

# The Achilles' heel of sport performance – misuse of drugs, and consequence to the longevity and credibility of an athlete

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## Abstract

Despite efforts by the World Anti-Doping Agency (WADA) to ensure fair play, the use of banned substances and drug misuse persists in sports. Key factors include the competitive nature of sports, the desire to excel, incentives, and the perceived success of reaching the top levels. The athlete's support system or entourage often facilitates doping, undermining fair competition and ignoring health risks. Doping is not just about gaining a competitive edge but also about enhancing performance, training intensity, and recovery. Some substances are used as masking agents for other prohibited drugs, indicating a sophisticated approach to doping. Various classes of commonly abused drugs in sports include analgesics, stimulants, narcotics, and diuretics, which extend beyond anabolic steroids, emphasising the health risks associated with their misuse. The rationale behind the selection of drugs for this review was their potential for dependency, adverse effects, legal repercussions, and doping violations. Many of these drugs are not prohibited and are used to treat various medical conditions, making their misuse harder to detect. The reliance on these drugs in sports is likely to increase, posing ongoing challenges to the integrity of sports and athletes' health. This review underscores the need to address the root causes of doping, including competitive drive and the role of the athlete's entourage. Improved communication about athlete well-being, along with enhanced research, advocacy, and education, is crucial for combating doping and safeguarding the future of sports.

**Keywords:** addiction, competition, doping, gateway, incentives, networks

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## Introduction

A current burden in the broader sports industry is the use of drugs to enhance physical performance, which may provide an athletic advantage and the rewards that come with winning.<sup>1</sup> This drives many athletes to strive for a victorious outcome by any means necessary.<sup>2</sup> Doping has thus become a prominent practice in many sports events,<sup>3,4</sup> and for consumers.<sup>5</sup> The use of legal/illegal drugs to enhance athletic performance is often to deal with stress and to recover from physical pain and injury.<sup>3</sup> These drugs include beta-adrenergic receptor blockers, anabolic steroids, stimulants, narcotics, diuretics, and general analgesics.<sup>6</sup> Thus, a vast number of drugs developed for various pharmacotherapeutic uses have been discovered to possess other potential benefits when used in different professional and non-professional activities.<sup>7</sup> Thus, in many sporting activities, the use of banned substances still prevails, despite the World Anti-Doping Agency (WADA) code and other organisations' significant efforts to curb the use of substances to enhance athletic performance.<sup>8,9</sup> Therefore, the policies and testing methods of anti-doping agencies need to remain a step ahead of the evaders of anti-doping tests.<sup>10</sup> This commentary focuses on a selected number of drugs from the drug classes mentioned above, for their specific interest, or that have a history of misuse by general consumers and athletes. In South Africa, there are numerous anecdotal reports demonstrating the widespread use of selected drugs for various benefits in sports. These drugs include, but are not limited to, probenecid, naproxen,

tramadol, phentermine, cocaine, oxycodone, meldonium, codeine, ephedrine, paracetamol, hydrochlorothiazide, and methylprednisolone (Table I). The use of phentermine by athletes is largely due to its appetite suppression properties.<sup>6</sup> Cocaine is classified as a stimulant, and its effects are mediated in both the central and peripheral nervous systems.<sup>11</sup> Probenecid is a uricosuric agent used by athletes to mask the presence of other misused agents in urine samples, and naproxen is a nonsteroidal anti-inflammatory drug (NSAID) that can provide prolonged pain relief for users.<sup>7,8</sup> Additionally, tramadol is a weak opioid receptor agonist used as an analgesic in the treatment of acute and chronic pain.<sup>3</sup> Oxycodone shares an identical mechanism to other opioids, and specifically exerts its analgesic effects by binding to mu opioid receptors in the central nervous system (CNS).<sup>12</sup> Meldonium is one of the drugs included in WADA's prohibited list in January 2016, based on reports of increased use that was identified during the London 2012 Olympics and Paralympics.<sup>13</sup> It is classified by WADA as an ergogenic substance that forms part of the 'metabolic modulator' category. Over 170 athletes have tested positive for meldonium.<sup>14,15</sup> The successful inclusion of meldonium on this list was significant for the addition of other drug substances that are primarily used in the management of various disease conditions. Further research, policy adjustments, and identification of other substances underpin the 'flagging' or successful inclusion of other pharmacological substances on the prohibited or monitored list of substances in sports. The use

of the analgesic, codeine, by athletes is common, being used approximately four times more often than the athlete's age-matched general population.<sup>16</sup> Codeine is not prohibited by WADA but has been included (2021) in the WADA monitoring list for further investigation into its health risks and performance-enhancing potential. On the one hand, the use of ephedrine gives athletes an unfair advantage during competition because of its stimulant effects, and prolonged use may lead to long-term effects such as dependence and addiction. On the other hand, paracetamol also provides improved endurance and temperature regulation, however, its prolonged use may result in side-effects such as liver damage.<sup>17</sup> The diuretic hydrochlorothiazide (HCTZ) is used to decrease blood pressure by decreasing blood volume and increasing water excretion from the body by the kidneys, hence the diuretic property used in sports.<sup>18,19</sup> Glucocorticoids (GC) are hormones that occur naturally in the body with anti-inflammatory and immunosuppressive effects. Specifically, methylprednisolone (MP) is an intermediate-acting, synthetic GC with the same effects at a therapeutic dose administered orally or parenterally.<sup>20</sup> GCs are prohibited in competitions by WADA because of their perceived ergogenic effects.<sup>21</sup> The misuse of drugs in sports is a critical issue that impacts athletes' health, performance, and reputation. This review examines some of the common reasons behind drug misuse, the types of drugs commonly abused, and the extensive consequences of drug abuse on athletes' careers and lives.

### Reasons for misuse/abuse

Athletes often experience immense pressure to excel in their sporting activities, which can lead to drug misuse. The primary reasons for abuse and misuse often include performance enhancement, pain management, and coping with mental health issues. A significant number of athletes resort to performance-enhancing drugs, such as anabolic steroids, growth hormones, and stimulants, to gain a competitive edge. The intense physical demands of sports often lead to injuries, prompting some athletes to misuse painkillers to manage chronic pain and continue competing. Additionally, the stress and anxiety associated with high-level competition can drive athletes to misuse substances, including recreational drugs, as a coping mechanism.

### Performance enhancement, pain, stress and anxiety management

Phentermine is often used by athletes in competitive sports for its appetite suppressant activity, which may be beneficial for athletes looking to lose weight or maintain a certain body weight.<sup>22</sup> Tramadol, which is used by athletes in the treatment of pain, is currently not prohibited but has been placed on WADA banned list as from 1 January 2024. This specifically allows athletes to continue training or compete, despite the injury that may have resulted in such pain.<sup>23</sup> The consequence of this for the athlete may result in more severe injuries.<sup>23,24</sup>

Meldonium was brought to the attention of the sporting authorities as a drug that was used mainly by athletes from Eastern European countries.<sup>25</sup> Codeine is being investigated as

it has been suggested to have ergogenic effects.<sup>26</sup> It is used by athletes to increase their pain threshold, hence enhancing their performance.<sup>26</sup> Further research however needs to be conducted to ascertain whether codeine increases sports performance, and whether it should be prohibited in sport.<sup>26</sup> Paracetamol is an analgesic agent that inhibits central prostaglandins to modulate pain and inflammation.<sup>27</sup> As a result, paracetamol is used in sports to increase pain tolerance in athletes.<sup>27,28</sup> Additionally, in sports, paracetamol improves endurance by reducing the activation of brain structures involved in pain and cognitive processing.<sup>29</sup> Inhibited prostaglandins also allow athletes to exert their energy for longer periods.<sup>30</sup> Some studies suggest that paracetamol may reduce body temperature during exercise, which allows athletes to improve their tolerance to exercise in the heat.<sup>29</sup> According to the literature, paracetamol is not prohibited in sport by WADA. The use of paracetamol by athletes may thus increase globally, due to these effects.<sup>29</sup> Hydrochlorothiazide (HCTZ) allows for rapid weight loss, especially in weight-class sports, and is also a useful masking agent to increase the rate of elimination of prohibited substances such as stimulants and anabolic agents, and thus conceals the effects of these substances.<sup>18</sup> Hence HCTZ is classified as a prohibited substance both in and out of competition by the WADA under S5: diuretics and masking agents class.<sup>18</sup> Systemic use of methylprednisolone (MP) is prohibited by the WADA in-competition due to its ergogenic effects.<sup>21</sup> It has been abused by athletes widely for unfair advantage against their competitors.<sup>31</sup> The benefit of MP use during physical exercise emanates from its ability to inhibit the release of pro-inflammatory cytokines due to damaged muscle during exercise, consequently preventing inflammation.<sup>31</sup> Furthermore, the drug promotes and enhances dopamine release from the CNS, thus providing for positive mood changes and preparing the body for the next session of intense physical exercise.<sup>31</sup>

### Consequences on longevity and credibility

Tramadol's use is of concern in sports such as professional cycling due to its side-effects, such as dizziness and sedation, which lead to reduced attention, which may result in accidents and injuries.<sup>23</sup> Furthermore, the most prominent unwanted effect associated with long-term use of tramadol is the development of dependency/addiction.<sup>32</sup> Cocaine case studies of athletes who use the drug have shown a pattern of detrimental central effects, including issues of time disorientation and perceptual misjudgements, which tend to impair performance in competition.<sup>33</sup> In particular, the behaviour often evolves into cocaine abuse in conjunction with other drugs, which may lead to death.<sup>33</sup> Oxycodone's long-term use, as with most opioids, carries the risk of death from overdose. The drug has shown that when abused over many decades, the potential for neurodegeneration manifests.<sup>14</sup> Ephedrine mainly presents mild adverse effects that last for only a short period. However studies have observed that ephedrine demonstrates no withdrawal symptoms after long-term use.<sup>34</sup> It remains unknown if ephedrine is safe for children (adolescents), and as such should be avoided.<sup>34</sup> The use of MP for more than 14 days results in the suppression of

**Table I:** Substances used in South Africa, scheduling status and consequences for athletes<sup>42-49</sup>

| Drug/<br>Substance                            | Purpose in<br>sport (misuse)         | Health risk and<br>longevity impact                                 | SA scheduling<br>status  | WADA/SAIDS<br>status                                         | Notable SA cases                                                                                                                                                                                                                                                                                                                                                 | Sanctions/consequences                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------|--------------------------------------|---------------------------------------------------------------------|--------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Anabolic<br>steroids                          | Muscle mass,<br>strength gains       | Liver damage,<br>hormonal<br>imbalance,<br>cardiovascular<br>issues | Schedule 5/6<br>(SAHPRA) | Prohibited<br>(WADA 2025 List)                               | <b>Seipati Peo</b> , Jan 2023; athletics; stanozolol metabolites, 19-norandrosterone<br><br><b>Molefe Kasonkola</b> , Jan 2023; bodybuilding; multiple (Nandrolone, Boldenone, Diuretics)<br><br><b>Ephias Mkutchwa</b> , 2023; Boldenone and 19-Norandrosterone<br><br><b>Minor</b> (name redacted), Feb 2023; athletics; testosterone and metabolites          | 4-year ban (extended to 2027); competed while under provisional suspension, resulting in disqualification<br><br>6-year ban (until Jan 2029); one of the harshest sanctions issued<br><br>4-year ban; tested positive at IFBBSA Championships<br><br>18-month ban (until August 2024); detected at National Athletics Championships |
| Erythropoietin<br>(EPO)                       | Endurance<br>enhancement             | Blood thickening,<br>stroke risk                                    | Schedule 6               | Prohibited                                                   | <b>Nicholas Seoposengwe</b> , July 2024; athletics; Erythropoietin, Trenbolone and its metabolite Eptrenbolone                                                                                                                                                                                                                                                   | 5-year sanction; no hearing held                                                                                                                                                                                                                                                                                                    |
| Stimulants (e.g.<br>amphetamines,<br>cocaine) | Alertness,<br>reduced fatigue        | Addiction, heart<br>issues, insomnia                                | Schedule 6               | Prohibited in-<br>competition                                | <b>Juanita de Kecker</b> , May 2023; athletics; Methylphenidate<br><br><b>Bafana Dube</b> , Oct 2022; athletics; 5-methylhexan-2-amine<br><br><b>Kagiso Rabada</b> , Jan 2025; cricket; Benzoyllecgonine (Cocaine metabolite)                                                                                                                                    | 2-year ban (2024-2026); no provisional suspension accepted<br><br>2-year ban (until Oct 2024); voluntary provisional suspension accepted<br><br>1-month sanction; no hearing held                                                                                                                                                   |
| Cannabinoids                                  | Anxiety<br>reduction, pain<br>relief | Cognitive<br>impairment,<br>dependency                              | Schedule 6               | Prohibited in-<br>competition                                | <b>Nicole van Wyk</b> , May 2023; mixed martial arts; Cannabinoids/Carboxy THC                                                                                                                                                                                                                                                                                   | 2-year sanction; no hearing held                                                                                                                                                                                                                                                                                                    |
| Beta-2<br>Agonists (e.g.<br>Salbutamol)       | Bronchodilation<br>for asthma        | Heart palpitations,<br>tremors                                      | Schedule 4               | Limited<br>use with<br>therapeutic<br>use exemption<br>(TUE) | <b>Mosito Lehata</b> , March 2021; athletics; Salbutamol                                                                                                                                                                                                                                                                                                         | 5-year sanction; no hearing held                                                                                                                                                                                                                                                                                                    |
| Diuretics<br>& Masking<br>Agents              | Weight loss,<br>mask other<br>drugs  | Dehydration,<br>kidney damage                                       | Schedule 5/6             | Prohibited                                                   | <b>Maria Helena Jansen</b> , Mar 2023; bowls; Hydrochlorothiazide, chlorothiazide<br><br><b>Zohra Crain</b> , Jan 2023; powerlifting; Amiloride and Hydrochlorothiazide<br><br><b>Anton Gerasimov</b> , May 2023; bodybuilding; Chlorothiazide, Hydrochlorothiazide, Oxandrolone, Stanozolol, Anastrozole, Fluoxymesterone, Drostanolone, Metenolone, Trenbolone | 7-month ban; detected at National Women's Bowls Championship<br><br>9-year sanction; no hearing held<br><br>6-year sanction; no hearing held                                                                                                                                                                                        |

**Sources:** Bayever (2013),<sup>42</sup> South African Medical Association (2024),<sup>43</sup> van der Berg (2022),<sup>44</sup> Smith and Mokoena (2023),<sup>45</sup> SAIDS (2024a),<sup>46</sup> SAIDS (2024b),<sup>47</sup> Lambley (2023),<sup>48</sup> SAHPRA (2025).<sup>49</sup>

**Abbreviations:** SAIDS – South African Institute for Drug-Free Sport, TUE – Therapeutic Use Exemption, WADA – World Anti-Doping Agency, SAHPRA – South African Health Products Regulatory Authority, IFBBSA – International Federation of Bodybuilding and Fitness South Africa

the hypothalamic-pituitary-adrenal axis (HPA), leading to adrenal insufficiency.<sup>20</sup>

The adverse effects associated with the abovementioned drugs can be catastrophic and debilitating, both short- and long-term, but more so for athletes who have aspirations and intent for the ergogenic potential and effect. As illustrative examples, in the case of high-performance athletes' headaches and gastrointestinal disorders, will not be conducive to excelling or even participating in sports.<sup>23,35</sup> Moreover, respiratory depression is associated with drugs such as oxycodone.<sup>36,37</sup> Likewise, visual disturbances and ocular irritation, will impede performance and training, and stimulants may adversely impact the cardiovascular, central nervous, gastrointestinal, and renal systems.<sup>38,39,40,41</sup> This may lead to an increased risk of strokes, heart attack, and/or death on the competitive playing field.<sup>25,41</sup> These adverse effects should be a strong indicator and deterrent for general misuse, and more so for the competitive athlete, in training and competition.

## Conclusion

The pervasive use of drugs to enhance physical performance in sports, driven by the desire for competitive advantage and the associated rewards, remains a significant burden in the sports industry. Pain treatment often aims to mask the underlying injuries. Meldonium, with its performance-enhancing properties, has a global potential for abuse. Drugs such as hydrochlorothiazide and probenecid are likely to continue being used for doping. Methylprednisolone, which is important for protein synthesis, and long-term use of drugs such as oxycodone can lead to severe health issues such as neurodegeneration and adrenal insufficiency, impacting athletes' ability to perform at their best. Appetite suppressants, such as phentermine, will remain in use, particularly where weight categories are a requirement in specific sports. Ephedrine is well placed for activities that require improvement in aerobic endurance capacity, reduced fatigue, and thus provide a competitive advantage. In almost all sports or activities, good vision is important. As such, caution is required as some drugs have the propensity to cause visual disturbances and ocular irritation, which may negatively impact sports performance. Adverse effects, such as headaches, gastrointestinal disorders, respiratory depression, and cardiovascular complications, not only hinder athletic performance but also pose serious health risks to athletes, both in training and competition. The presence of such detrimental effects should serve as a strong deterrent against the misuse of drugs in sports, emphasising the importance of promoting fair play, integrity, and the well-being of athletes in all sporting endeavours. Therefore, the importance of sound communication for all involved in the decision-making process related to the well-being of the athlete is emphasised.

## Future studies

It is of vital importance that studies are conducted, focussing on ethical frameworks for balancing athletes' pursuit of excellence and the imperative to maintain fairness and integrity in sport

should be improved on, and critically evaluated. Greater attention should be paid to the knowledge gaps concerning athletes' use of performance-enhancing drugs (PED). This should include examining the cultural, societal, and institutional factors that perpetuate doping practices and the effectiveness of current anti-doping policies and regulations. Longitudinal studies tracking athletes' health over extended periods could provide valuable insights into the cumulative effects of doping on overall well-being. It is recommended that studies be conducted to assist regulatory anti-doping agencies in providing enhanced education and understanding that promotes the health and overall well-being of athletes and prevents indiscriminate PED use rather than outright penalties.

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## Conflict of interests

The authors declare no conflicts of interest.

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