **Why used?**

- To reduce anxiety.
- To reduce hand tremor.

## **2. METHODS**

### **(a) Manipulation of blood and blood components**

#### **Why they are banned?**

They give athletes an unfair advantage by increasing blood oxygenation. There are also health risks involved with blood hyperviscosity and the invasive techniques in transfusion.

#### **Why used?**

- To improve performance by increasing the oxygen carrying capacity of blood.

### **(b) Chemical and physical manipulation**

#### **Why they are banned?**

They give unfair advantage to athletes.

#### **Why used?**

- To improve performance.

### **(c) Gene doping**

#### **Why they are banned?**

Have the capacity to improve the athlete performance.

#### **Why used?**

- To improve performance.

## **5. Conclusion**

Recently, drugs designed especially for athletes to enhance performance have been produced, used, and athletes punished. The administration of prohibited substances to athletes with an indisputable clinical need is now possible under strict regulations. While great progress has been achieved to catch up with the dopers and their

rogue scientific advisors, many challenges remain in the future, not the least of which will be the necessity to prevent gene doping from damaging sport.

#### **Conflict of interest**

None.

#### **References**

1. Gerdes LI. Performance Enhancing Drugs. Michigan: Greenhaven Press; 2007.
2. Catlin DH, Fitch KD, Ljungqvist A. Medicine and science in the fight against doping in sport. *Journal of Internal Medicine*. 2008;264:99-114.
3. World Anti-Doping Agency. 2017. Available from: <http://www.wada-ama.org/en/about-wada/history/>. Accessed January 15, 2017.
4. Bowers LD. Athletic Drug Testing. *Clinics in Sports Medicine*. 1998;17:299-318.
5. Graf-Baumann T. Medicolegal aspects of doping in football. *Britain Journal of Sports Medicine*. 2006;40:i55-i57.
6. Brukner P. *Drugs in Sport*. Canberra: SMA publications; 1995.
7. Tricker R, Cook DL, McGuire R. Issues related to drug abuse in college athletics: athletes at risk. *Sport Psychology*. 1989;3:155-6.
8. Brukner P, Khan K. *Drugs and the Athlete*. In: *Clinical Sports Medicine*. New York: McGraw-Hill; 2001.
9. Taylor TL. *Physiology of Exercise and Healthy Aging*. In: *Older Athletes and Substance abuse*. Illinois: Human Kinetics; 2008.
10. Emran MA, Hossain SS, Salek AKM, Khan MZ, Ahmed SM, Khandaker MNZ, Islam MT. Drug abuse in sports and doping. *Bangladesh Medicine Journal*. 2014;43:46-50.
11. Anshel MH. A survey of elite athletes on the perceived causes of using banned drugs in sport. *Journal of Sport Behavior*. 1991;14:283-310.
12. Brukner P, Khan K. *Drugs and the Athlete*. In: *Clinical Sports Medicine*. New York: McGraw-Hill; 2007.