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Athletes' (Anti) Doping Knowledge: A Systematic Review
Conocimiento (anti) dopaje de los atletas: una revisión sistemática

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Abstract. This systematic review critically examines the scope of athletes' knowledge on anti-doping regulations, focusing on literature from 2018 to 2022. Adhering to PRISMA guidelines, we scrutinized electronic databases including Scopus, ScienceDirect, PubMed, and Google Scholar, yielding 4,009 articles, with 17 meeting our criteria for in-depth analysis. Our findings reveal a significant disparity in anti-doping awareness across different sports disciplines and regions. Notably, the review highlights that while some athletes demonstrate a comprehensive understanding of anti-doping rules, a considerable portion remains unaware of crucial aspects, potentially leading to inadvertent doping violations. The synthesis of the selected studies indicates that current educational programs on anti-doping are insufficiently tailored to address the diverse needs of athletes worldwide. Consequently, we advocate for the development of targeted educational interventions that align with the varying levels of existing knowledge among athletes. By enhancing the specificity and reach of anti-doping education, we aim to empower athletes to uphold the integrity of sports and adhere to the World Anti-Doping Code, thereby mitigating the risks of both intentional and unintentional doping.
Keywords: Doping in sport, anti-doping, education, knowledge, athlete.

Resumen. Esta revisión sistemática examina críticamente el alcance del conocimiento de los atletas sobre las regulaciones antidopaje, centrándose en la literatura de 2018 a 2022. Siguiendo las pautas PRISMA, analizamos bases de datos electrónicas que incluyen Scopus, ScienceDirect, PubMed y Google Scholar, lo que arrojó 4009 artículos, con 17 cumpliendo con nuestros criterios para un análisis en profundidad. Nuestros hallazgos revelan una disparidad significativa en la concienciación antidopaje entre diferentes disciplinas deportivas y regiones. En particular, la revisión destaca que, si bien algunos atletas demuestran una comprensión integral de las reglas antidopaje, una parte considerable sigue sin conocer aspectos cruciales, lo que podría conducir a violaciones de dopaje inadvertidas. La síntesis de los estudios seleccionados indica que los programas educativos actuales sobre antidopaje no están suficientemente diseñados para abordar las diversas necesidades de los atletas de todo el mundo. En consecuencia, abogamos por el desarrollo de intervenciones educativas específicas que se alineen con los distintos niveles de conocimiento existente entre los atletas. Al mejorar la especificidad y el alcance de la educación antidopaje, nuestro objetivo es capacitar a los atletas para que defiendan la integridad de los deportes y se adhieran al Código Mundial Antidopaje, mitigando así los riesgos del dopaje tanto intencional como no intencional.
Palabras clave: Dopaje en el deporte, antidopaje, educación, conocimiento, deportista.

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Introduction

The battle against doping in sports is as old as the Olympic Games themselves, with athletes historically seeking to enhance their performance by any means necessary (Muller, 2010). This is possible because they are required to perform to the best of their ability (Burnett, 2023). Despite ongoing efforts to combat it, doping remains a significant issue in sports today. Scientists are continually seeking to expand our understanding of doping and develop strategies to prevent its use among athletes (Vlad et al., 2018). Doping, as defined by the World Anti-Doping Agency (WADA), is any infraction of the anti-doping rules set forth in The Code (WADA, 2021), which not only undermines the integrity of sports but also adversely affects an athlete's physiology.

In response to this challenge, WADA, (2021) proposed a new model of harmonized international regulations through The Code. This framework is essential for all National Anti-Doping Organizations (NADOs) that have ratified the International Convention on Doping in Sport to adhere to a coherent and effective anti-doping policy. The Code encompasses standards across various domains, including Testing and Investigations (ISTI), Laboratories (ISL), Therapeutic Use Exemptions (ISTUE), the Prohibited List, Results Management (ISRM), Privacy and Personal Information Protection (ISPPPI), code compliance by signatories (ISCCS), and Anti-Doping Education (ISE).

Doping has a detrimental effect on the physiology of the athlete. Although certain substances and methods may lead to an immediate enhancement in performance, sustained use of doping can have detrimental effects on the user's physical well-being. It is widely acknowledged that the use of performance-enhancing drugs has negative effects on cardiovascular health (Adami et al., 2022), research has shown that the use of anabolic-androgenic drugs, specifically, has negative effects on heart health (Fishbein, 2016; Herrera, 2018). This assertion is supported by numerous studies (Kouidi et al., 2021; Albano et al., 2021) investigating the cardiovascular effects of anabolic-androgenic drug use (S1). Furthermore, aromatase inhibitors, which fall under the S4 category of doping substances, have been shown to have adverse effects on the cardiovascular system (Boszkiewicz et al., 2022).

Beyond the health implications, doping in sports is also ethically indefensible. The International Convention Against Doping in Sport was ratified on October 19, 2005, during the 33rd session of the UNESCO Conference in Paris (UNESCO, 2005). The rejection of doping is grounded in human rights, ethical principles, and educational values, aligning with the UNESCO International Charter on Physical Education and Sport and the Olympic Charter.

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Despite the implementation of anti-doping regulations, frequent anti-doping rule violations continue to occur, as evidenced by the ADRV report published by WADA WADA (2023). Morente-Sánchez et al (2019) suggest that such violations may stem from athletes' inadequate understanding of doping regulations. This issue is reflected in the use of dietary supplements, which athletes tend to consume without full knowledge of their implications (Del Arco et al., 2023).

One of the key strategies to combat doping in sports is the provision of anti-doping education. Athletes must receive this education (Ceylan et al., 2020), not only to increase their knowledge but also to positively influence their ethical stance on doping (García-Martí et al., 2022). Anti-doping education serves as one of the efforts to provide anti-doping knowledge (Murofushi et al., 2018; Zhumabayeva et al., 2022). Through anti-doping education, athletes are expected to become well-informed and committed to fostering a clean sport environment. This study aims to review athletes' knowledge of doping in sports and is expected to provide a foundation for evaluating anti-doping measures, particularly those related to anti-doping education.

Method

Insclusion criteria

The criteria for submitted articles are that they are in English and have been published in peer-reviewed journals. The article is limited to publishing between 2018 and 2022. The method of the research and the objectives of the research are presented in the article. Show an athlete sample and discuss the athlete's knowledge of doping and/or anti-doping.

Search strategy

The process of literature search involved regular examination of 'keywords', 'titles', and 'abstracts', as well as the 'full text' of the articles found. The study employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria. A duplicate check of the same article using the Mendeley Duplicate checker is followed by a check by the author. The research team read the 'title' and the 'abstract' and then read the 'full text' to rate the quality with a score of 2 = worthy, 1 = sufficiently worthy and 0 = not worthy. Literature searches were restricted to the period 2018-2022 and were conducted in the electronic databases Scopus, ScienceDirect, PubMed, and Google Scholar. The search strategy for articles used the combined keywords "athlete" AND "doping" OR "anti-doping" AND "knowledge" for publications published during the same period. The process of searching for an article is shown in Figure 1.

Results

There were 17 articles (n=17) in the final sample of the study (Table. 1). Included are articles published in 2018 (15%), 2019 (30%), 2020 (25%), and 2022 (30%). Figure 2 shows the number and percentage of publications included in the study.

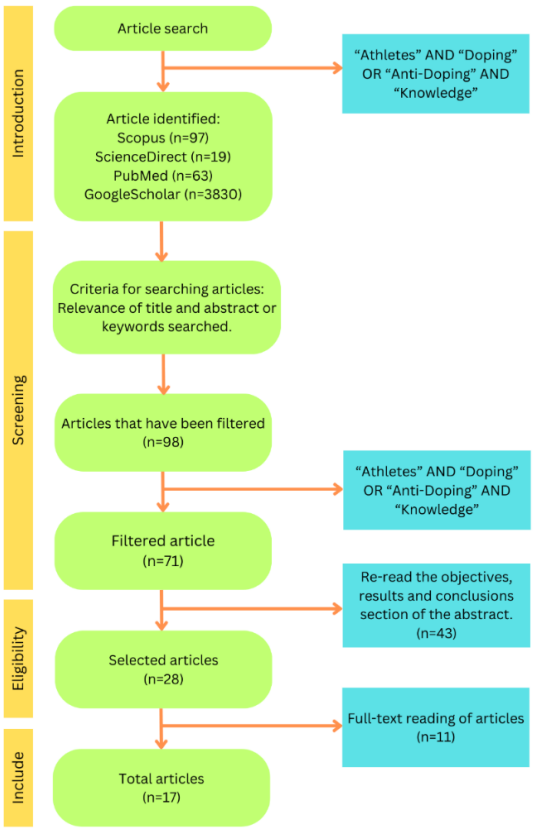

Figure 1. PRISMA Article Selection Flowchart

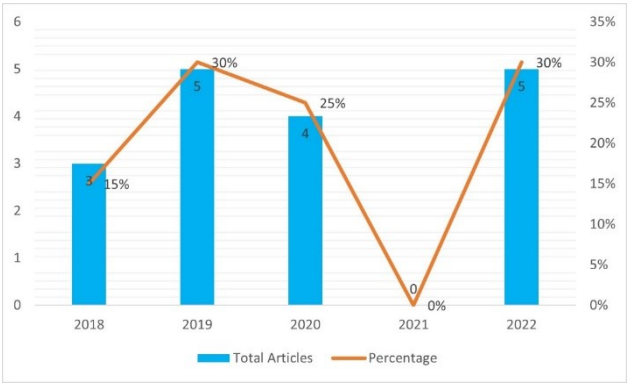

Figure 2. The quantity and percentage of articles that are included

Methodology

The methodological characteristics of the sample, in line with the research objectives, primarily employ a cross-sectional research design (n=9), with one sample adopting a descriptive-exploratory approach (n=1), one using a qualitative methodology (n=1), and one using a quantitative method (n=1). In addition, 5 samples did not provide any information about their study design. The data collection method employed in the sample study was predominantly

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comprised of questionnaires (n=15) with a smaller portion utilising a combination of interviews and questionnaires (n=2). The approach ensures a comprehensive understanding of the participants' views on the matter at hand.

Characteristics of the sample

The study was conducted in 13 different countries. Samples were taken from Australia (n=1), Nigeria (n=2), Malaysia (n=2), Spain (n=1), Saudi Arabia (n=1), Jamaica (n=1), Turkey (n=2), Malawi (n=1), Indonesia (n=2), India (n=1), Romania (n=1), Ethiopia (n=1) and Poland (n=1).. Demographic data of the athlete sample was uncertain as certain articles lacked detailed information on their characteristics. Based on the available data, the included articles had a total of 10,494 athletes, comprising 6,972 male athletes, 3,101 female athletes, and 421 athletes of unknown gender. The sample involved ranged in age from under 15 years old and over 25 years old.

Quality of the article

The articles have to be submitted in the English language. Using https://www.scimagojr.com/, articles were identified as having different quartile ratios. Of the articles included, the following categories were identified: no quartiles detected (n=4), in quartile 4 (n=5), quartile 3 (n=1), quartile 2 (n=4) and quartile 1 (n=3).

Table 1.
Investigating athletes' knowledge of doping

Author(s) & Years	Database Literature Detected	Country	Objective	Sample	Age (Years)	Sex	Design & Method	Finding
(Orr et al., 2018)	Scopus Science Direct PubMed Google Scholar	Australia	Assessing Athletes' Understanding of Performance-Enhancing Substance Side Effects and the World Anti-Doping Agency Prohibited List	Elite and sub-elite athletes (n=1925)	≤ 15.00 ≥ 23.00 (average age 20.60 years)	M=1148 F=775	Cross-sectional (Questioner)	The athletes in the study had a limited understanding of the prohibited list of substances and their side effects.
(Ijadunola et al., 2018)	Scopus Google Scholar	Nigeria	To determine the level of awareness, knowledge, and opinions of university athletes regarding drug testing and performance-enhancing substances (PES).	College athletes (n=4327)	15.00–33.00 (average age 23.30 ± 3.20 years)	M=2785 F=1542	Cross-sectional (Questioner)	Most Nigerian university athletes are aware of the various types of performance-enhancing substances (PES) and the negative consequences associated with their use.
(Chiang et al., 2018)	Scopus Google Scholar	Malaysia	Measuring knowledge, attitudes, and practices of drug use in sport among Malaysian student-athletes	Athletes from high schools and universities (n=182)	16.00–24.00	M=109 F=73	Cross-sectional (Questioner)	Student athletes' understanding of doping was moderate, and they demonstrated a rejectionist attitude toward it.
(Morente-Sánchez et al., 2019)	Scopus Science Direct PubMed Google Scholar	Spain	Investigate and compare elite and under-18 footballers' attitudes, beliefs and knowledge about doping.	Football player (n=1324)	average age 22.56±5.62 years	M=1276 F=48	Descriptive Exploratory (Questionnaire and interview)	The study found that the footballers surveyed had a considerable lack of knowledge of doping. Additionally, they significantly used nutritional supplements.
(Alharbi et al., 2019)	Scopus Science Direct PubMed Google Scholar	Saudi Arabia	Assessing male gym members' knowledge, attitudes and practices towards anabolic steroids in Riyadh, Saudi Arabia.	Gym member (n=482)	The study participants' average age (±SD) was 27.20 (±6.90)	M=482	Cross-sectional (Questioner)	Knowledge of the adverse effects of AAS is rather limited.
(Turfus et al., 2019)	Scopus ScienceDirect Google Scholar	Jamaika	The study examines the use of dietary supplements and understanding of the World Anti-Doping Code among young athletes, and the differences between track and field athletes and athletes from other sports.	Athletes (n=127)	12.00–19.00	M=82 F=45	(Questioner)	Athletes do not have sufficient knowledge about doping. They are aware of the health risks but are unsure about its use.
(Yalcin et al., 2019)	Scopus Google Scholar	Turkey	To determine the level of doping awareness and preferences among Turkish U-23 national team players.	Athletes (n=100)	18.00–23.00	M=70 F=30	(Questioner)	Athletes do not have a sufficient level of knowledge about doping and although they know doping has dangers to health they are not clear about the use of doping
(Ityodugh et al., 2019)	Google Scholar	Nigeria	Investigating Doping Knowledge and practices among High School Athletes	High school athlete	12.00–20.00 years and above	M=203 F=113	Cross-sectional (Questioner)	A good understanding of the issue of doping in sport is assumed among high school

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				(n=316)				athletes.
(Ozkan et al., 2020)	Scopus Google Scholar	Turkey	To investigate the knowledge, attitudes and behaviour of elite Turkish athletes with regard to doping.	Turkey's elite athletes (n=202)	The mean age was 20.8±3.61 years.	Most are male (n=139)	Cross-sectional (Questioner)	The elite athletes in the sample had a low level of knowledge about doping.
(Kaoche et al., 2020)	Google Scholar	Malawi	Assess the knowledge of football players, coaches and sponsors	Athlete (n=275) Coach (n=24) Sponsor (n=15)	18.00 to 36.00 years	M=314	Cross-sectional (Questioner)	The participants showed a considerable understanding of performance-enhancing substances. Athletes are able to recognize growth hormones, stimulants, amino acids, and anabolic steroids as substances that can improve their performance.
(Jaafar & Hamat, 2020)	Scopus PubMed Google Scholar	Malaysia	This study examines Malaysian university athletes' knowledge, perceptions and beliefs about doping and the anti-doping climate.	College athletes (n=614)	-	M=314 F=283 Doesn't mention sex (n=17)	Cross-sectional (Questioner)	The participants demonstrated a lack of knowledge regarding doping and anti-doping measures. The culture surrounding athletes' use of performance-enhancing drugs appears to perpetuate incorrect beliefs and attitudes.
(Doewes et al., 2020)	Google Scholar	Indonesia	Describe the 2020 ASEAN Para Games Indonesia athletes' and coaches' understanding of anti-doping.	Athlete (n=32) Coach (n=16)	-	-	Qualitative (Questionnaire and interview)	Athletes and coaches comprehend the prohibition of doping and its side effects. Nevertheless, their knowledge of doping lacks specificity, including the comprehension of anti-doping violations, the list of prohibited substances, and athletes' right to apply for therapeutic use exemptions.
(Krishnan et al., 2022)	Scopus ScienceDirect PubMed Google Scholar	India	To assess elite athletes' understanding of anti-doping policies, their attitudes towards doping rule violations and the current prevalence of doping practices.	Elite athletes (n=181)	18.00–35.00	M=181	(Questioner)	Athletes' understanding of anti-doping agencies and violations of anti-doping regulations is deficient.
(Mytskan et al., 2022)	Scopus Google Scholar	Romania	Investigating the distinct perspectives of Sambo athletes concerning the issue of doping in contemporary sports.	Professional athletes (n=97)	-	-	(Questioner)	Elite athletes are generally familiar with the World Anti-Doping Agency's Prohibited List. The athletes are knowledgeable about their rights and obligations during the doping control process. Athletes are also aware of the detrimental impacts of doping on the physique. The necessary information is obtained from the national federations and WADA.
(Sepriani et al., 2022)	Scopus Google Scholar	Indonesia	Identification of athletes' knowledge of doping at the 20th PON in 2021	Athletes (n=40)	-	M=26 F=14	Quantitative (Questioner)	Athletes participating in the 20th PON Papua 2021 possess a limited understanding.
(Mohammed et al., 2022)	Scopus Google Scholar	Ethiopia	Measuring knowledge, attitudes and behaviours towards doping among athletes in the Amhara region of Ethiopia.	Athlete training center and club (n=155)	16.00–37.00	M=97 F=55	Cross-sectional (Questioner)	Adequate knowledge and attitudes towards doping were reported by almost two thirds and less than half of the participants respectively.
(Duda & Stula, 2022)	Scopus Google Scholar	Poland	Assessing knowledge of the problems and attitudes of young adults playing sport towards the dangers of doping	Young people involved in sporting activities (n=120)	16.00	M=60 F=60	(Questioner)	Insufficient knowledge of doping in sport among the young people surveyed

Discussion

The findings from the reviewed articles paint a complex picture of athletes' knowledge of doping, which varies

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significantly across different contexts and levels of competition. While the results section has highlighted the diversity in understanding, the discussion now aims to delve deeper into the implications of these findings and their relevance to different sporting environments.

Athletes' knowledge of doping is not uniform; it is influenced by a myriad of factors including educational background, competitive level, and the specific demands and peculiarities of their sporting context. Among those, reported limited (Orr et al., 2018; Morente-Sánchez et al., 2019; Alharbi et al., 2019; Turfus et al., 2019; Yalcin et al., 2019; Ozkan et al., 2020; Jaafar & Hamat, 2020; Doewes et al., 2020; Krishnan et al., 2022; Duda & Stula, 2022; Sepriani et al., 2022), fair (Ijadunola et al., 2018; Chiang et al., 2018), and good knowledge (Ityodugh et al., 2019; Kaoche et al., 2020; Mytskan et al., 2022; (Mohammed et al., 2022). This variation suggests that a one-size-fits-all approach to anti-doping education may not be sufficient. Instead, tailored programs that consider the unique characteristics of each sporting milieu may be necessary to effectively enhance athletes' understanding and adherence to anti-doping regulations.

The sample of athletes from schools and universities had a good knowledge of doping (Ityodugh et al., 2019), moderate knowledge (Ijadunola et al., 2018; Chiang et al., 2018), and even a reported lack of knowledge (Jaafar & Hamat, 2020). The athletes reported their awareness of the adverse effects of doping (Orr et al., 2018; Ijadunola et al., 2018; Yalcin et al., 2019), but it was also reported that there were athletes who were unaware of the side effects of using doping substances such as AAS (Alharbi et al., 2019). Although the side effects of doping are well known, athletes do not have a full understanding of the specifics of doping (Doewes et al., 2020). Elite athletes who have competed at the national level or above are reported to have a lack of knowledge (Orr et al., 2018) (Morente-Sánchez et al., 2019) (Yalcin et al., 2019; Ozkan et al., 2020; Doewes et al., 2020; Krishnan et al., 2022; Sepriani et al., 2022; Mytskan et al., 2022). Interestingly, elite athletes who know a lot about doping (Mytskan et al., 2022) claimed that they had enough information from the national federation and WADA. This confirms that athletes need information to support their knowledge of doping.

The role of anti-doping education is underscored by studies showing that athletes who received targeted education had a more accurate understanding of doping than those who did not (Murofushi et al. 2018; Zhumabayeva et al. 2022). This educational impact extends beyond mere knowledge acquisition; it also influences athletes' moral perspectives on doping, suggesting that education can be a powerful tool in shaping ethical behavior in sports (García-Martí et al., 2022). Another study reported an increase in knowledge and attitudes towards doping among athletes who received sessions or socialization about doping (Krishnan et al., 2022).

Comprehension is the capability acquired by an individual after obtaining knowledge. An individual needs external information to acquire knowledge. As a result of the process of acquiring knowledge, an individual will have justified confidence in their understanding (Bolisani & Bratianu, 2018). As in comprehending a rule, an individual necessitates information regarding the rule to be stored in memory for the rule to be accepted and deemed valid.

The responsibility for avoiding doping lies with the athletes, as they must ensure that no prohibited substances enter their bodies (WADA, 2021). However, the support system around the athletes, including coaches, medical professionals, and even social circles, plays a crucial role in informing and influencing athletes' decisions regarding doping. The widespread use of supplements and the varied sources from which athletes obtain information highlight the need for reliable and accessible anti-doping resources (Macovei & Mihailescu, 2021). Some athletes have the opinion that doctors are responsible for doping (Chiang et al., 2018). Among athletes, the use of supplements remains widespread (Morente-Sánchez et al., 2019; Turfus et al., 2019). Athletes have reported obtaining information about supplements from the internet (Krishnan et al., 2022), friends (Chiang et al., 2018; Krishnan et al., 2022), coaches (Chiang et al., 2018), parents and health professional (Turfus et al., 2019).

In conclusion, the expanded discussion within this systematic review has underscored the importance of context in comprehending athletes' knowledge of doping. The derived results are not merely indicative of athletes' awareness but also reflect the diverse environments and challenges they encounter. This nuanced understanding is pivotal for the development of effective anti-doping strategies that cater to the varied needs of athletes across different backgrounds and competitive levels. The review reveals a complex landscape of understanding, shaped by factors such as educational background, competitive level, and cultural context. This diversity necessitates anti-doping education programs that are customized to meet the unique requirements of distinct athlete populations. While the study's reliance on self-reported data and a focus on quantitative analysis present limitations, the implications for anti-doping strategy development are profound. Continuous monitoring and updating of educational materials are crucial to keep abreast of the evolving doping methods. Moreover, integrating qualitative research could enrich our comprehension of athletes' attitudes and beliefs about doping. The support system surrounding athletes, including coaches and medical professionals, is instrumental in shaping athletes' doping decisions, emphasizing the need for trustworthy and accessible information resources. Future research should concentrate on longitudinal studies to evaluate the enduring effectiveness of anti-doping education and to investigate the influence of cultural and environmental factors on athletes' knowledge and attitudes towards doping.

Conclusions

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The conclusion of your study effectively encapsulates the diverse levels of understanding athletes have regarding (anti) doping and underscores the pressing need for comprehensive anti-doping information. It acknowledges the dynamic nature of doping substances and the annual updates to the prohibited list, which necessitate ongoing education for athletes and their support networks. Recognizing the influence of the environment on athletes' attitudes towards doping, the study advocates for the extension of anti-doping education beyond athletes to include coaches, managers, parents, medical personnel, and friends, reinforcing the collective effort required to foster a culture of clean sports. The call for further research to evaluate anti-doping education programs by assessing athletes' knowledge is a crucial step towards enhancing the effectiveness of these programs and ensuring they are responsive to the evolving landscape of sports doping.

Conflict of interest

The authors declare no conflict of interest in this work.

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