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Anti-Doping Education and Prevention Strategies among Athletes: A Narrative Review

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Abstract

Background: Doping is a major problem in competitive sport, despite stringent anti-doping policies. Recent evidence reveals education is a key preventative approach to enhancing athletes' awareness, ethical decision-making and long-term engagement with clean sport.

Objective: This narrative review intended to consolidate the available research on anti-doping education, athletes' understanding and prevention tactics in sport.

Methods: A narrative literature review was performed using the Scopus database. We selected papers published in English between 2020 and 2025 using keywords linked to anti-doping, education, intervention, and athletes. Fifteen papers were included in the final narrative synthesis according to pre-defined inclusion and exclusion criteria.

Results: Athletes' anti-doping awareness remains inconsistent among athletic demographics despite past exposure to education. Values-based education, anti-doping literacy and athlete-centred educational approaches were consistently more effective than information-based initiatives in the improvement of knowledge, ethical awareness and decision-making. The review also found dietary supplement use was a key contributor to inadvertent doping, highlighting the need for supplement risk education and evidence-based decision making. In addition, sustained anti-doping prevention requires ongoing education, multidisciplinary stakeholder involvement and instructional initiatives customized to particular athlete groups.

Conclusion: Anti-doping education should go beyond knowledge transmission and cover ethical values, anti-doping literacy, supplement awareness and context appropriate educational tactics. Continuous, multidisciplinary, and evidence-based educational initiatives are needed to improve clean sport and reduce the number of purposeful and unintentional anti-doping rule infractions.

Keywords: anti-doping education, athlete knowledge, doping prevention, athletes, health

INTRODUCTION

Doping still remains one of the greatest challenges of modern competitive sport, threatening the health of players, fair competition and integrity of sport. Despite increasingly rigorous anti-doping policies, the use of prohibited substances and methods for the enhancement of athletic performance continues in a wide range of sports. Survey-based research have suggested substantially higher estimations of doping conduct than the official anti-doping testing results that regularly report only a modest proportion of unfavorable analytical findings in the range of roughly 1.1% to 1.6% . A recent study among Dutch professional athletes indicated that 12.5% of athletes had used doping in the past 12 months, indicating that the real incidence of doping might be significantly greater than what is reported by conventional testing (Balk et al., 2023). These results imply that doping remains a global challenge and that comprehensive anti-doping measures including testing, regulation and education are needed to preserve athletes and the spirit of sport (Pitsiladis & Cai, 2024)

Doping control, biological monitoring and sanctions remain important elements of the global anti-doping system, but are almost exclusively employed to identify anti-doping rule violations after the fact rather than to prevent them. The recent evidence suggests that testing alone is not enough to produce a sustainable clean sport environment, since the effectiveness of testing depends on risk-based techniques and its deterrent effect, and not just the number of samples gathered (Lauritzen & Solheim, 2024). As a consequence, WADA has gradually changed its anti-doping policy to prevention, by focusing on education under the International Standard for education (ISE). The ISE suggests that athletes should primarily acquire knowledge about anti-doping through well-organized educational programs and not through doping tests or through direct contact with illegal drugs. This suggests that education is an active, not passive, approach to doping prevention (Reynoso-Sánchez et al., 2025).

Anti-doping education is wide-ranging and covers much more than just the information about banned drugs and testing techniques. Instead it is meant to enhance knowledge of athletes, establish ethical standards, optimize decision-making abilities and promote long-term commitment to clean sport (Barkoukis et al., 2022). Recent statistics show that anti-doping education has developed through time, from a compliance strategy to a holistic prevention approach that integrates information, ethical values, athlete empowerment and behavioral skills (Sipavičiūtė et al., 2020).). Implementation of the International Standard for Education (ISE) of the World Anti-Doping Agency (WADA) supports educational courses to foster critical thinking, personal responsibility and values of clean sport during the careers of athletes (Patterson et al., 2021). Evidence suggests that well-designed educational programs can raise athletes' awareness, reduce susceptibility to doping, strengthen moral values, support responsible use of nutritional supplements and encourage appropriate anti-doping behaviours (Hurst et al., 2023). Moreover, recent systematic reviews point out that anti-doping education has a positive impact on athletes' knowledge, attitudes and intentions to behave but these impacts need to be constantly reinforced, and not in a single anti-doping education session (Nicholls et al., 2025; Reynoso-Sánchez et al., 2025). Additionally, athlete support personnel (e.g. coaches, physiotherapists, sports physicians, nutritionists and other health care professionals) should be provided with good anti-doping education as they play a key role in influencing athletes' decision-making regarding medication use, dietary supplements and ethical sporting behaviour (Patterson et al., 2021)

Anti-doping education is increasingly dealt with in the literature . However, the research base is scattered across different athlete demographics, teaching approaches and outcome measures. The majority of previous research have concentrated on one dimension of anti-doping (e.g. athletes' knowledge, intervention efficacy, dietary supplement use or

attitudes towards doping) without trying to synthesise how various components contribute to effective doping prevention. It is also challenging to provide consistent findings and practical recommendations that are widely applicable to sporting settings, due to the variations in educational content, the way programmes are delivered, the target groups and the evaluation methods. Hence, there is a need for a more holistic narrative review of the current evidence on anti-doping education, athletes' knowledge and prevention strategies to develop an integrated understanding of how these components interact to promote clean sport and guide future educational programmes. The present narrative review, therefore aims to integrate existing studies about anti-doping education, athletes' understanding and preventive strategies in sport. This study, in particular, focuses on recent findings on athletes' anti-doping knowledge, educational interventions, supplement awareness, and preventative techniques to provide practical recommendations for increasing anti-doping education and supporting clean sport.

METHODS

Design Study

The design of this study was a narrative literature analysis to synthesize the current evidence on anti-doping education, athletes' awareness and prevention tactics in sports. The study intended to summarise and critically examine existing studies on the field of anti-doping educational approaches, athletes' knowledge and awareness and doping prevention strategies in sport. The review was framed by the study question: "What does the current literature report regarding anti-doping education, athletes' knowledge, and prevention strategies in sport?"

Criteria for Inclusion

Studies were considered eligible if they met the following criteria: (1) original research articles or review articles published in peer-reviewed

journals; (2) involved athletes, coaches, or other sport-related participants; (3) examined anti-doping education, athletes' knowledge, awareness, attitudes, or prevention strategies; (4) were published in English between 2020 and 2025; and (5) were available in full text. Studies were excluded if they: (1) focused exclusively on laboratory detection methods, pharmacological mechanisms, or analytical techniques without discussing educational or preventive aspects of anti-doping; (2) were conference abstracts, editorials, commentaries, letters, or other non-peer-reviewed publications; or (3) were unavailable in full-text format.

Search Strategy

A comprehensive literature search was conducted using the Scopus database on June 20, 2026. Scopus was selected because it is one of the largest multidisciplinary databases, providing extensive coverage of high-quality peer-reviewed literature in sports science, medicine, public health, and related disciplines. The search strategy combined keywords related to anti-doping, education, intervention, and athletes using Boolean operators (AND/OR). The following search string was used:

("anti-doping" OR doping) AND (education OR intervention) AND athlete

The search was limited to articles published in English between 2020 and 2025. The inclusion criteria were as follows: (1) original research articles or review articles published in peer-reviewed journals; (2) studies involving athletes, coaches, or other sport-related participants; (3) studies focusing on anti-doping education, athletes' knowledge, awareness, attitudes, or prevention strategies; (4) articles published in English between 2020 and 2025; and (5) articles available in full text.

Study Selection

After the literature search, the retrieved records were evaluated by titles and abstracts to check their relevance to the topic of review. Full text assessment of articles identified as possibly eligible was performed using

the established inclusion and exclusion criteria. Studies on anti-doping education, knowledge, awareness or preventative techniques in athletes were included in the final narrative synthesis

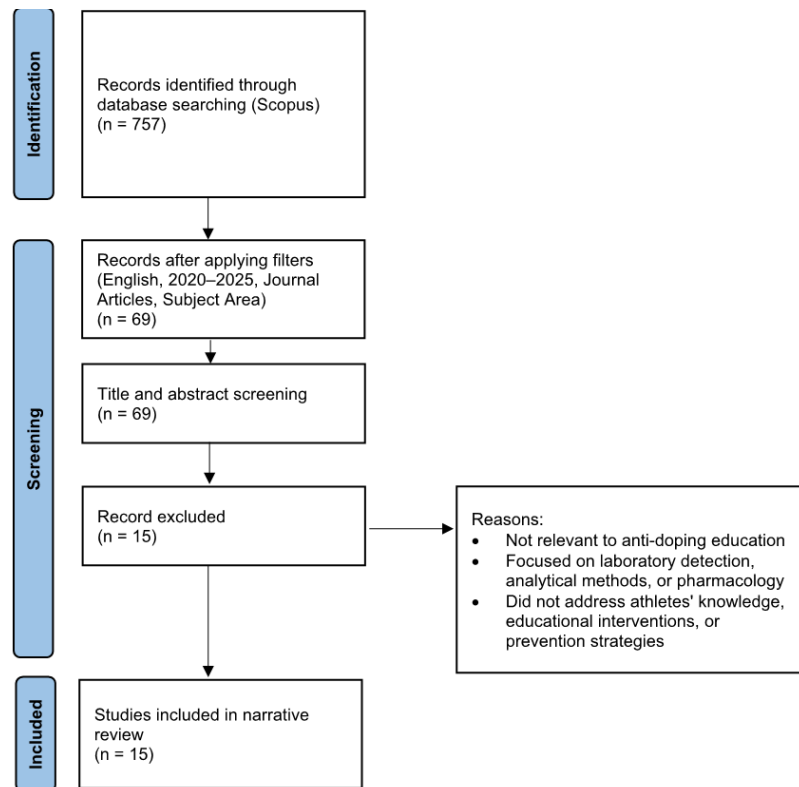


Figure 1. Flowchart of literature search and study selection process.

Data Extraction

A consistent data extraction table was used to retrieve relevant information from each included study. Data gathered includes initial author, year of publication, country, study design, characteristics of participants, study objectives, educational strategy or intervention, and primary findings on anti-doping knowledge and preventative strategies. The retrieved data were grouped into thematic areas to permit narrative synthesis.

Data analysis

A narrative synthesis approach was used to synthesize the included studies. The findings were arranged into four main themes: (1) Athletes' understanding of anti-doping, (2) Anti-doping educational initiatives, (3)

Supplement-related awareness and inadvertent doping prevention, and (4) Prevention tactics and determinants of anti-doping awareness. Similarities, discrepancies and emerging patterns throughout the included research were identified and critically reviewed to provide an overview of current data.

RESULTS

Characteristics of the Included Studies

A preliminary search of the literature using the Scopus database found 757 entries. After filtering for publication year (2020-2025), language (English), document type (journal articles) and subject areas, 69 entries remained for screening by title and abstract. Fifteen papers were included in the final narrative synthesis after full text evaluation based on the defined inclusion and exclusion criteria (Figure 1).

The selected research were published between 2021 and 2025. The included studies represented different geographic regions including Europe, Asia, Australia and Africa. Most studies had a cross-sectional design, but some used qualitative, mixed-methods or intervention approaches in assessing anti-doping education and prevention initiatives. The study populations were mostly elite athletes, university athletes, young athletes, paralympic athletes, coaches and anti-doping stakeholders. Table 1 shows the basic characteristics of the included research.

Athletes' Knowledge of Anti-Doping

Knowledge of anti-doping varies widely across populations of athletes with several studies reporting significant gaps in athletes' knowledge of anti-doping legislation. Sepriani et al., (2022) found that Indonesian national athletes lacked sufficient understanding of prohibited substances, therapeutic use exemptions (TUEs), and anti-doping rules, indicating the necessity for ongoing teaching campaigns. Likewise, Murofushi et al., (2023) observed that Japanese university athletes typically

overestimated their anti-doping knowledge, while objective assessments revealed significant gaps in their comprehension of anti-doping regulations. Likewise, Inai et al., (2023) reported that professional triathletes scored much higher than leisure athletes on anti-doping knowledge, suggesting that earlier exposure to education and competitive experience may have contributed to greater anti-doping literacy. However, knowledge gaps regarding supplement contamination and banned drugs were still apparent in both groups.

Differences in anti-doping knowledge were also detected with respect to athletes' competitive level and educational experience. Many Paralympic competitors had been through doping control before they had received organized anti-doping education (Blank et al., 2023). Such findings suggest anomalies in the timing of educational provision . In a similar vein, Qvarfordt et al., (2024) underlined that Paralympic athletes demanded improved access to anti-doping education that was more inclusive and contextualized to their sport. These findings taken together suggest that while previous anti-doping education and previous competitive experience are associated with better knowledge, there remain substantial misconceptions about prohibited substances, therapeutic use exemptions, and dietary supplements among diverse athlete populations, highlighting the need for earlier, ongoing and context-specific educational programmes.

Table 1. Characteristics of the Included Studies

Author (Year)	Country/Setting	Athlete Level	Study Design	Type of Education / Intervention	Outcome Measured	Main Implication for Anti-Doping Education
Woolway et al., (2021)	Germany, Greece, Italy, Russia, UK	Elite athletes	Cross-sectional	Values-based education	Clean sport values and value priorities	Adapt educational content to athletes' cultural values and sporting contexts.
Blank et al., (2022)	Austria	Junior elite athletes	Validation study	Anti-doping literacy programme (GRADE IT)	Anti-doping literacy, trust, and legitimacy	Assess anti-doping literacy, trust, and legitimacy rather than factual knowledge alone.
Manges et al., (2022)	Germany and Austria	Elite adolescent athletes	Randomized intervention study	Values-based education	Moral disengagement and doping susceptibility	Implement values-based education to strengthen ethical decision-making and reduce doping susceptibility.
Blank et al., (2023)	Multinational Europe (Austria, Germany, Switzerland, UK)	Paralympic athletes and coaches	Cross-sectional	Previous anti-doping education	Educational exposure and perceptions of anti-doping	Provide structured anti-doping education before athletes undergo doping control and involve athlete support personnel.
Veltmaat et al., (2023)	13 European countries	Elite athletes	Qualitative study	Doping vulnerability assessment	Perceived doping vulnerability	Address psychological and environmental risk factors alongside knowledge-based education.
Murofushi et al., (2023)	Japan (University setting)	University athletes	Cross-sectional	Previous anti-doping education	Subjective and objective anti-doping knowledge	Use objective knowledge assessments to identify educational needs and correct misconceptions.

Author (Year)	Country/Setting	Athlete Level	Study Design	Type of Education / Intervention	Outcome Measured	Main Implication for Anti-Doping Education
Myoenzono et al., (2023)	Japan	Olympic and Paralympic athletes	Cross-sectional	Supplement awareness education	Supplement use and supplement knowledge	Integrate supplement risk education into anti-doping programmes to reduce unintentional doping.
McLean et al., (2025)	Australia	Expert stakeholders	Systems analysis	Systems-based prevention approach	Stakeholder interactions contributing to unintentional doping	Promote collaboration among athletes, coaches, healthcare professionals, anti-doping organizations, and supplement manufacturers.
Inai et al., (2023)	Japan	Elite and recreational triathlon athletes	Cross-sectional	Previous anti-doping education	Anti-doping knowledge and awareness	Provide continuous anti-doping education across all competitive levels, particularly for recreational athletes.
Juma et al., (2022)	Kenya	Competitive athletes	Qualitative study	National anti-doping education	Educational barriers and implementation challenges	Expand access to structured anti-doping education, particularly in resource-limited settings.
Sepriani et al., (2022)	Indonesia	National athletes	Cross-sectional	General anti-doping education	Anti-doping knowledge	Strengthen continuous anti-doping education to improve athletes' knowledge and awareness.
Murofushi et al., (2022)	Japan (University setting)	University athletes	Cross-sectional	Learning motivation for anti-doping	Learning motivation and objective knowledge	Promote athletes' motivation to learn as part of anti-doping education programmes.

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Author (Year)	Country/Setting	Athlete Level	Study Design	Type of Education / Intervention	Outcome Measured	Main Implication for Anti-Doping Education
Qvarfordt et al., (2024)	Sweden	Paralympic athletes	Cross-sectional	Previous anti-doping education	Perceptions of the anti-doping system	Develop inclusive anti-doping education tailored to the needs of Paralympic athletes.
(Murofushi et al., 2024)	Japan (University setting)	University athletes	Cross-sectional	Supplement awareness	Supplement beliefs, anti-doping awareness, and supplement use	Increase awareness of supplement-related risks to prevent unintentional anti-doping rule violations.
Pöppel & Büsch, (2022)	Germany	Young elite athletes	Cross-sectional	Tailored anti-doping prevention	Educational needs and prevention preferences	Tailor anti-doping education according to athletes' age, experience, and competitive environment.

Anti-Doping Educational Interventions

Instructional interventions have frequently been found to increase athletes' anti-doping literacy, ethical awareness and decision-making, however their success depends on the teaching style chosen. Manges et al., (2022) discovered that values-based education significantly reduced moral disengagement and doping susceptibility in elite adolescent athletes, suggesting that programmes based on ethical principles are more effective than those based on simple factual information. Likewise, Blank et al., (2022) created and validated the GRADE IT framework that showed that the evaluation of anti-doping literacy, trust and perceived legitimacy of anti-doping organizations offers a more holistic evaluation of educational outcomes than the simple evaluation of factual knowledge.

Research also indicates that learner-centred and context-specific educational strategies are more successful than conventional information-based curriculum. Woolway et al., (2021) observed that athletes' value priorities differed across European countries and recommended that anti-doping education should be culturally tailored rather than adopting a "one size fits all" approach. Blank et al., (2023) also observed that many Paralympic athletes first got formal anti-doping education after they had experienced doping control, showing the necessity to incorporate education earlier in the careers of athletes and to include athlete support personnel. Taken together these studies suggest that successful anti-doping education needs to incorporate values-based learning, anti-doping literacy and athlete-centred teaching techniques, considering athletes' competitive level, cultural background and sports setting.

Supplement Awareness and Unintentional Doping Prevention

The most commonly reported challenge in the reviewed publications was inadvertent doping through the use of dietary supplements. Myoenzono et al., (2023) reported that Olympic and Paralympic athletes were extensively using nutritional supplements, but

they had major gaps in their awareness of the safety of supplements and the potential risk of contamination with illegal chemicals. The results indicate that athletes may unintentionally violate anti-doping regulations even if they have a positive attitude towards clean sport.

Likewise, Murofushi et al., (2024) reported that athletes' opinions of the necessity of sport supplements were substantially related to supplement use and that increased awareness of anti-doping rule violations (ADRVs) led players to reconsider supplement use. The authors also recommended that anti-doping education should not only include information on prohibited substances but also improve athletes' knowledge of the risks associated with supplements and promote evidence-based decision making before using dietary supplements.

McLean et al., (2025) took a broader systems perspective to demonstrate that preventing unintentional doping required coordinated operations from multiple stakeholders, including athletes, coaches, healthcare professionals, anti-doping organizations, and supplement producers. Instead of only condemning the athletes, the study revealed that supplement-related anti-doping education should be integrated into a wider preventative approach which encourages safe supplement usage and reduces the probability of accidental anti-doping rule infractions. These findings highlight the importance of enhancing awareness of supplements, raising athletes' knowledge of the hazards of contamination and promoting interdisciplinary teamwork as critical elements of successful unintentional doping prevention.

Prevention Strategies and Current Challenges

The included studies consistently emphasized that effective anti-doping prevention requires comprehensive strategies extending beyond the delivery of educational information alone. Veltmaat et al., (2023) identified multiple psychological, social, and environmental factors contributing to athletes' vulnerability to doping, suggesting that

prevention programmes should address broader contextual influences rather than focusing exclusively on knowledge acquisition. Similarly, Pöppel & Büsch, (2022) reported that young elite athletes preferred anti-doping programmes tailored to their age, sporting experience, and competitive environment, highlighting the importance of individualized educational approaches.

Several studies also identified practical challenges affecting the implementation of anti-doping education across different sporting contexts. Juma et al., (2022) found that athletes in Kenya experienced limited access to structured anti-doping education because of insufficient educational resources and inconsistent programme implementation. Likewise, Qvarfordt et al., (2024) reported that Paralympic athletes required more accessible and inclusive educational programmes that addressed their specific needs and experiences. Furthermore, McLean et al. (2025) demonstrated that preventing unintentional doping requires coordinated collaboration among athletes, coaches, healthcare professionals, anti-doping organizations, and supplement manufacturers, emphasizing that effective prevention depends on a systems-based rather than athlete-centred approach. Collectively, these findings indicate that anti-doping prevention should be implemented as a continuous, context-specific, and multidisciplinary process. Sustainable programmes should combine evidence-based education, stakeholder collaboration, ethical development, and practical decision-making support to strengthen clean sport and reduce both intentional and unintentional anti-doping rule violations.

DISCUSSION

Current Status of Athletes' Anti-Doping Knowledge

The present analysis reveals that athletes' anti-doping knowledge remains variable within and between sports, competitive levels and athlete

populations despite the increased availability of anti-doping education. Higher understanding was found in elite athletes than in university or recreational athletes. Nevertheless, a considerable amount of misconceptions regarding prohibited substances, therapeutic use exemptions (TUEs), nutritional supplements and anti-doping processes was common in all groups. These findings indicate that repeated exposure to anti-doping education does not guarantee appropriate understanding, particularly when training programmes focus on factual information without assessing knowledge retention or practical decision-making.

One of the major findings of this review is the disparity between athletes' perceived and objectively measured anti-doping knowledge. Several studies have shown that athletes often exaggerated their knowledge of anti-doping legislation while objective assessments found significant knowledge deficits. This mismatch may provide a false sense of confidence that may increase the danger of both intentional and unintentional anti-doping rule infractions. Therefore, future education courses should feature standardised and objective assessment of anti-doping knowledge to identify learning requirements and track the effectiveness of the education delivered over time.

Educational Approaches Beyond Information Delivery

The results of this analysis reinforce the emerging understanding that successful anti-doping education should go beyond the mere delivery of factual information about forbidden drugs and rules. Modern educational strategies are increasingly focusing on values-based learning, anti-doping literacy, ethical reasoning and athlete-centred learning as vital components of sustained doping prevention. These tactics contribute to athletes' awareness of anti-doping rules, and development of critical thinking, personal responsibility and moral commitment to clean sport.

Another key implication is the necessity of instructional practices which are context-specific. The research analyzed show that the efficiency

of instruction is determined by the age of the athletes, the level of competition, the cultural background and the athletic environment. As a result, uniform educational programmes may not sufficiently meet the varied learning demands of different groups of athletes. These results are in line with the educational concept advocated by the World Anti-Doping Agency in the International Standard for Education that supports lifelong, individual, and values-based education for athletes throughout their careers.

Supplement Awareness and Unintentional Doping

The use of dietary supplements is one of the greatest modern-day issues in anti-doping education, as many anti-doping rule infractions are not a result of intentional doping, but happen unintentionally. The research examined reveal that athletes regularly use supplements to promote health, recovery or performance and have poor knowledge of contamination risk, forbidden compounds and product quality. The dilemma is compounded by the common perception that supplements on the market are fundamentally safe.

The results show that supplement education should be included in anti-doping efforts, rather than as a separate instructional topic. Educational efforts should encourage critical assessment of the need to supplement, consultation with appropriately competent health practitioners before supplement usage and preference use of independently quality certified supplements. Such approaches may lower unintended anti-doping rule infractions and encourage safer and more educated supplement practices.

Practical implications for the anti-doping education

The conclusions of this analysis have various practical consequences for anti-doping agencies, sport governing bodies, coaches, health care experts and athlete support personnel. First, anti-doping education should be a continuing learning process starting early in the growth of the athlete

and maintained throughout the athlete's sports career, rather than a one-time instructional session. Continued education will potentially increase information retention, ethical decision-making and long-term commitment to clean sport.

Second, effective anti-doping education needs multidisciplinary teamwork. Athletes' decisions about drug use and food supplementation are often influenced by coaches, sports physicians, physiotherapists, nutritionists, pharmacists and other athlete support workers. Their active involvement in teaching programmes can thus improve athletes' informed decision-making and lower the risk of intentional and unintentional anti-doping rule violations.

Finally, anti-doping education should be customized to the individual features and educational needs of the diverse athlete populations, including young athletes, university athletes, elite athletes, recreational athletes and Paralympic athletes. This research demonstrates that customised instructional approaches are more likely to boost engagement, improve learning outcomes and encourage long-term commitment to clean sport ideals across a range of athletic situations.

Limitations

There are several limitations in this review. The literature search was limited to the Scopus database only, thus relevant research indexed in other databases may not be included. Second, the inclusion of only articles in English between 2020 and 2025 may have resulted in the exclusion of crucial evidence from earlier studies or from publications in other languages. Third, given this was a narrative review, no rigorous methodological quality evaluation was performed for the included studies. Hence, the findings should be considered as a qualitative synthesis of the present data and not as a quantitative evaluation of intervention effectiveness.

Future Directions

Future research should concentrate on longitudinal and intervention study designs to evaluate the long-term impact of anti-doping education. More research is also needed into instructional programs for youth athletes, Paralympic athletes and athletes from developing nations where anti-doping education is comparatively underexplored. Moreover, future research needs to explore the integration of digital learning platforms, tailored educational strategies and behavioural science techniques to increase athletes' knowledge, ethical decision-making and compliance with clean sport standards. Increased coordination among anti-doping groups, coaches, health care providers, and educational institutions may further boost the effectiveness of anti-doping prevention efforts.

CONCLUSION

This narrative review shows that anti-doping education is essential for promoting clean sport by boosting athletes' understanding, strengthening ethical principles, and enabling informed decision-making. However, substantial knowledge gaps persist with respect to the usage of illegal substances, therapeutic use exemptions, and nutritional supplements among different athlete populations. The findings also reveal that values-based education, anti-doping literacy and athlete-centred educational techniques are more effective than information-based courses alone. Furthermore, increasing awareness and multidisciplinary cooperation among athletes, coaches, healthcare experts and anti-doping organizations is important to minimize unintentional doping. Future anti-doping education should therefore be an ongoing process, evidence-based and adapted to the needs of different athlete groups, in order to reinforce long-term compliance with anti-doping legislation and foster a sustainable culture of clean sport.

CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party.

AUTHOR'S CONTRIBUTION

Faza conceptualized the study, conducted the literature search, selected eligible studies, extracted and analyzed the data, prepared the figures and tables, and drafted the manuscript. Amalia contributed to the literature search, study selection, data extraction, manuscript revision, and validation of the findings. Wicaksono assisted with the literature search, data extraction, reference management, figure preparation, and manuscript editing. Saputri supervised the study, contributed to the study conceptualization and methodology, critically reviewed the manuscript, validated the interpretation of the findings, and approved the final manuscript.

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