

DRUG ABUSE IN SPORT PERFORMANCE – A SYSTEMATIC REVIEW

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Abstract

This study is a systematic review on the use of prohibited substances and their effects on sports performance. The use of banned substances, in order to increase the performance capacity, constitutes a problem worldwide. The research is based on the analysis of the most relevant studies on the issues addressed published in the last 5 years in the PubMed database. From the 78 results of the screening, we analyzed a total of 14 scientific studies and summarized the latest findings in this field.

Rezumat

Studiul de față reprezintă o revizuire sistematică cu privire la utilizarea substanțelor medicamentoase interzise și a efectelor acestora în sportul de performanță. Utilizarea substanțelor interzise în scopul creșterii capacității de performanță reprezintă una dintre cele mai răspândite probleme din întreaga lume sportivă. Cercetarea se bazează pe analiza celor mai relevante studii științifice cu privire la problematica abordată, aparute în ultimii 5 ani și publicate în baza de date PubMed. Din numărul total de 78 de articole, au fost analizate un număr de 14 studii științifice și am sumarizat cele mai noi informații din acest domeniu.

Keywords: doping, sports performance, incentives, banned substances

Introduction

Experts on performance sport define performance sports as the result from a specific activity, usually competitions designated by a number or a rating scale value [1]. Using certain substances for the body's physical and mental performance growth, has been practiced since ancient times. Historical documents signal, for the first time, the use of certain substances since 3200 BC in China, the Ma Huang plant, with beneficial action on the nervous and muscular system [2]. The concept of doping was used for the first time in 1889, and the first negative effects were recorded in 1896 at the

first modern Olympics, when a sports cyclist died of an overdose. Together with the industrial revolution, pharmaceuticals developed extensively so, they started to synthesize various substances, from anabolic steroids to amphetamines.

Later, in 1963, the Council of Europe developed a comprehensive definition of the concept of doping. Particularly, the doping would mean the administration or use of organism extraneous substances, regardless of modality, and of physiological substances in amounts exceeding therapeutic doses, in healthy persons, for the unique purpose of artificial and unethical growth of performance, during competitions.

According to WADA - World Antidoping Agency (2010), the term became current around the turn of the 20th century, originally referring to illegal drugging of racehorses. The practice of enhancing performance through the use of foreign substances or other artificial means, however, represents a problem worldwide [3].

In its turn, the International Olympic Committee developed the Anti-Doping Code, for the Olympic Movement, including "classes of prohibited substances and prohibited methods." One of the most significant achievements in the fight against doping in sport to date has been the drafting, acceptance and implementation of a harmonized set of anti-doping rules, is the World Anti-Doping Code. According to Angell et al. (2012), these drugs are reported in the majority of adverse findings in athlete drug screenings and, thus, are more likely to be relevant to the healthcare professionals responsible for the well-being of athletes [5].

Materials and Methods

The systematic review of the data obtained from study publication aimed to obtain better information on the effects of using forbidden substances in performance sport.

The criteria that led to the inclusion in the systematic review studies are those based on highlighting the negative effects of doping in sport performance.

The characteristics of the studies, on which we have been conducted the systematic review of publications in the PubMed database, highlight a fairly wide range of substances used for the purpose of enhancing the performance, regardless of the gender of the subjects. Finally, the systematic review was conducted on a total of 14 studies, published in the past 5 years (PubMed database) (Figure 1).

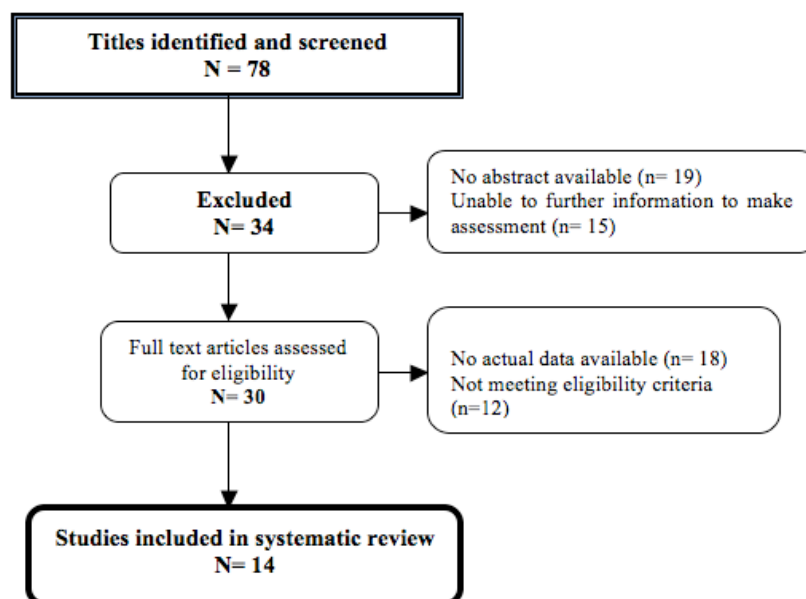


Figure 1
Study flow diagram

Results and Discussion

Most studies (90%) point out the fact that drug abuse in professional sports has negative effects on health. Thus Angell *et al.* (2012) argue that the abuse of steroids and stimulants (including amphetamines and cocaine) have adverse effects on the cardiovascular system. Also, in recent years there has been a significant increase in the consumption of dietary energy supplements (DES) associated with the parallel advertising against obesity and favoring high physical performance. These aspects are underlined by Avelar-Escobar *et al.* (2012) who present a case study of a young patient who developed acute mixed liver injury (hepatocellular and cholestatic) after ingestion of various "over the counter" products to increase muscle mass and physical performance (NO Xplode[®], creatine, L-carnitine, and Growth Factor ATN[®]) [6].

Research on drug abuse, on a significant proportion of racquet sports athletes, have resulted in a percent of 46% athletes reported using nutritional supplements; 10% and 24% of the studied males would use doping substances, if the practice would help them achieve better results in competition and if it had no negative health consequences; a further 5% to 10% indicated potential doping behaviour regardless of potential health hazards [7]. In what regards the effects of drug abuse in performance tennis,

Maquirriain (2010) demonstrates that, concerning the athlete gender, male 86.53% (45/52) tennis players showed significant higher incidence of performing a doping offence than females 13.46% (7/52) [8].

The longitudinal study conducted by WADA between 2004-2009, shows that the most frequently detected diuretic in laboratory tests is furosemide, a very active diuretic that promotes renal elimination of salts, with immediate effect starting in 20-60 minutes after administration. Furosemide causes a dose-dependent effect, used in small doses does not affect VO_2 (oxygen uptake), but abuse significantly increases the body's maximum oxygen consumption [9] with side effects on the athlete body. Another drug frequently detected in athletes urine is hydrochlorothiazide, a drug used in treating hypertension, edema and diabetes *insipidus* [10].

In its turn, ephedrine abuse has adverse cardiovascular effects: tachycardia, arterial vasoconstriction and hypertension, as well as: neuropathy, myopathy, psychosis, addiction, stroke, insomnia, myocarditis, arrhythmias, myocardial infarction or sudden death [11].

The investigated studies, also reported the illegal abuse of anabolic steroids with side effects on the cardiac tissue, resulting in cardiomyopathy characterized by impaired systolic and diastolic function. Also, they increase low-density lipoprotein cholesterol and decrease high-density lipoprotein cholesterol and these lipid abnormalities represent a major risk factor for coronary heart disease [12]. The use of doping pharmacological agents is one of the major negative aspects in sports, that is presently carefully monitored [13].

One of the current problems on doping in sport is the genetic doping [14]. Along with pharmacological manipulations, chemical or physical, genetic doping is one of the forbidden methods in sport performance and represents the inappropriate use of proteins such as erythropoietin, the growth hormone, the fibroblast growth factor, endorphins, in the purpose of enhancing performance.

The possibility of gene doping, defined as the transfer of nucleic acid sequences and/or the use of normal or genetically modified cells to enhance sport performance, is a real concern in sports health [15]. Recent studies demonstrate that the use of testosterone, as well as the growth factor, produced significant gains in total and appendicular lean mass, muscle strength, and aerobic endurance with significant reductions in whole-body and trunk fat [16]. Contrary to appearances, the use of incentives does not make the athlete work less, on the contrary it takes more effort, making more and more frequent training sessions for the substances synthesis. Most

of stimulants, such as amphetamines and derivatives, and a number of agents are metabolized to amphetamine or metamphetamine [17].

As stated in the National Anti-Doping strategy for the period 2007 - 2012, in the past 15 years, in our country, it has been found the use of prohibited substances and methods among athletes, which represents a danger to the public health and to the essential principles of sport and Olympism. The scientific research results have demonstrated that the abuse of banned substances has adverse health effects on the athlete health, sometimes on a long term. The misuse of stimulants has caused numerous deaths among athletes, both globally and nationally. The pharmacological effects of the psychomotor stimulants reside in the decrease of the feeling of fatigue with the installation of a state of euphoria, manifested by the intensity of sensory and psychomotor activity. Amphetamine is not without risk in conditions of great effort and there is no medical justification for the use of amphetamines in sport [18].

The use of diuretics in order to enhance athletic performance is considered a very risky practice. This can lead to dehydration which can endanger the user. Many deaths were attributed to misuse of such drugs, with side effects on those who use it: dehydration, cramps, diarrhea, dizziness, headache, anxiety, restlessness, weakness, numbness of extremities, and irregular heart rhythm.

Recent research demonstrates that genetic doping with erythropoietin induces increased numbers of erythrocytes and, also, increases the capacity to secure and carry a greater amount of oxygen quantity, which increases endurancing enhancer. The negative effects of genetic doping are producing myocardial infarction.

Conclusions

Doping in the performance sport remains a topical issue. We believe that there should be policies to combat this issue both within each national sports structures, as well as, the sports clubs, national laws, etc. which must respect the laws on the prevention and fight against doping in sport. A major impact in this respect is ANAD (National Anti-Doping Agency), which makes special efforts, through information campaigns, to reduce the extension of this phenomenon. Also, an important role is played by health education, which emphasizes educational programs, through which they are helped to understand that doping is a real danger to the human body. The purpose of these programs is to reach a better understanding on the part of the athletes and coaches, of the consequences these substances have, both on sports performance, and especially on health.

References

1. Epuran, M., Holdevici, I., Tonița, F. (2001). Psihologia sportului de performanță. Teorie și practică. Editura FEST, București, p.37
2. Vâjăială, G.E., Man, F.T., Scurt istori. In Vâjăială G.E. (coord). 3. WADA (2010). A Brief History of Anti-Doping. Retrieved from <http://www.wada-ama.org/en/About-WADA/History/A-Brief-History-of-Anti-Doping/> 2007
4. WADA, List of Prohibited Substances and Methods. Retrieved from <http://list.wada-ama.org/list/s1-anabolic-agents/> 2012
5. Angell PJ, Chester N, Sculthorpe N, Whyte G, George K, & Somauroo J., Performance enhancing drug abuse and cardiovascular risk in athletes: implications for the clinician. *Br J Sports Med.* 2012;46 Suppl 1:i78-84.
6. Avelar-Escobar G., Méndez-Navarro J., Ortiz-Olvera N.X., Castellanos G., Ramos R., Gallardo-Cabrera V.E., Vargas-Alemán Jde J., Díaz de León O., Rodríguez E.V., & Dehesa-Violante M. Hepatotoxicity associated with dietary energy supplements: use and abuse by young athletes. *Ann Hepatol.* 2012;11(4):564-9.
7. Kondric, M., Sekulic, D., Petroczi, A., Ostojic, L., Rodek, J., & Ostojic, Z. Is there a danger for myopia in anti-doping education? Comparative analysis of substance use and misuse in Olympic racket sports calls for a broader approach. *Subst Abuse Treat Prev Policy*, 2010, 6, 27.
8. Maquirriain, J., Epidemiological analysis of doping offences in the professional tennis circuit. *J Occup Med Toxicol*, 2010, 5, 30.
9. Cadwallader, A. B., De La Torre, X., Tieri, A., & Botrè, F, The abuse of diuretics as performance-enhancing drugs and masking agents in sport doping: pharmacology, toxicology and analysis. *British journal of pharmacology*, 2010, 161(1), 1-16.
10. WADA. The 2008 WADA Laboratory Statistics. Retrieved from http://www.wada-ama.org/rtecontent/document/WADA_2008_LaboratoryStatisticsReport_Final.pdf 2009
11. Martínez-Quintana E., Rodríguez-González F., & Cuba-Herrera J. Myocardial necrosis and severe biventricular dysfunction in the context of chronic ephedrine abuse. *Adicciones.* 2010;22(1):25-8.
12. Kanayama, G., Hudson, J. I., & Pope Jr, H. G. Illicit anabolic-androgenic steroid use. *Hormones and behavior*, 2010, 58 (1), 111-121.
13. Pițigoi, G., Păunescu, C., Mitrea, N., Baconi, D., Păunescu, M., Burcea, C., Arsene, A. L. New approaches regarding the dynamics of the doping pharmacologic agents in sports. *Farmacia*, 2012, 60(1), 111-119.
14. Vâjăială, GE., & Andrieașu, GI.. Dopajul genetic. In Vâjăială, GE. (coord). Dopajul în sport. Prevenire și combatere. Editura FEST, București, 2007, 73-88
15. Crișan O., Health claims in food supplement advertising, *Farmacia*, 2012, 60(1), 138-142
16. Sattler, F. R., Castaneda-Sceppa, C., Binder, E. F., Schroeder, E. T., Wang, Y., Bhasin, S., Kawakubo M, Stewart Y., Yarasheski K.E., Ulloor J., Colletti P., Roubenoff R., & Azen, S. P.. Testosterone and growth hormone improve body composition and muscle performance in older men. *Journal of Clinical Endocrinology & Metabolism*, 94(6), 1991-2001.
17. Holt, R. I., Erotokritou-Mulligan, I., & Sönksen, P. H.. The history of doping and growth hormone abuse in sport. *Growth Hormone & IGF Research*, 2009, 19(4), 320-326.
18. Amor, M., & Potzaicin, I.B., Efectele secundare ale utilizării substanțelor interzise și metodelor interzise. Vâjăială, GE (coord.) Dopajul în sport. Prevenire și combatere. Editura FEST, 2007, 51-65.

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