Doping in sport: an overview

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Abstract
Doping, the illegal use of performance-enhancing drugs or techniques in sport, continues to be a significant issue that threatens the integrity and fairness of athletic competition. This article explores the motivations behind athletes’ decision to dope, emphasises the pharmacist’s pivotal role in combating it by staying informed on the World Anti-Doping Agency (WADA) Code, ensuring legitimate medication use, and educating athletes about doping and nutritional supplements. Furthermore, the role of the WADA in combating doping, the impact of doping on sports performance, and the substances and methods prohibited in sports are then discussed. The findings highlight the need for stringent anti-doping measures to preserve the principles of fair play and protect the health and well-being of athletes.

Keywords: doping, sports, performance-enhancing drugs, WADA, athletes, substance abuse, sports medicine, pharmacist

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Introduction
Doping, which involves the illegal use of banned performance-enhancing drugs (PEDs) or techniques to enhance athletic performance, has been a practice dating back to the creation of sport itself. From the ancient use of substances in chariot racing to recent doping scandals at the Olympic Games, drug abuse in sport has become a growing concern.

Doping poses a significant threat to the integrity and reputation of sport, as it grants an unfair advantage to those who partake in such practices. By doing so, it undermines the fundamental principles of fair competition and sportsmanship. The ban on PEDs serves not only as an ethical measure but also to safeguard the well-being of athletes. PEDs can have severe health implications, potentially causing long-term damage.

Numerous international sports organisations, including the International Olympic Committee (IOC), actively enforce stringent anti-doping policies to uphold the principles of fair play. Pharmacists, as the custodians of medicine, also play a crucial role in this effort by upholding anti-doping regulations and supporting athletes. They can ensure that athletes adhere to anti-doping rules, verify medication compliance with the Prohibited List, and educate athletes about the risks associated with doping.

Why do athletes dope?
Drug abuse is a prevalent issue that affects athletes across various sports, age groups, and skill levels. While gaining a competitive edge is often a motive for doping, athletes are not immune to the challenges and struggles faced by society. Factors such as mental health disorders, injuries, and pain contribute to their decision to engage in doping.

A common reason for doping is the desire to enhance cognitive abilities, stamina, strength, and power, ultimately improving athletic performance. However, athletes may turn to doping as a form of self-medication to alleviate stress and anxiety from the pressure to perform and succeed or when suffering from a mental health disorder. Moreover, athletes may resort to using doping substances to self-treat injuries and manage physical pain to continue participating in their sport.

The pharmacist’s role in combating doping in sports
Sport and exercise participation, from amateur to elite international levels, is witnessing a global surge, demanding a greater need for guidance and support from well-informed healthcare professionals. Pharmacists, with their extensive pharmacological knowledge, role in patient counselling, and unique position within the community, can play a crucial role in the fight against doping in sports. By providing athletes with expert knowledge on medicine use in sports, including prohibited substances and anti-doping regulations, pharmacists can significantly support athletes. Moreover, they can contribute to the anti-doping movement by helping prevent inadvertent use of prohibited substances and promoting awareness and education (Table I).

By adhering to these responsibilities, pharmacists contribute significantly to the fight against doping in sport and play an integral part in promoting fair, clean, and safe sports environments for athletes worldwide.

The World Anti-Doping Agency
In response to a cycling doping scandal in 1998, the IOC organised the First World Conference on Doping in Sport in 1999, leading to the establishment of the World Anti-Doping Agency (WADA). WADA aims to ensure doping-free sport, promoting health, fairness, and equality. The agency implements anti-doping programmes globally, setting rules, conducting research, providing education, and monitoring compliance through collaborating with sporting bodies, governments, and stakeholders.
Sports performance encompasses four key components: skill, strength, endurance, and recovery (Figure 1). Each sport requires a unique combination of these elements. Skill-focused sports like target shooting or chess rely heavily on concentration and may benefit from drugs that reduce anxiety or fatigue and increase concentration. Sports emphasising explosive, anaerobic power, like sprinting or boxing, favour a muscular build and are susceptible to PEDs that increase muscle mass and strength. Endurance-based sports, such as cycling, triathlons or long-distance running, benefit from doping methods that boost aerobic capacity, like blood transfusions or erythropoietin (EPO). Additionally, contact sports rely on injury recovery and may benefit from growth hormones and other factors that aid tissue regeneration.

### Top sports with the highest number of ADRVs committed by athletes

Athletics, cycling, and weightlifting were the sports with the highest number of Anti-Doping Rule Violations (ADRVs) committed by athletes (Figure 2).

### Nationalities of athletes with the highest number of ADRVs

The top three nationalities with the highest number of ADRVs are Russia, with 135 cases; India, with 59 cases; and the United States, with 57 cases (Figure 3).

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**Table 1: Responsibilities of pharmacists in doping control and anti-doping support for athletes**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Responsibilities and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staying informed and documenting</td>
<td>Stay abreast of the latest WADA prohibited list and regulations to ensure full compliance with anti-doping regulations in sport. Document an individual’s participation in competitive sport in their medication record to facilitate appropriate treatment and adherence to anti-doping guidelines.</td>
</tr>
<tr>
<td>Dispensing medications and monitoring TUEs</td>
<td>Ensure that any medications dispensed to athletes are compliant with the anti-doping rules and do not contain prohibited substances. Verify the validity and necessity of Therapeutic Use Exemptions (TUEs) that allow athletes to use prohibited substances for legitimate medical reasons. Ensure proper documentation of TUEs.</td>
</tr>
<tr>
<td>Educating athletes and providing support</td>
<td>Educate athletes about the risks of doping, the consequences of using prohibited substances, and the importance of adhering to anti-doping regulations for the integrity of sports and athlete health. Educate about the benefits and risks associated with nutritional supplements to promote safe and effective supplementation practices. Support athletes in maintaining their health and well-being through legitimate means, helping them navigate medications that are allowed within the anti-doping framework.</td>
</tr>
<tr>
<td>Being vigilant and reporting suspected violations</td>
<td>Exercise vigilance in distinguishing between legitimate medical use of medications and potential misuse for performance enhancement. Consider refusing to supply medications if there is clear intent for illegitimate performance enhancement. Report any suspicious or questionable practices related to doping to relevant anti-doping authorities or sports organisations to maintain the integrity of sport competitions.</td>
</tr>
</tbody>
</table>

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**Figure 1:** Exploring the components of sports performance and doping

Adapted from Handelsman

**Figure 2:** Top 10 sports with the highest number of ADRVs

(WADA Anti-doping rule violations report 2023)

**Figure 3:** Nationalities of athletes with the highest number of ADRVs
Prohibited substance list 2023

The prohibited list is a crucial part of the World Anti-Doping Programme, updated annually through a consultation process by WADA (Table II). It plays a crucial role in ensuring fair play, safeguarding athlete health, and upholding the core values of sport. It encompasses more than 300 drugs and metabolites, which are classified into various groups.

Prohibited substances

Non-approved substances (S0)

This category includes drugs that are not approved by any regulatory health authority for human use and are always prohibited. It covers substances in various stages of development, discontinued drugs, designer drugs, and those approved only for veterinary use. An example mentioned is BPC-157, a peptide known for its potential therapeutic effects in healing and tissue repair.

Anabolic agents (S1)

Anabolic agents stand out as the most abused substances in sport. According to the 2020 anti-doping testing figures, the top nationalities with the highest number of ADRVs are:

- Russia: 135
- India: 59
- United States: 47
- Italy: 23
- Brazil: 23
- France: 23
- Kazakhstan: 22
- Romania: 21
- China: 13
- United Kingdom: 8

The prohibited list includes substances and methods that are banned during the period when an athlete is participating in a sports competition, as well as those that are banned both in and out of competition. Athletes are not allowed to use these substances or methods at any time, whether during competition or in their everyday life.

Substances of abuse

Substances that are identified as such because they are frequently abused in society outside of the context of sport, e.g., recreational drugs like cocaine, heroin, MDMA/“ecstasy”, THC.

Table II: The prohibited list

<table>
<thead>
<tr>
<th>Prohibited substances in sports</th>
<th>Prohibited methods in sport</th>
<th>Substances prohibited in specific sports</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0 Non-approved substances</td>
<td>M1 Manipulation of blood and blood components</td>
<td>P1 Beta-blocker</td>
</tr>
<tr>
<td>S1 Anabolic agents</td>
<td>M2 Chemical and physical manipulation</td>
<td></td>
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<tr>
<td>S2 Peptide hormones, growth factors, related substances, and mimetics</td>
<td>M3 Gene and cell doping</td>
<td></td>
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<tr>
<td>S3 Beta-2 agonists</td>
<td></td>
<td></td>
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<tr>
<td>S4 Hormone and metabolic modulators</td>
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<td></td>
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<td>S5 Diuretics and other masking agents</td>
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<td></td>
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<td>S6 Stimulants</td>
<td></td>
<td></td>
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<td>S7 Narcotics</td>
<td></td>
<td></td>
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<tr>
<td>S8 Cannabinoids</td>
<td></td>
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<tr>
<td>S9 Glucocorticoids</td>
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</tbody>
</table>

MDMA/“ecstasy” = Methylendioxyamphetamine, THC = Tetrahydrocannabinol.
report, stanozolol was the most frequently abused anabolic agent, followed by dehydrochloromethyl-testosterone and drostanolone ranking third.\textsuperscript{12,13}

Among selective androgen receptor modulators (SARMS), enobosarm emerged as the most abused substance. Clenbuterol occupied the second position, and ligandrol LGD-4033 third.\textsuperscript{13}

Although anabolic agents have legitimate medical uses, athletes misuse them to enhance performance, seeking increased muscle mass, strength, and improved athletic performance.\textsuperscript{12,13}

**Peptide hormones, growth factors, related substances, and mimetics (S2)**

Athletes commonly misuse peptide hormones, growth factors, related substances, and mimetics to enhance performance, increase muscle mass, improve energy and exercise capacity, and reduce risk of heart disease.\textsuperscript{12,13}

The 2020 report highlighted that EPO and substances affecting erythropoiesis were the most misused within this category. Although these substances have therapeutic uses, such as treating anaemia, athletes misuse them to elevate red blood cell count, which in turn enhances oxygen transport and endurance capabilities.\textsuperscript{13}

**Beta-2 agonists (S3)**

Beta-2 agonists are substances that have been prohibited in sport since the 1990s. However, there have been changes in the regulations to allow for the inhalation of specific beta-2 agonists, including salbutamol, formoterol, and salmeterol, aimed to strike a balance between allowing athletes with legitimate medical needs to use certain inhalers for respiratory conditions while preventing the misuse of beta-2 agonists for performance enhancement.\textsuperscript{12}

According to the 2020 report, the most frequently reported beta-2 agonists in this category were terbutaline and higenamine. These findings highlight the continued monitoring and regulation of beta-2 agonist usage in sport to maintain fair competition and prevent abuse.\textsuperscript{13}

**Hormone and metabolic modulators (S4)**

Athletes often use aromatase inhibitors and anti-oestrogenic substances, including anti-oestrogens and selective oestrogen receptor modulators (SERMS), not to directly enhance performance but to counteract the adverse effects of anabolic steroid abuse.\textsuperscript{12,13}

Aromatase inhibitors block the conversion of androgens to oestrogens, leading to artificially elevated levels of androgens in the body. Androgens possess various performance-enhancing effects.\textsuperscript{12,13}

The most frequently reported occurrences within this category included tamoxifen, meldonium and clomifene.\textsuperscript{13}

**Diuretics and other masking agents (S5)**

Furosemide and hydrochlorothiazide were the most reported Adverse Analytical Findings (AAFs) for diuretics and other masking agents.\textsuperscript{11}

Diuretics are therapeutically used to treat conditions such as oedema or volume overload in patients with heart failure, cirrhosis, kidney disease, or pulmonary oedema. In sports they are used to manipulate or falsify the results of doping controls and to conceal the use of prohibited substances.\textsuperscript{12}

**Stimulants (S6)**

Stimulants are used to enhance sports performance by increasing alertness, concentration, metabolic rate, power, strength, and reducing fatigue.\textsuperscript{12}

Methylphenidate had the highest occurrence, followed by cocaine and amphetamine.\textsuperscript{13}

Cocaine and methylenedioxymethylamphetamine (MDMA or “ecstasy”) are classified as substances of abuse within this category due to their societal misuse, extending beyond performance enhancement in sport.\textsuperscript{13}

Drugs used for cough and cold treatment, like ephedrines, fall into the threshold category, where their concentration must exceed a specific level for sanctions to be imposed. Exceptions to the ban on stimulants include clonidine and imidazoline derivatives used for dermatological, nasal, ophthalmic, or otic purposes.\textsuperscript{13}

**Narcotics (S7)**

Narcotics are powerful painkillers, typically used in post-surgical treatments. However, athletes may misuse these drugs to mask pain and enable them to compete for longer periods. Narcotics such as morphine, heroin, and pethidine can be highly addictive.\textsuperscript{12}

The highest occurrence was oxycodone, followed by morphine.\textsuperscript{13}

Proper pain management and seeking appropriate medical advice and alternatives are crucial to ensure both the athlete’s well-being and compliance with anti-doping rules.\textsuperscript{10}

**The cannabinoids (S8) and Carboxy-THC 91.99%**

While there may be claims about the positive effects of cannabis in sport, like muscle relaxation and decreased anxiety, it is important to note that WADA prohibits the use of cannabinoids in competition. This includes natural and synthetic cannabinoids, such as tetrahydrocannabinol (THC) and cannabidiol (CBD).\textsuperscript{13}

**Glucocorticoids (S9)**

Glucocorticoids have several effects on the body that may be perceived as beneficial for athletes. These effects include increased effort and energy due to higher glucose levels during exercise, reduced muscle swelling and pain due to their anti-inflammatory properties, decreased sense of fatigue, increased euphoria, and quicker replenishment of glycogen stores.\textsuperscript{12}
Propranolol had the highest occurrence under AAFs in this class.13

Conclusion

Doping threatens fair competition and athlete health in sports. Reasons for doping include performance enhancement, pressure to succeed, and managing challenges. The global rise in sport and exercise participation requires support from informed healthcare professionals. Pharmacists, with their pharmacological knowledge and patient counselling role, play a crucial role in combating doping in sport by providing expert knowledge on medicine use and contributing to anti-doping efforts. WADA enforces global anti-doping policies with the prohibited list, which bans substances. The 2020 anti-doping rule violation report shows anabolic agents as the most abused substances. To protect sports integrity and athletes, a comprehensive approach is needed, including education, awareness, and strict enforcement. Efforts must create fairness and sustainability in clean sports.

References