

DOPING IN COMPETITIVE SPORTS: STAKES AND CHALLENGES FOR RESOURCE LIMITED COUNTRIES

Charles Ntungwen Fokunang^{1*}, Dobgima John Fonmboh², Estella Tembe Fokunang¹, Bissou Mahop³, Lovet Benyella Fokunang⁴, Thérèse Bwemba Abong⁵, Michel Disake Mbarga⁶, Jeane Yonkeu Ngogang⁷, Robert Njana⁷, Ejoh Richard²

¹Department of Pharmacotoxicology and Pharmacokinetics, Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Cameroon.

²Department of Nutrition, Food Science and Bioresource Technology in the College of Technology, University of Bamenda, Cameroon.

³Department of sports medicine, Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Cameroon

⁴Lead Scientist GE Life Sciences CYTIVA, Logan, Utah, USA.

⁵National Ethics Committee for Human Health Research of Cameroon (CNERSH), Yaoundé, Cameroon

⁶Inspectorate General, Ministry of Sports, Yaoundé, Republic of Cameroon

⁷Organisation Camerounaise de lute contre le dopage dans le sport (OCALUDS), Yaoundé, Cameroun.

***Corresponding Author: Charles Ntungwen Fokunang**

Department of Pharmacotoxicology and Pharmacokinetics, Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Cameroon.

Article Received on 26/09/2020

Article Revised on 16/10/2020

Article Accepted on 06/11/2020

ABSTRACT

Doping is an old tradition in sports and has continued to be lucrative as sports become competitive motivation, with greater financial rewards and fame. The youths of resource limited countries and the globally have increasingly engaged in drug consumption in schools and in the community. Doping is now a public health concern in Cameroon and has prompted the state to step in for sensitization of the danger of consumption of substance of abuse not only for sports but for other uses. Cameroon's Minister of Territorial Administration recently, has called for combined efforts from Cameroonians to fight against illegal drug trade and abuse which he said is gaining grounds in school milieu especially in the commercial capital and urban towns, Drug abuse is growing in the city, in primary schools, colleges and even universities, and there are a lot of drugs circulating among the students. There is the need for the state to sensitize with the local population and have an evaluation of investigating the sources of substances of abuse. Illicit drug abuse and trade is dangerous for sports and is the cause of crimes and corruption, which hinders socio-economic development and also causes huge losses to individuals and families. In low income limited countries, there is a need for information to provide baseline assessments of new trends in drug abuse. This information is useful in making decisions on allocating resources to tackle drug abuse problems. The United Nations International Drug Control Programme (UNIDCP), in collaboration with the Economic Community of Central African States (ECCA) and the World Health Organization, mapped out countries in Central Africa sub regions in which to carry out a rapid assessment of drug abuse. This paper reviews the stakes and challenges of doping in resource limited countries for competitive sports, illustrate the profile of drug use and abuse, give an insight into ways of diagnostics, and control strategies.

KEYWORDS: anti-doping, doping, resource limited countries, ergogenic aids, competitive sports, WADA.

INTRODUCTION

The word doping originated from '*dop*', a term that conventionally refers to a stimulant drink used in tribal ceremonies in South Africa during the eighteenth century. Doping first surfaced in an English dictionary in 1889, where it was described as a narcotic potion for reducing the performance of racehorses.^[1] There is a long history of doping in sports from the ancient Greco-Roman times, ergogenic aids in the form of natural products, bland chemicals and animal extracts generally in the attempt to enhance human performances to the limit.^[2] In recent times, significant achievements in

science and biotechnology have favoured the introduction of synthetic molecules, recombinant hormones and genetic manipulation of athletes.^[2,3] Since ancient times, competitive athletes have been familiar with the use of ergogenic aids and they have continued illegally to use unfair and harmful substances because their high quest for victory, along with the fame of glory and money, will probably overcome health and legal risks.^[1,3]

From data mining, it has been shown that the phenomenon of doping is complex and multifaceted. It

involves a number of causes and factors that do not originate solely in the athletic field, making universality its main feature. It is in fact observed in all ages and levels of competition, and it concerns all sports, even the most unpredictable.^[4] The increasing number of athletes testing positive for antidoping substance controls is an indication that the current strategy might be analytically adequate to unmask most (but not all) doping practices, but it is probably ineffective to prevent athletes to dope and modify this upsetting trend. As doping becomes complex, the use of medications, food supplements, alcohol and social drugs, a reinforced preventive policy is needed to be put in place.^[3,5]

Ergogenic aids are commonly used, misused and abused, to produce a broad scale of effects, ultimately improving performance, body weight, aggressiveness, mental concentration and physical strength, delaying fatigue and pain desensitization.^[5] There is increasing evidence that the use of dietary supplements and ergogenic aids is popular not only in competitive sports, but also in the daily life of athletes and the populace for leisure. In the latter case, unfair use of such substances is barely restricted or regulated regardless of the potential harms for their health, whereas in the former, there are several national and international bodies who adopt rigorous and expensive policies to prevent cheating in competitive sports and the athletic field.^[4,6]

In sports, doping is conventionally referred to as the use of performance enhancing drugs, particularly those that are forbidden by the organizations that regulate competitions. From the biological perspective, doping can be regarded as a multifaceted issue, and targets all bodily functions including cerebral, metabolic, cardiovascular, respiratory, haematological and, in the very near future, genetic.^[5,7] Generally, athletes might take great athletic advantage from a variety of nutritional supplements and drugs, which have been originally developed to supply nutrients that are missing or not consumed in sufficient quantity in a person's diet or treat

pathologies, respectively. However, some of these agents end up as an effective means of enhancing performances, attracting unaware or naive athletes or regrettable coaches and physicians.^[8] By the World Anti-Doping Agency (WADA) definition, doping should be intended as any 'anti-doping rule violation', which include one or more of the following: (i) presence of a prohibited substance or its metabolites or markers in an athlete's bodily specimen; (ii) use or attempted use of a prohibited substance or a prohibited method; (iii) refusing, or failing without compelling justification, to submit to sample collection after notification, as authorized in applicable anti-doping rules or otherwise evading sample collection; (iv) violation of applicable requirements regarding athlete availability for out-of-competition testing, including failure to provide whereabouts information and missed tests that are declared based on reasonable rules; (v) tampering, or attempting to tamper, with any part of doping control; (vi) possession of prohibited substances and methods; (vii) trafficking in any prohibited substance or prohibited method and (viii) administration or attempted administration of a prohibited substance or prohibited method to any athlete, or assisting, encouraging, aiding, abetting, covering up or any other type of complicity involving an antidoping rule violation or any attempted violation.^[7,8]

Given the WADA definition of doping, the number of illicit substances or methods available to the athletes is limited to those included in the 'Prohibited List' as described in table 1, originally issued in 1963 under the leadership of the International Olympic Committee (IOC). Since 2004, as mandated by the World Anti-Doping Code, WADA is responsible for the preparation and publication of the list on an annual basis. The list is a cornerstone of the code and a key component of harmonization. It is an International Standard identifying Substances and Methods prohibited in-competition, out-of-competition and, in particular, sports.^[9] In the list, substances and methods are mainly classified by categories rather than by biological effects.

Table 1: Substances and methods prohibited in- and out-of-competition, classified according to the current WADA 'Prohibited List.'^[3,5]

PROHIBITED SUBSTANCES

S1. Anabolic agents

Anabolic androgenic steroids (AAS)

Other anabolic agents, including but not limited to clenbuterol, tibolone, zeranol and zilpaterol

S2. Hormones and related substances

Erythropoietin (Epo)

Growth hormone (Hgh), insulin-like growth factors, mechano-growth factors (MGFS)

Gonadotrophins (LH, HCG), prohibited in males only

Insulin

Corticotrophins

S3. Beta-2 agonists

S4. Agents with anti-estrogenic activity

Aromatase inhibitors

Selective estrogen receptor modulators (serms)

Other anti-estrogenic substances

S5. Diuretics and other masking agents

S6. Stimulants (prohibited in-competition)
S7. Narcotics (prohibited in-competition)
S8. Cannabinoids (prohibited in-competition)
S9. Glucocorticosteroids (prohibited in-competition)
P1. Alcohol (prohibited in particular sports)
P2. Beta-blockers (prohibited in particular sports)
 Prohibited methods
M1. Enhancement of oxygen transfer

Doping substances and methods are also classified according to the supposed ergogenic effects as well as illustrated in table 2. An alternative and more pragmatic approach to categorize doping substances is based on their presumptive ergogenic effect on power, endurance or concentration capacities. This classification would ease the process to relate the various methods and substances to the potential users. Accordingly, endurance athletes (cyclists, cross-country skiers and marathon runners) most frequently use unfair means capable of increasing the oxygen-carrying capacity of the blood

(e.g. erythropoietin, artificial oxygen carriers and blood transfusion).^[10] Power athletes (sprinters, body builders and boxers) are more likely to use anabolic agents (e.g. anabolic androgenic steroids, growth hormone, insulin-like growth factors and human chorionic gonadotropin), whereas athletes of disciplines where concentration, steady action and ability to control movements are required (bridge, archery and shooting) may frequently misuse sedative molecules such as b-blockers and calcium channel blockers.^[11,12]

Table 2: Doping substances and methods classified according to the supposed ergogenic effects.^[8]

- ✓ Increase of endurance performances and oxygen-carrying capacity of the blood
- ✓ Erythropoiesis-stimulating substances (e.g. erythropoietin)
- ✓ Blood transfusions
- ✓ Artificial oxygen carriers
- ✓ Anti-asthmatic agents
- ✓ Increase of power performances and muscle mass
- ✓ Anabolic androgenic steroids (AAS)
- ✓ Recombinant hormones and gonadotrophins (growth hormone, LH and HCG)
- ✓ Other non-steroid anabolic agents (anti-inflammatory drugs)
- ✓ Sports where concentration, steady action and ability to control movements are required b-blockers
- ✓ Calcium channel antagonists
- ✓ Masking agents (e.g. diuretics)
- ✓ 'Transversal' methods
- ✓ Gene doping
- ✓ Other substances with unlikely performance-enhancing activity
- ✓ Stimulants
- ✓ Narcotics

There is a cutting-edge form of doping, useful in most sport specialties, which involves masking substances (e.g. diuretics) or innovative techniques to produce complex biological effects (e.g. gene doping).^[11] Finally, there are substances unlikely to possess performance-enhancing activity, but still banned on the athletic field, such as stimulants and narcotics.^[9, -11] On the Prohibited List, the WADA clearly mandates that the use of any drug should be limited to medically justified indications,^[12] and it is clear that the potential health risks of several permitted supplements and drugs, which are conventionally considered safe and are not routinely included within anti-doping testing, are currently overlooked. Just because a substance is sold over the counter does not necessarily mean that it is safe.^[13] The increasing use of ergogenic aids by athletes is an issue that interferes with the degree that a large number of supplements may contain substances that are banned in sport. In reality, the sport supplement industry is an area of major controversy with respect to liability, as it is

poorly regulated when compared with prescription drugs, but yet it is a potential source of doping violations.^[14] There are also additional problems, in that the manufacturing processes with some of the supplements may not always ensure uncontaminated and accurately labelled products and may not follow appropriate government regulations, product testing and certification programmes especially with the heavy influx of these products from Asia into other African countries.^[9] Major controversy also surrounds the use of drugs that do not enhance performance, but athletes may be taking for social or recreational purposes. The crucial question is why should stimulants, such as cocaine and marijuana, be banned when their use is now widespread outside the sports? Taking drugs inappropriately is against the spirit of sport, but testing may be considered an invasion of privacy, especially outside periods of athletic competition.^[15,16]

Banned bioactive molecules considered during and after competition

These substances are under the class of substances that have not been placed on the market. The substances are under 9 group of substances as shown in table 3.

Table 3: Some banned bioactive new chemical entities considered during and outside competitions during.^[8]

S0. Substances that have not been placed on the market	Retired drugs such as sibutramine	Designer substances tetrahydrogestrinone	Drugs used in veterinary medicine
S1. Anabolic agents	Exogenous anabolic steroids androstendiol and gestrinone	Endogenous anabolic steroids with exogenous administration: dihydrotestosterone, testosterone	Other anabolic agents: tibolone, zilpaterol, zeranol.
S2. Peptide hormones and growth factors	Erythropoiesis stimulating agent: erythropoietin, darbepoetin	Luteinizing hormone in men; choriogonadotrophin	Corticotrophin, growth hormones, Insulin-like growth factor 1 (IGF 1)
S3. Beta 2 agonists	Sulbutamol 1600 ug/24h	Formoterol 54 ug/24h	Clenbuterol
S4. Hormones and metabolic modulators	Aromatase inhibitors; anastrozole, letrozole	Metabolic mediators: insulin	-
S5. Diuretics and other masking agents	Masking agents: glycerols, plasma substitutes	Diuretics> Acetazolamide, Furosemide, indapamide	-
S6; CNS stimulants	Non-specific stimulants: amphetamine, fenfluramine	Specific stimulants: adrenaline, ephedrine, pseudoephedrine	-
S7. Narcotics	Buprenorphine, fentanyl	Medatone, morphine	-
S8. Cannabis extract	Cannabis, hashish	Tetrahydrocannabinol	-
S9. Corticosteroids	Cortison, hydrocortisone	Prednison, methylprednisolone	-

Standard Prohibited doping methods.

This consist of manipulation of blood and its components, physical and chemical handling and genetically doping as illustrated in table 4.

Table 4; Standard Prohibited doping methods.^[8]

M1. Manipulation of blood and its composition	Involves administering products containing red blood cells in the systemic circulation	Enhance increase in the bioavailability of oxygen and its rapid cellular transportation.
M2. Physical and chemical manipulation	Alteration of the integrity and validity of sample collected during doping analysis for control	Administered through intravenous infusions or by injection of more than 50 mL for six hours
M3. Genetically manipulated doping	Involves transfer of polymers of DNA/nucleic acids or analogs	The use of normal or genetically modified organisms.

Doping epidemics

Following implementation of educational programmes and intensification of in- and out-competition testing, it is expected that the substance-abusing behaviour would decrease. Unfortunately, this has not been the case. New, more powerful and undetectable forms of doping are now abused by professional athletes, although sophisticated networks of distribution have developed.^[10,15,16] Although the current estimations on the prevalence of doping in sports are elusive, as most investigative tools (e.g. results of antidoping tests and anonymous surveys) do not possess unquestionable statistical power, the emerging scenario reflects large numbers still biased by a concerning underestimation. Regardless of the athletes involved in professional sports, who obviously represent the tip of the iceberg, it follows that the use of performance-enhancing drugs in

the general population may be, in absolute terms, a sizeable problem as it is among the professional athletes, reflecting the ratio between the physically active young individuals in the population and the small number of professional athletes.^[17] Drug misuse and abuse of medicaments have reached the proportion of a public health problem, not only for sportsmen but also for many young people and their health both in developed and resource limited nations. Although most adults who use banned substances are collegiate or professional athletes, wider range of younger individuals are using them, from casual sports and fitness participants to serious athletes who attend training camps and sporting for positions on competitive sports teams.^[18]

In the early 1980s, it was first highlighted that 6.6% of high school seniors used steroids and more than two-

thirds of the group had started using them when they were 16 years old or younger.^[19] The distribution in certain cases the use of certain prohibited substances for non-medicinal purposes constitute criminal acts in some countries. As the sale of these products is prohibited or subject to severe legal restrictions, athletes received or purchased doping products from colleagues, team managers, unfair physicians and black market over the past decades.^[3,20] The internet is the most striking example and so far, there are plenty of resources and virtual stores on the Web, offering a variety of doping products, from androgenic anabolic steroids to recombinant hormones.^[19,21] From a clinical perspective, this is unacceptable. First, as most of these manufacturers are not forced to strict or certified production procedures, the claimed products may be unsafe and harmful, in that they are of dubious quality and sometimes cut with products that are toxic, posing additional threats to the health of the users. Unfortunately, they may even turn to be unhelpful, because there is no guarantee that they really contain the supposed ergogenic agent.^[22]

The aim of anti-doping Organizations and Committees is to keep sports doping-free to prevent that the use of potentially harmful substances jeopardizes the athlete's health and drops off fairness in competition.^[8] One of the most important achievements in the fight against doping in sport has been the drafting, acceptance and implementation of a uniform set of anti-doping rules, the World Anti-Doping Code. After years of disorganization and lack of communication between national and regional antidoping agencies, the WADA Code has provided the framework for harmonized policies, rules and regulations within sport organizations and among public authorities.^[20] This harmonization works to address the problems that previously arose from disjointed and uncoordinated anti-doping efforts, such as, among others, a scarcity and splintering of resources necessary to conduct research and testing, a lack of knowledge about specific substances and procedures being used and to what degree and an uneven approach to penalties for athletes found guilty of doping. The sanctions provided for in the World Anti-Doping Code follow a principle of rules and exceptions.^[14,23] Considering the biochemical and haematological monitoring of athletes, some other initiatives have been carried out worldwide, including pre-competition blood screening and adoption of the haematological passport.

In March 2007, the International Cycling Union unveiled the new anti-doping programme, the so-called '100% Against Doping', a quantum leap forward for the cycling world in its efforts to fight doping.^[24] According to this evolutionary initiative, top-class cyclists are subjected to unannounced testing, especially in periods of preparation for their main targets.^[25] Another innovation aspect is the introduction of the so-called 'haematological passport', based on repeated evaluation over time of several haematological parameters to define an

individual profile that would enable the longitudinal comparison of athletes' data for identifying the use of illicit means.^[26] Extensive pre-competition blood testing is also carried out by other Sports Federations, including the Fédération Internationale de Ski (FIS) (the testing programme includes out-of-competition testing and blood testing as well as in-competition testing at numerous FIS World Cup events) and the International Association of Athletics Federations (athletes may be subject to testing in-competition and by WADA, the national anti-doping organization of the country in which they are present, or by, or on behalf of, the IOC in connection with the Olympic Games).^[11,27]

With the inception of the WADA, anti-doping effort has been fortified and resources invested in anti-doping testing are rising steeply, increasingly involving public funding. Several top-class athletes have been familiar with doping over the past decades and will probably continue to dope in the future, as their inclination to victory, their mirage of glory and money, will always overcome the risk of being found guilty. So far, the strategy based on prosecuting athletes appears unsuccessful, and it may even turn to be unproductive and costly,^[28] and more radical strategy is required. Although the advent of protein chip technology may enable the screening of large numbers of athletes for a variety of illegal drugs,^[16,29] screening of every athlete for all prohibited substances appears unrealistic, for both economical and technical reasons (number and type of unfair practices are growing and evolving). Regardless of the enormous complexity from implementation of this approach on a large scale, when a repressive strategy is inflated, it may also produce unpredictable ethical and medical outcomes. Although the main purpose of clinical and laboratory medicine is to prevent, diagnose and treat diseases and not to ensure fairness in competition, each new test introduced within anti doping panels will also need to be evaluated and assessed to demonstrate that its efficiency in detecting cheating exceeds the clinical and ethical risk of either true or false-positive results.^[30] It is important to state that funding for antidoping campaigns will probably undergo an inevitable restriction, because most healthcare systems are struggling to convey extraordinary resources for prevailing pathologies such as atherosclerosis and cancer.^[22,27] An alternative strategy might be considered, focused at harm reduction rather than ensuring fairness in competition. The identification of abnormal deviations from reference individual values, regardless of pathological or artificial causes, would allow the follow up and target the athlete by a conventional and relatively inexpensive laboratory tests, which are affordable to governments and healthcare systems and also available to most clinical laboratories.^[31] Although this strategy is not efficient to legally detect cheating, it is a good health method that would allow for safeguard of the athlete's health until 'deviated' biochemical or haematological profiles have returned to the baseline. The athletes would no longer be considered 'positive', with all the jurisprudential

implications especially in the presence of false-positive tests, but they would be temporarily withheld from competitions for clinically justified motivations.^[2,23]

World Antidoping Code

The World Anti-Doping Code (Code) is the core document that harmonizes anti-doping policies, rules and regulations within sport organizations and among public authorities around the world. It works in conjunction with six International Standards which aim to foster consistency among anti-doping organizations in various areas.

These Standards are

- The International Standard for Testing and Investigations (ISTI)
- The International Standard for Laboratories (ISL)
- The International Standard for Therapeutic Use Exemptions (ISTUE)
- The International Standard for the Prohibited List (The List)
- The International Standard for the Protection of Privacy and Personal Information (ISPPPI)
- The International Standard for Code Compliance by Signatories (ISCCS)

In addition to the above Standards, two new International Standards are set to come into force on 1 January 2021 alongside the 2021 World Anti-Doping Code and related suite of Standards. These are:

- The International Standard for Education (ISE)
- The International Standard for Results Management (ISRM)

Code and international standards revisions

The Code was never designed to be a document that stood still. As anti-doping developed, so would the ideas that would form rules, regulations and policies in the future. Following the experience gained in the application of the 2004 Code, WADA initiated consultation processes in 2006, 2011 and 2017 to review the Code. These review processes were fully collaborative processes that involved the whole anti-doping community, all of whom sought an enhanced Code that would benefit athletes around the world. WADA initiated the first Code review in 2006. After three phases and the publication of several preliminary drafts, the revised Code was unanimously adopted by WADA's Foundation Board and endorsed by the 1,500 delegates present on 17 November 2007 at the Third World Conference on Doping in Sport in Madrid, Spain. The revisions to the Code took effect on 1 January 2009.

The revision process for the 2015 Code began at the end of 2011 and, following three phases of consultation over a two-year period, and with 2,000 changes submitted, the revised Code was unanimously approved on 15 November 2013 at the World Conference on Doping in Sport in Johannesburg, South Africa. The revisions to the Code took effect on 1 January 2015.

The revision process for the 2021 Code began at the end of 2017 and, following three phases of consultation over a two-year period, with over 2,000 comments received, the revised Code was unanimously approved on 7 November 2019 at the World Conference on Doping in Sport in Katowice, Poland. The revised Code is set to come into force on 1 January 2021.

Each of these review processes were collaborative and transparent exercises that have resulted in a stronger, more robust tool to protect the rights of clean athletes worldwide.

Code compliance

To date, approximately 700 sport organizations have accepted the World Anti-Doping Code. These organizations include the International Olympic Committee (IOC), the International Paralympic Committee (IPC), International Federations (IFs) (including all IOC-recognized IFs), National Olympic and Paralympic Committees, as well as National and Regional Anti-Doping Organizations (NADOs and RADOs). Signatories are required to undertake three steps in order to be fully compliant with the Code: **acceptance, implementation, and enforcement**.

Code **acceptance** means that a Signatory agrees to the principles of the Code and agrees to implement and comply with the Code.

Once a Signatory accepts the Code, it must then implement it. The **implementation** of the Code is the process that a Signatory goes through to amend its rules and policies so that all mandatory articles and principles of the Code are included.

Finally, **enforcement** refers to the Signatory actually enforcing its amended rules and policies in accordance with the Code.

Code compliance monitoring program

In recent years, WADA has put a growing emphasis on ensuring that Code Signatories have quality anti-doping programs in place; and, in keeping with strong demand from stakeholders, that their compliance be monitored rigorously. To do so, in 2016, WADA initiated development of an ISO9001:2015 certified Code Compliance Monitoring Program that was expanded in 2017. The Program, which represents the most thorough review of anti-doping rules and programs that has ever taken place, aims to reinforce athlete and public confidence in the standard of Anti-Doping Organizations' work worldwide. On 1 April 2018, the International Standard for Code Compliance by Signatories (ISCCS) entered into force, which further reinforced WADA's Code Compliance Monitoring Program by creating a clear framework for WADA's compliance activities and outlining the responsibilities and consequences applicable to Signatories.

Code signatories

Sport organizations within the following categories have accepted the Code:

- Olympic Movement
- National Anti-Doping Organizations
- Outside the Olympic Movement

Education & Prevention Tools

The World Anti-Doping Agency offers many different tools to assist stakeholders with their education programs and help them educate target groups with suitable activities. There are tool kits of activities customized for Coaches, Teachers, Program Officers and Sport Physicians, and many different brochures providing anti-doping information. Also, WADA has created interactive computer games such as the Play True Quiz and Play

True Youth Quiz, and other tools such as card games. Books and videos exploring numerous subjects related to the fight against doping in sport are also available.^[30]

An Overview of potential doping control where an athlete has used a prohibited substance

This process is summarized in the schematic in figure 1. From the time sample is taken from the athlete to the hearing in case of positive results from taking substances not for exempted use during or out of competition. Anti-Doping Rule Violations (ADRVs) when proven is subject to hearing by the investigation and sanction panel. It is mandatory for high profile international athletes to undergo antidoping testing and obtain their results for a clean and safe competition ethics.^[19]

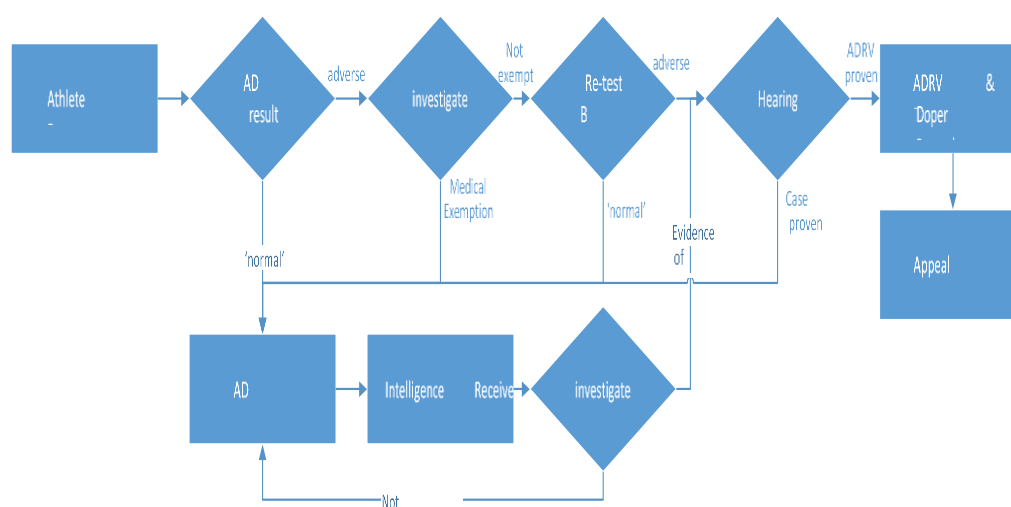


Fig 1: Overview of potential doping control where an athlete has used a prohibited substance.^[3]

Scale of Doping

The scale of doping varies by sport. International testing data, published by the World Anti-Doping Agency (WADA), shows that 1.5-2% of drug tests have an adverse result. Academic research, echoed in several of the interviews conducted, suggests, "we only catch the dopey dopers". This is borne out with non-analytic detections of dopers using intelligence, many cases of which show that dopers have cheated drug tests. The effectiveness of the testing regime is determined by the quality of testing and how well targeted those tests are. It is possible to come to a judgement on how likely it is that someone attempting to cheat could do so, and the types and numbers of athletes most susceptible to doping.^[25] This forms the basis for a risk-based approach to testing, which increases the effectiveness and efficiency of anti-doping measures. The testing conducted by United Kingdom antidoping (UKAD) is already using intelligence and risk-based assessments to determine those most susceptible to doping. In addition, it is using a broad spectrum of in-competition and out-of-competition testing.

Effective Testing

Given the known methods used to cheat drug tests, effective testing needs to have the following features: Random, no-notice testing out-of-competition; Use blood, urine and other physiological testing methods; Broad spectrum analysis (i.e. looking at the composition of the sample and comparing it with normal samples, rather than looking for specific drugs); Frequent tests for high risk individuals with longitudinal comparisons (i.e. the biological passport approach); Supervision of sample production (i.e. ensuring that the athlete cannot tamper or exchange the sample). Most developed countries meet these criteria in its anti-doping approach which is not the case with resource limited countries. It is also important to recognize that the quality of the testing regime is more important than the sheer volume of tests; i.e. a qualitative rather than quantitative testing approach.^[5,8]

Doping Sanctions

The sanctions for those caught committing Anti-Doping Rule Violations (ADRVs) are widely held to be effective. There was a view that the increase from a two-

year ban to a four-year ban for a first offence (under the 2015 World Anti-Doping Code) may have made it overly harsh in some circumstances. As the current penalties can end a sporting career, it was suggested that prison sentences or fines would not be stronger deterrents to athletes or support staff than a four-year ban and in some cases a lifetime ban.^[31]

Data-sharing of doping information

Where data-sharing agreements are not already in place, some of those involved in law enforcement and anti-doping investigations expressed frustration at the lack of an effective data-sharing framework. Access to clear data sharing provisions would allow sport governing bodies, and others involved in the anti-doping landscape, to verify intelligence and share information to prevent, detect or investigate allegations of doping. In the main, the current data protection regime allows this, but often those with the relevant data do not always understand that they can share it with other organizations and/or law enforcement. This is particularly true of national sports governing bodies. Resource limited countries need to clearly establish who is covered by each of the bodies so as to ensure whether or not they fall within the remit for anti-doping tests.^[8]

Criminalization of Doping

None of those interviewed were in favour of criminalising doping in sport. This was a unanimous view. The reasons given included: The standard of proof in a criminal court is 'beyond reasonable doubt'. It may be quicker to deal with an incident using regulatory or disciplinary proceedings, which must be proved to the civil standard of the 'balance of probabilities'.

Where a charge is proved or admitted, the judicial bodies of the regulatory authorities may impose a financial penalty greater than the maximum financial penalty available to a criminal court.

It is unlikely that anti-doping cases will take priority for investigation by police as more serious offences will have precedence for the allocation of limited resources. Strict liability is not sufficient for criminal cases; it would be necessary to show a form of intent. This may lead to more appeals.

Prosecutors make their decisions in accordance with the Code for Crown Prosecutors and the Director of Public Prosecution's Guidance on Charging. The Full Code Test of the Code for Crown Prosecutors has two stages: (i) the evidential stage; followed by (ii) the public interest stage. If there is sufficient evidence of doping in sport, it may not be in the public interest to prosecute.

Sports governing bodies expect that their internal investigations will be negatively affected by the criminalisation of doping in sport. Experience with corruption cases shows that sports governing bodies need to wait as police have the evidence, or to avoid contempt

of court. This slows down justice (and can prevent it completely where an investigation is not concluded properly because of police priorities).

Criminalisation would not introduce significant additional deterrence. It has been suggested that the legislative approach taken by most European countries, such as Italy, which have criminalized doping, is beneficial because it makes the powers of investigation clearer and also helps influence athletes with ADRVs to co-operate with inquiries. Police prioritization will, rightly, focus on serious crimes at the expense of antidoping offences. A specialist sports crime unit could give anti-doping offences an appropriate priority for investigation and have the appropriate powers to conduct investigations, however setting up such a unit only makes sense if additional criminal offences were created, or a compelling public interest justified diverting limited resources from other areas.^[14]

Substances that are not listed on the prohibited substances with potential doping effect

One of the substances that are currently extensively studied for doping potential is paracetamol, a substance commonly used as an analgesic and antipyretic. It has been noticed that in the case of cyclists, the athlete's performances have been improved. So if in the case of cyclists it can increase performance, by lowering body temperature; why couldn't it be used for athletes practicing marathon, or athletes who run the 5000 and 10000 meters distances?^[16] Some herbal extracts were suspected to have doping effects, so the ginseng root was tested to detect possible performance enhancing effects, but according to studies conducted on athletes under the supervision of the IOC, no positive tests were observed. However, it is specified that due to contamination with other doping substances, the tests could be positive, due to which the nutraceuticals should be carefully checked prior to use, in order to prevent possible disqualification from competitions.^[17]

Studies have also been conducted to see whether NSAIDs, diclofenac and ibuprofen, both being nonselective COX non-steroidal anti-inflammatory drugs, could have an effect on the testosterone / glucuronidated epitestosterone ratio, but the results did not reveal any modification.^[28]

Substances subject to a monitoring program

There are three classes of substances part of a monitoring program: central nervous system stimulants such as bupropion, nicotine, phenylephrine, phenylpropanolamine, sinephrine and pipradrol; narcotics: hydrocodone, tramadol, talpentadol; and glucocorticoids, banned in competition through all ways of administration. Also, telmisartan, an angiotensin II antagonist class on AT1 receptors and meldonium substance used in angina pectoris, can be included in the same category. Central nervous system stimulants as well as narcotics will not be used in competitions, while

glucocorticoids, meldonium and telmisartan are banned both outside and in competitions.^[23] Due to the fact that methylmorphine (codeine) converts approximately 10% into morphine, the codeine/morphine ratio should also be checked and be monitored.

Substances that are not prohibited but with potential performance increasing capacity of the athlete

L-carnitine is an endogenous compound, an amino acid synthesized in the liver and kidneys from lysine and methionine, two essential amino acids. It can be found especially in food of animal origin, but also in plants such as soy beans, although in much smaller quantities. L-carnitine administration increases the HDL cholesterol fraction, and has neuroprotective properties in Alzheimer's disease.^[11] For athletes, the use of L-carnitine is based on the release of energy from lipids, saving a part of the glycogen from the muscles.^[19] Arginine is a semi-essential amino acid that could be used to increase performance, because of NO (nitrogen monoxide) release and the formation of citrulline, NO having a vasodilatory effect. Athletes can use arginine to increase physical performance, muscle mass and also their resistance in high effort.^[6,19] Hydroxycitric acid is a substance often found in food supplements and it can be extracted from species such as *Hibiscus sabdariffa* or *Garcinia cambodgia*. It was reported to be used for weight loss, but according to clinical trials, it does not have lipolysis effects. Tyrosine is an essential amino acid that cannot be synthesized by the body and should be obtained through careful nutrition. It can also be used by athletes, with many beneficial effects such as reducing fat, controlling appetite. However, it is a dopamine precursor and so people with mental disorders or hyperthyroidism should not use it, as well as people with high risk of skin cancer because this amino acid leads to increased melatonin secretion. Another aspect to be considered is the period of the day when it is administered, because it is a precursor of adrenaline and noradrenaline that can cause stimulation of the nervous system.^[9] Other amino acids or derivatives used to increase muscle strength and endurance are: carnosine, citrulline, glutamine, glycine and taurine. Taurine and carnosine have particular effects, being used as energizing substances.

Substances that are dopant after a dose threshold is exceeded

There are some pharmacological classes of substances that have a quantitative upper limit, so can be used only in very small amounts, as: central nervous system stimulants such as caffeine and beta 2 selectives such as salbutamol or fenoterol. caffeine can be considered as a dopant substance due to its effects: slight bronchodilatation, which is beneficial for athletes participating in endurance races, and also increases the diuresis which can be beneficial if an athlete is doped and wants to rapidly eliminate the other drug in their body. Other effects of caffeine are: cerebral vasoconstrictor, increases gastric acidity and also the

appetite. An athlete is considered doped when the urine concentration of caffeine is above 12 µg/mL.^[22] Most beta 2 selective substances are banned from competitions, but there are exceptions such as salbutamol, which has a maximum inhalation dose of 1.6 mg/24h.

If salbutamol is present in a concentration higher than 1000 ng/mL in urine the athlete can be considered as doped. Formoterol is a substance used in asthma and it is in the same category as salbutamol. The dose of inhaled formoterol is 54 µg/ 4h, and urine concentration should not exceed 40 ng/mL, otherwise the athlete is sanctioned according to the rules.^[18,21] Specific central nervous system stimulants are substances that also have thresholds, ephedrine and methylephedrine are prohibited when the concentration reaches values higher than 10 µg/mL, pseudoephedrine is prohibited when concentrations are greater than 150 µg/mL. Adrenaline is not forbidden when used locally in nasal or ophthalmic administration.^[23] Other substances that have a superior limit, that can lead to the elimination of the athlete from the competition are: bupropion, nicotine, pipradol, phenylephrine and phenylpropanolamine.

Doping Challenges In Resource Limited Countries

In resources limited countries the challenges in doping regulations are high. The lack of infrastructure for analysis of doping substances, inadequate expert, lack of experts in the field of doping and the enforcement of regulations where there exists. When companies label food or supplements as "all natural," they may be hoping that you will assume their products are safer and better than other products. However, in the context of foods or supplements, it is very difficult to know what is meant by "all-natural." In fact, even the Food and Drug Administration (FDA) recognizes the difficulty in defining this term, and it has not associated the term "natural" with any nutritional or other health benefit. Most products are dumped in these poor countries where regulations are not tight.^[8] Unfortunately, some companies intentionally mislead consumers about the ingredients in their supplements. For instance, some manufacturers may advertise an "all-natural" weight loss pill, but then spike it with sibutramine, which is an investigational drug that was removed from the market for safety reasons. Other companies may advertise herbal sex-enhancement pills, but when tested, these pills frequently contain powerful and synthetic Viagra-like drugs.^[31]

There are plenty of things that are natural that are not safe, such as hemlock, arsenic, and various other poisons produced by plants and animals. Because anyone can produce supplements without prior experience or training, you can't assume that manufacturers understand ingredients or how to use them safely. In the supplement industry, another issue is that some manufacturers try to make ingredients appear natural by using misleading names. For example, there are numerous supplements

available to consumers that list “geranium oil” on the label, but the products actually contain methylhexanamine, a synthetically produced stimulant that is prohibited in-competition. Most people in the low-income community use natural product and natural doesn’t mean there are no prohibited ingredients.^[3]

“Natural” herbal products may also pose an anti-doping risk to athletes because, although it is rare, some plants naturally produce substances prohibited in sport. For example, *Cannabis sativa* naturally produces prohibited THC; the ephedra plant produces prohibited ephedrine and pseudoephedrine; *Citrus aurantium* (orange peel or bitter orange) produces prohibited octopamine; and *Tinospora crispa* produces prohibited higenamine.^[15] It’s also worth noting that herbal supplements sometimes naturally contain compounds that could interact with each other or with medications. If you are considering using an herbal product, you should consult a specialist to understand what compounds are produced by the plant and the potential interactions. On the other hand, there are many safe and healthy supplement ingredients that are not naturally derived or harvested. For example, the FDA allows some nutrients to be synthesized in a factory and sold in supplements, such as vitamin C. This means that you shouldn’t put too much stake in the fact that something is “natural,” or think that it is inherently better just because it’s natural.^[21]

Challenges of African Athletes To The Perception Of Western Notions Of Doping

The International Olympic Committee (IOC) has reinforced the power of World Anti-Doping Agency (WADA), making it a central authority in the fight against cheating in sports. By WADA definition of doping as the use of prohibited substances and methods designed to enhance athletic performance, the question with African sports is that are prohibited substances defined only by their chemical components? This is not the case in African sports where many of whom take spiritual methods to enhance their performances very seriously, whether it work or not.^[8]

Football in sub Saharan Africa is popularly associated with witchcraft what in Cameroon can be referred to as *mugaang, grigri, otomoquooh, juju or jars*. Athletes use them to enhance their performance in ways that are similar to doping as WADA defines it, and even to sabotage opponents. The key to these practices, however, is not the chemical content of the substances, but the spiritual powers they carry. We are faced therefore with spiritual doping.^[10,11]

Spiritual doping

According to Cameroonian footballers the spiritual world is strongly linked to the material world, and actions in the former have direct and far-reaching consequences on the latter. In West Africa, accusations of spiritual performance-enhancing practices can be much more serious than those involving materials and chemicals.

The concept of *grigri* is difficult to prove, mainly due to the fact that it is surrounded in secrecy and is constantly changing. Information about these practices can be extracted principally from rumours and accusations not evidence based. Stories are told of small pieces of particular herbs, pieces of tree bark, or small threads that the players acquire from healers who imbue them with supernatural powers.^[11]

A boot reading ‘Holy Trinity’ shows how young footballers try to tap the power of the Holy Spirit to enhance their performance. Aware of the fact that the match referees would sanction the players if they were caught, the footballers hide them under their shin guards, in their boots, or in the rubber band sockets of their shorts. Others are concoctions of herbs prepared by healers that footballers drink, or wash their face, hands or feet in before started a match competition. These objects and herbs are performance enhancers and allow the players to accomplish miraculous feats on the field. When some FIFA officials have expressed concerns about these supposed African forms of doping, they have been suspicious of their chemical composition, but undermined their more important spiritual properties.

One can therefore class *grigri* as a psychological factor or as superstition in nature. But the fact that athletes regularly scrutinise and accuse other players of using spiritual powers and sometimes lead to total haul of a tournament is an indication that there is more to it than meet the eyes. When African footballers demonstrate extraordinary skills on the field, their opponents and even teammates closely scrutinise them for any evidence of spiritual enhancements.^[23]

Age tampering

Another form of “cheating”, a public secret in the world of international football, is players giving false age declaration. This practice is common with athletes coming from countries where the birth registration is not well developed. Athletes from different parts of the world produce documents to their future clubs that state they are younger than their real biological age, ideally 16-20 years. Selection of players from Africa in preparation for trials in European football clubs often involves finding ways to obtain documents that show the player to be younger than he actually is. While the football clubs and sporting bodies seek to catch and sanction the players, players from sub Saharan African do not consider the practice as cheating and detest their poor training conditions, and lack of sporting infrastructure. Athletes tamper with their age as a way of equalising the playing field.^[25] They attempt to compensate for the fact that aspiring athletes in the western hemisphere, who from a young age have better access to good sports infrastructure and equipment, are in a privileged position to transform their athletic talent into a long-term career.

While international sporting bodies talk about athletes needing to take individual responsibility for different forms of “cheating”, young African footballers address large-scale power relations that they see as being turned against them. By adjusting their age, the footballers challenge the moral high ground on which international sports institutions claim to stand, and demonstrate how “cheating” is not always cheating, but instead a challenge to unequal power relations.^[16]

Challenge of What is ‘cheating’ and who defines cheating in sports?

WADA’s anti-doping strategies are based on the separation of the body and the mind, the biological and the psychological, the physical and the spiritual. It consistently prioritises the physical, assuming that being a “clean” athlete means being free from prohibited chemicals. While the kind of regulation that WADA seeks to apply on a global level is useful, it is at odds with the ideas of West African athletes, for whom the spiritual and the physical are deeply entangled.^[3,7,11]

Is *grigri* a form of doping that WADA should attempt to regulate then? Should international sporting bodies clamp down on footballers’ age tampering? This is not the case as age tempering is not in their definition of terms. The importance of spirituality in sport is endemic to resource limited countries especially Africa. The Thai owner of Leicester City famously flew Buddhist monks in from Thailand to bless the players during the team’s miraculous 2015-2016 season. The African game also gives us a different view into what “performance-enhancing” and “cheating” really mean. The shift in perspective allows us to avoid taking WADA’s and the IOC’s definitions for granted and stop regarding them as a universal truth. Instead, we should see them for what they are as it is a traditional internationalized concept developed and adopted in a certain historical period, developed from a specific philosophical standpoint, and applied from a position of power globally.^[1,23]

CONCLUSION

There is the need for the Government to introduce new legislation to tackle doping in sport, including a need to create a specific criminal offence for doping in sport in low limited resource countries, Criminalising the act of doping in sport in would be disproportionate in the battle to keep sport clean. However, developing nation approach to combating doping could be strengthened through better use of existing powers, improved data sharing and more effective liaison between sports governing bodies, Capacity building in education campaign and expert in doping testing is likely to help sensitize young people from doping. Some improvements in the support for doping control measures are possible; most of which can be achieved through funding agreements between international actor in doping and sport governing bodies Funding should be sought from a wider range of sources, beyond government, to enable more robust anti-doping activities.

Integrity units in sports governing bodies should be capable of conducting investigations to WADA standards and share this information with other doping organizations. There should be a review of Therapeutic Use Exemptions (TUEs) and thresholds for personal use of substances on the WADA banned list.

ACKNOWLEDGEMENTS

This project was done in collaboration with the Cameroon anti-doping organization (CADO), and the laboratory for preclinical animal and Pharmacotoxicology research of the Faculty of Medicine and Biomedical Sciences, of the University of Yaoundé 1, Cameroon.

Authors contribution This work was carried out in collaboration among all authors. Authors CNF, ETF, DJF, designed the study. Authors BM, LBF, TBA did data mining/case studies. Authors MDM, RN, ER contributed to writing of first draft. All authors read and approved final draft.

Consent. It is not applicable.

Ethical approval. It is not applicable.

Competing interests; Authors have declared that no competing interest exist.

REFERENCES

1. Ama PFM, Betnga B, Ama Moor VJ, Kanga JP Football and doping: study of African amateur footballers; Br J Sports Med, 2003; 37: 307–310.
2. Hardy J, McNeil JJ, Capes AG. Drug doping in senior Australian rules football: a survey for frequency. Br J Sports Med, 1997; 31: 126–8.
3. Ohaeri J, Ikpeme E, Ikwuagwu U, et al. Use and awareness of effects of anabolic steroids and psychoactive substances among a cohort of Nigerian professional sport men and women. Hum Psychopharmacol, 1993; 8: 429–32.
4. Bailly D, Beuscart R, Leignel C, et al . Alcool et sport. Etude des attitudes et des motivations des sujets sportifs vis-à-vis des boissons alcoolisées. Sem Hôp Paris., 1993; 69: 113–20.
5. Toohey JV, Corde BW. Intercollegiate sports participation and non-medical drug use. Bull Narc., 1981; 33: 23–7. 13 Spence JC, Gauvin L. Drug and alcohol use by Canadian university athletes: a national survey. J Drug Educ, 1996; 26: 275–87.
6. Verroken M. Drug use and abuse in sport. Baillieres Best Pract Res Clin Endocrinol Metab, 2000; 14: 1–23.
7. Lippi G, Guidi GC Gene manipulation and improvement of athletic performances: new strategies in blood doping. Br J Sports Med, 2004; 38: 641.
8. Vlad AR, Haneu G, Popescu GC, Lungu IA. Doping in sport, a never-ending story?. Advance

- pharmaceutical Bulletin, 2018; 8(4): 529-534. Doi: 10.15171/apb.2018.062.
9. World Anti-Doping Agency The World Anti-Doping Code. The 2008 Prohibited List. http://www.wada-ama.org/rtecontent/document/2008_List_En.pdf (last retrieved 7 March 2008), 2008.
 10. Lippi G, Franchini M, Salvagno GL, Guidi GC Biochemistry, physiology, and complications of blood doping: facts and speculation. *Crit Rev Clin Lab Sci*, 2006; 43: 349–391.
 11. Uroš Kovač. 'Juju' and 'jars': how African athletes challenge Western notions of doping The conversation academic rigour journalistic flair, October 28, 8.27am SAST Doctoral student in Anthropology, University of Amsterdam, 2016.
 12. Lippi G, Schena F, Franchini M, Salvagno GL, Guidi GC Serum ferritin as a marker of potential biochemical iron overload in athletes. *Clin J Sport Med*, 2005; 15: 356–358.
 13. Orchard JW, Fricker PA, White SL, Burke LM, Healey DJ The use and misuse of performance-enhancing substances in sport. *Med J Aust*, 2006; 184: 132–136.
 14. Baron DA, Martin DM, Abol Magd S Doping in sports and its spread to at-risk populations: an international review. *World Psychiatry*, 2007; 6: 54–59.
 15. Hampton T Researchers address use of performance-enhancing drugs in nonelite athletes. *JAMA*, 2006; 295: 607–608.
 16. Papadopoulos FC, Skalkidis I, Parkkari J, Petridou E 'Sports Injuries' European Union Group. Doping use among tertiary education students in six developed countries. *Eur J Epidemiol*, 2006; 21: 307–313.
 17. Wanjek B, Rosendahl J, Strauss B, Gabriel HH Doping, drugs and drug abuse among adolescents in the State of Thuringia (Germany): prevalence, knowledge and attitudes. *Int J Sports Med*, 2007; 28: 346–353.
 18. Laure P, Binsinger C Doping prevalence among preadolescent athletes: a 4-year follow-up. *Br J Sports Med*, 2007; 41: 660–663.
 19. Laure P, Lecerf T, Friser A, Binsinger C Drugs, recreational drug use and attitudes towards doping of high school athletes. *Int J Sports Med*, 2004; 25: 133–138.
 20. Van Eenoo P, Delbeke FT The prevalence of doping in Flanders in comparison to the prevalence of doping in international sports. *Int J Sports Med*, 2003; 24: 565–570.
 21. Alaranta A, Alaranta H, Holmila J, Palmu P, Pietilä K, Helenius I Self-reported attitudes of elite athletes towards doping: differences between type of sport. *Int J Sports Med*, 2006; 27: 842–846.
 22. Hoberman J History and prevalence of doping in the marathon. *Sports Med*, 2007; 37: 386–388.
 23. Dumestre-Toulet V, Kintz P 19-norsteroids: doping, Internet, toxicology and analysis. *Eur J Emerg Med*, 2001; 8: 80.
 24. Weiss AP Measuring the impact of medical research: moving from outputs to outcomes. *Am J Psychiatry*, 2007; 164: 206–214.
 25. Stengel D, Porzsolt F Efficacy, effectiveness, and efficiency of diagnostic technology. In Porzsolt F, Kaplan RM (eds) *Optimizing Health: Improving the Value of Healthcare Delivery*. Secaucus, NJ: Springer US, 2006; 217–231.
 26. Kayser B, Mauron A, Miah A Current anti-doping policy: a critical appraisal. *BMC Med Ethics*, 2007; 8: 2.
 27. Lippi G, Banfi G, Franchini M, Guidi GC New strategies for doping control. *J Sport Sci*, 2008; 26: 441–445.
 28. Baron DA, David M, SAMIR AM. Doping in sports and its spread to at-risk populations: an international review WPA SECTION REPORT *World Psychiatry*, 2007; 6: 118-123.
 29. The World Anti-Doping Code in sport Update for 2015 Australia prescriber, 2015; 38: 167–70.
 30. Devcic S, Bednarik J, Maric D, Versic S, Sekulic D et al. Public Identification of Factors Associated with Potential Doping Behavior in Sports: A Cross-Sectional Analysis in High-Level Competitive Swimmers *Health*, 2018; 15: 1720. doi:10.3390/ijerph15081720 www.mdpi.com/journal/ijerph.
 31. Jules A., Heuberger I, Adam F., Cohen C, Review of WADA Prohibited Substances: Limited Evidence for Performance-Enhancing Effects; *Sports Medicine*, 2019; 49: 525–539. <https://doi.org/10.1007/s40279-018-1014-1>.