

Aspects regarding the use of drugs among athletes

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Abstract

Drug abuse among athletes is a current and very important issue, both ethically and in terms of health risks. In addition to the drugs prescribed for the treatment of some diseases, athletes can also use substances that artificially increase their performance, such as: stimulants, anabolics, opioids, erythropoietin, diuretics as well as substances used to mask the prohibited substances.

The aim of this study is to review the data from the literature about the use of various drugs by athletes, for therapeutic purposes, or to increase sports performance. *Methods:* We identified several studies using the on-line databases, and the inclusion and exclusion criteria. Searches were limited to full-text English-language journal articles published between 2003 and 2014. *Results:* After the primary analyses we selected a total of 30 relevant studies on this topic.

Even if there is progress in detecting prohibited substances that increase sports performance, doping prevalence persists in sport.

Conclusion: In order to prevent and disrupt drug abuse, appropriate measures should be taken by physicians and coaches, such as warning about the risks of doping, appropriate training, appropriate nutrition and an appropriate psychological approach.

Key words: *abuse, drugs, doping, sports performance, prohibited substances*

Rezumat

Abuzul de medicamente printre sportivi este o problemă actuală și foarte importantă, atât din punct de vedere etic, cât și din punct de vedere al riscurilor pentru sănătatea acestora. Pe lângă medicamentele care le sunt prescrise pentru tratamentul unor suferințe, sportivii pot utiliza și substanțe care să le crească artificial performanțele sportive, cum ar fi: stimulante, anabolizante, opioide, eritropoietină, diuretice și alte substanțe folosite la mascarea altor substanțe interzise.

Scopul acestui studiu este acela de-a trece în revistă datele din literatura de specialitate privind folosirea medicamentelor de către sportivi, în scop terapeutic sau pentru creșterea performanței sportive. *Metode:* folosind cercetarea bazelor științifice on-line și utilizând criterii de includere și excludere, am identificat câteva studii relevante. Căutările au fost limitate doar la articole complete din reviste scrise în limba engleză, publicate între anii 2003 și 2014. *Rezultate:* după o analiză primară am selectat 30 de studii relevante în ceea ce privește aceste subiecte.

Chiar dacă există progrese în detectarea substanțelor prohibite care cresc performanța sportivă, totuși persistă o prevalență a dopajului în sport.

Concluzie: pentru prevenirea și întreruperea abuzului de medicamente este necesară luarea de către medici și antrenori a unor măsuri corespunzătoare, cum ar fi atenționarea asupra riscurilor dopajului, antrenament corespunzător, nutriție adecvată și o abordare psihologică adecvată.

Cuvinte cheie: *abuz, medicamente, dopaj, performanță sportivă, substanțe interzise*

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Introduction

Currently, in modern sports, both amateur and professional, in all sporting branches and at any competitive level there is a wide use of both legal or prohibited substances [1, 2, 3].

A significant proportion of drugs are prescribed in certain situations for therapeutic purposes (e.g. NSAIDs, β_2 adrenergic agonists, corticosteroids) as well as nutritional supplements and recreational drugs [1].

The proportion of use or manipulation of synthetic or autologous substances in order to increase sport performance, varies between 5% and 31%, athletes using these substances despite possible risks and penalties [4, 5].

The causes for which athletes use these substances that increase performance, respectively for doping, are varied. As synthesized by Reardon C.L. et al., these causes include: the desire to increase sport performance and implicitly the achievement of victory, the overcoming of strenuous states caused by injuries, the physical pain or the retirement from sports life that occurs much earlier than in other activities, as well as the self-treatment of some mental illnesses (e.g. depression), sometimes seen as tiredness [2].

Currently, drug abuse in performance sports is closely monitored both because of their negative health effects and ethical reasons [6, 7].

An important achievement in the fight against drug abuse in performance sports was the establishment in 1999 of the "World Anti-Doping Agency - WADA", which has assumed responsibility for international doping control.

Subsequently, in 2004, the drafting and implementation of the "International Anti-Doping Code" [8] for the first time coordinated and harmonized the national and international anti-doping rules in all sports. It contains lists of prohibited substances and methods, lists that are updated every year.

Regarding doping tests these were introduced in 1968 at the Olympic Games in Mexico and widespread in the 1970s [1].

The aim of this study is to review the data from the literature about the use of various drugs by athletes, for therapeutic purposes or to increase sports performance.

Methods

We identified several studies using the following on-line databases: NCBI, PubMed, Research Gate, Semantic Scholar, Wiley Online Library, Google search. Searches were limited to full-text English-language journal articles published between 2003-2014, using the following key words: drugs, athletes, sport performance enhance, drug abuse, prohibited substances, nutritional supplements, stimulants, caffeine, creatine, drugs for athletes disorders. In our study we included scientific papers that had an available abstract, original data and discussed the use of drugs by athletes for therapeutic purposes or for increasing performance and review papers on these issues.

We have not included in the research case reports or studies discussing topics not related to the previous aspects.

Results and discussion

After the primary analyses we selected a total of 30 relevant studies on this topic.

From the analysis of the researched studies we have found the use of a wide variety of drugs, ~~used~~ both for the treatment of some athletes' disorders and for the increase of sports performance. Certain drugs can be prescribed for therapeutic purposes by applying a "therapeutic use exemption" by a specialist physician or a team of physician [1].

Among the drugs allowed for athletes are NSAIDs (Nonsteroidal anti-inflammatory drugs), such as propionic acid derivatives (e.g. naproxen, ketoprofen and ibuprofen). Thus, according to the study conducted by Da Silva E.R. et al., in 2011, related to the Pan-American Games in 2007, 64% of the tested athletes reported using NSAID's, namely one type of NSAID [9].

In sports competitions, osteoarticular injuries and/or skeletal muscle injuries frequently occur due to specific stresses. Consequently, inflammation occurs, which is manifested by pain and tenderness to touch, movement, temperature rise, stiffness and oedema, as well as reduced ability to produce force. Under these conditions, in order to reduce pain and discomfort and implicitly to reduce the duration of incapacity, NSAIDs are used in combination with immobilization or cryotherapy [9, 10].

The fact that some athletes tend to use NSAIDs, especially during sports competitions, suggests that

they can use it as ergogenic aid to improve performance. [9, 11] Athletes involved in long-term competition programs use the NSAIDs much more frequently outside the competition, but the literature on this issue is controversial [9, 12, 13].

Generally, an athlete's ability to tolerate pain is a decisive factor in performing a high intensity exercise [14, 15].

One of the most commonly prescribed analgesics, being considered among the safest non-opioid analgesics is paracetamol. Its analgesic effects are not altered during an exercise, thus being useful in treating moderate pain during exercise. [14, 16] Foster J. et al., in 2014, have investigated the influence of paracetamol on the performance of repeated cycling sprints; they found that acute dosing of 1.5 g paracetamol significantly improved the performance of repeated sprint exercises through a reduction in pain perception. The results obtained by these authors suggest that an exercise can be adjusted by the pain perception and an increased pain tolerance can improve the performance of the exercise [14].

Administered in therapeutic doses, paracetamol, as well as other analgesics, does not pose immediate health risks, although if used to mask skeletal muscle pain, there is an increased risk of injuries, because pain is an important warning signal of a possible tissue lesion [17]. In addition, if given chronically and at high doses, paracetamol may affect the liver, kidneys and the gastrointestinal tract [18].

In the case of athletes, β_2 adrenergic agonists can be legally used in certain circumstances (in the prevention and treatment of bronchial asthma, including exercise-induced bronchial asthma, but only by inhalation). In such situations athletes may apply for a writing notification regarding of the therapeutic use of such medications from a pulmonologist or by a team of physician [1, 19]. Since they are considered as stimulants, they are forbidden, except for 1600 micrograms per 24 hours of inhaled salmeterol. There are discussions about their ergogenic potential in non-asthmatic competitive athletes [2, 20]. If given orally, they can develop skeletal muscles, inhibit protein cleavage and reduce body fat [21].

Use of corticosteroids is only allowed for the treatment of allergic rhinitis as a nasal spray.

Caffeine, like creatine, is a compound often used by athletes; its use is not considered a doping infraction, although it is ergogenic in certain types of performance to some athletes because it is naturally found in many foods and energy drinks. [22]

Caffeine is a xanthine alkaloid derivative (1,3,7-trimethylxanthine), that exhibits a variety of dose-dependent effects in non-habitual consumers (tachycardia, mild increase in blood pressure, diuresis, fine tremor of the extremities). Used in moderate amounts, caffeine increases both energy availability and daily energy expenditure, increases sensation of liveliness and energy, produces insomnia, prevents central perception of fatigue, increases physical and motor performance as well as cognitive performance, and increases the ability to concentrate [23].

As Astorino T.A. and Roberson D.W. assert, caffeine ingested in capsules or powders and as a constituent of energy drinks or supplements is ergogenic for various high intensity exercise protocols (running, strength training or activities that stimulate sports team); ergogenic caffeine doses ranging from 2 to 9 mg/kg body weight. If higher doses are used, caffeine can cause side effects (anxiety, headache, insomnia) that diminish sport performance [24].

The nutritional supplements that can be consumed by athletes are vitamins, minerals, herbs, extracts and metabolites, some of which can have ergogenic effects. [2, 25] Of these, the most used for increasing sports performance is creatine, as it increases strength and muscle mass [26, 2].

Creatine is a biologically active compound, namely a guanidine compound synthesized in the liver and kidney from the amino acids arginine and glycine; in addition, it is also naturally found in a wide variety of traditional foods (meat and fish) and beverages, which makes its use not to be considered a doping infraction [22]. Its beneficial effects have been demonstrated especially in cyclists and at weightlifters [4, 27, 28]. Supplementation with creatine (5 g 4 times a day for 4-5 days or 3g/day for 30 days) intensifies the performance of high intensity repetitive sprinters, [22, 29], delaying the fatigue [4, 30], increasing power and energy production, but there is no compelling evidence that creatine loading beneficial for resistance athletes.

[4, 31] In some athletes, its administration may cause gastrointestinal disturbances.

Additionally, as Judkins C. (2012) shows, there is a risk that supplements will be contaminated with substances that are banned by the type of steroid or stimulant, without the manufacturer or the athlete knowing [2, 32].

Despite progress in performance enhancing substances detection, the prevalence of doping persists in all sports.

Sport is a physical activity which is performed for competition and the harmonious development of body and mind [33]. In order to compete, athletes use a series of substances that enhance performance, although there are numerous prohibitions on their consumption. Prohibited substances classes are specified by the "Anti-Doping Code for the Olympic Movement", developed by the "International Olympic Committee". These classes of substances are stimulants, opioid analgesics, anabolic steroids (androgens and β 2-adrenergic agonists, growth hormone and insulin-like growth factors, erythropoietin and diuretics and other masking substances) [7, 19].

Stimulants (e.g. amphetamine, D-methamphetamine, ephedrine, pseudoephedrine, phenylephrine, cocaine) are the second most common reason for a positive test [4, 31]. They increase anaerobic performance, improve response time and resistance, increase attention and liveliness, decrease fatigue, cause weight loss [4, 34].

Amphetamines increase muscle strength and strength, aerobic power and anaerobic capacity [2, 4, 35], and ephedrine can produce very little transient weight loss with low efficacy in athletic performance [2, 4, 36].

Opioid analgesics (e.g. morphine, methadone, petidine, fentanyl) are prohibited, although they have a more sedative effect than a stimulant one, because they may have an impact on the athletes behavior. Among the opioid analgesics are permitted codeine, tramadol and dextromethorphan [1].

Anabolic androgenic steroids (exogenous testosterone and synthetic androgen such as danazol, stanozol, nandrolone) can influence sport performance by increasing strength and muscle mass [2, 37, 4, 38, 39], but do not improve the body's strength [2, 40].

In case of co-administration of testosterone and growth hormone in men, there was an improvement in running capacity [2, 41].

Recombinant human growth hormone improves athletic performance probably by increasing muscle mass and improving exercise capacity [2, 4, 41, 42]. It works through insulin-like growth factor 1, producing lipolysis and protein anabolism, with a consequent decrease in body fat and weight gain muscle [2, 4, 31, 43].

In case of weight-class sports (e.g. boxing and wrestling) diuretics (e.g. furosemide, hydrochlorothiazide) can promote sport performance, as they can cause rapid weight loss [2, 5]. In addition, they can hurry the removal of prohibited substances through urine and thus mask their detection. The use of diuretics, as well as other masking substances (e.g. probenecid), can lead to muscle cramps, electrolyte imbalances, gout etc. [2, 5, 44].

As Elliott S. states that substances that stimulate erythropoiesis, such as recombinant human erythropoietin, increase oxygen transport capacity, improving oxygen release from tissues and are especially useful for resistance athletes because they increase aerobic power and exercise tolerance [2, 45].

In some sports (e.g. hunting, billiards), athletes can use beta blockers (e.g. propranolol) because of their anxiolytic effect and reduce the tremor of the extremities (hands) [2, 46].

To increase performance, athletes can use glucocorticoids that have both analgesic and anti-inflammatory effects, although they have many side effects (hyperglycemia, hypertension, etc.). Their administration is forbidden both by oral and rectal routes and by i.v. or i.m. [2, 5]

Consumption of cannabinoids (marijuana, hashish) is forbidden by WADA, which can produce alertness, dysphoria, memory disorders, psychosis [2, 47].

Alcohol is a recreational drug that can be used to increase performance, despite its sedating effects and diminishing coordination and concentration. Its use is forbidden in 6 sports (e.g. motor racing and motorcycle competitions, etc.) [2].

Even if there is progress in detecting substances that increase sports performance, doping prevalence persists in sports. Most of the studies analyzed highlight both the negative effects of drug

abuse on the health of the athletes who use them as well as the measures necessary to prevent them.

Conclusions

Under the current conditions when drug abuse among athletes is widespread, steps must be taken to prevent and disrupt it. The use of performance-enhancing substances by athletes is forbidden because it is unethical and harmful to their health. An important role in preventing doping of athletes returns to coaches, physical therapists and physicians. They should alert athletes to the risks of continuing doping, encouraging them to discontinue this abuse. They also need to provide athletes an adequate training and nutrition strategies and increase their self-confidence.

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