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Effects of long-term anabolic steroid use on the risk of prostate cancer: systematic review

Efectos del uso prolongado de esteroides anabólicos sobre el riesgo de cáncer de próstata: revisión sistemática

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Abstract

The use of testosterone-derived anabolic steroids, used to improve performance and muscle development, is associated with an increased risk of cancer, especially when used without medical reason. The study aimed to analyze the literature on the prolonged use of anabolic steroids and the risk of prostate cancer. To evaluate the existing literature on the subject, a scoping review was conducted using the PRISMA model and the method proposed by Arksey and O'Malley. Of the 49 documents selected for analysis, 22.4% were case studies and 32.7% were qualitative in nature. PubMed was the source selected for data collection (57.1%). The United States accounted for 49% of all publications, with English being the preferred language for most of them (73.5%). According to current research, steroid use does not appear to substantially increase the risk of prostate cancer in the short or medium term. However, it is clear that steroids have negative effects on mental health and many body systems. In conclusion, although steroids have serious and possibly long-lasting negative effects on health, there is no evidence that they increase the incidence of prostate cancer. Consequently, to reduce the dangers of steroid use, it is important to advocate for more comprehensive quantitative research with long-term follow-up and to establish measures for education, medical monitoring, and regulation.

Keywords: anabolic steroids, prostate cancer, health risk.

Resumen

El uso de esteroides anabólicos derivados de la testosterona, empleados para mejorar el rendimiento y el desarrollo muscular, está asociado con un mayor riesgo de cáncer, especialmente cuando se utilizan sin una razón médica. El estudio tuvo como objetivo analizar la literatura en referencia al uso prolongado de esteroides anabólicos sobre el riesgo de cáncer de próstata. Para evaluar la literatura existente sobre el tema, se llevó a cabo una revisión de alcance utilizando el modelo PRISMA y el método propuesto por Arksey y O'Malley. De los 49 documentos seleccionados para el análisis, el 22.4% eran estudios de caso y el 32.7% eran de carácter cualitativo. PubMed fue la fuente seleccionada para la recopilación de datos (57.1%). Estados Unidos representó el 49% de todas las publicaciones, siendo el inglés el idioma preferido para la mayoría de ellas

(73.5%). Según la investigación actual, el uso de esteroides no parece aumentar sustancialmente el riesgo de cáncer de próstata a corto o medio plazo. Sin embargo, es evidente que los esteroides tienen efectos negativos en la salud mental y en muchos sistemas del cuerpo. En conclusión, aunque los esteroides tienen efectos negativos graves y posiblemente duraderos en la salud, no hay pruebas de que aumenten la incidencia de cáncer de próstata. En consecuencia, para reducir los peligros del uso de esteroides, es importante abogar por una investigación cuantitativa más exhaustiva con seguimiento a largo plazo y establecer medidas de educación, monitoreo médico y regulación.

Palabras clave: esteroides anabólicos, cáncer de próstata, riesgo a la salud.

Introduction

Anabolic-androgenic steroids (AAS) are synthetic hormones derived from testosterone that serve a dual purpose: enhancing protein synthesis and muscle growth while promoting male secondary sexual characteristics (Mingxing & Yanfei, 2025; Esposito et al., 2023). Originally reserved for treating growth delay, hormonal abnormalities, and muscle wasting associated with chronic conditions (Tauchen et al., 2021), the non-medical use of AAS has increased dramatically in recent decades, driven primarily by aesthetic considerations and athletic performance enhancement (Skrzypiec-Spring et al., 2024).

In this context, prolonged AAS exposure can precipitate severe hormonal imbalances (Heerfordt et al., 2025). The prostate represents one organ particularly susceptible to such perturbations owing to its androgen sensitivity (Qasim et al., 2024). While estrogen and its analog dihydrotestosterone (DHT) regulate prostate cell proliferation and differentiation (Berrehail et al., 2022), sustained exposure to elevated hormone levels may promote cell proliferation, genetic mutations, and the formation of specific microenvironments conducive to prostate cancer and other neoplasms (Boye et al., 2024).

Experimental studies have demonstrated that supraphysiological androgen levels can disrupt the regulation of tumor suppressor genes while activating signaling pathways that drive cellular proliferation and angiogenesis (Eisermann et al., 2013; Sorrentino et al., 2023). Given the scarcity and frequently contradictory nature of available clinical evidence, there exists an urgent need for further investigation into the relationship between long-term AAS use and prostate carcinogenesis (Alfi et al., 2024).

Prostate cancer ranks prominently among male malignancies in both industrialized and developing nations, constituting the second leading cause of cancer-related mortality (Bray et al., 2024). According to the World Health Organization (WHO), multiple factors contribute to its rising global prevalence, including lifestyle and dietary shifts, an aging population, and substantial exposure to hormonal factors (OMS, 2022).

Concurrently, anabolic steroid use has surged in recent years, particularly among individuals aged 18 to 35 years (Hoseini & Hoseini, 2024). A considerable proportion of men worldwide have used AAS at some point, with many engaging in self-medication without prior medical consultation (Gestsdottir et al., 2021). Although cardiovascular, hepatic, and endocrine complications are well-recognized risks, this consumption pattern may also represent an overlooked risk factor for oncological conditions, including prostate cancer (Ielasi et al., 2024; Urios & Sanz-Valero, 2018).

In summary, elucidating the impact of long-term anabolic steroid use on prostate cancer risk is essential for advancing the understanding of hormonal pathways involved in prostatic carcinogenesis (Salerno et al., 2018; Mehralivand et al., 2024). Public education regarding the dangers of uncontrolled AAS use is urgently needed, and this research can provide the scientific foundation for such efforts. Moreover, it can help pave the way for more comprehensive preventive measures against long-term synthetic hormone exposure by strengthening public health regulations and educational initiatives targeting at-risk populations.

Based on this premise, the overarching objective of this study was to analyze the literature concerning prolonged anabolic steroid use and prostate cancer risk.

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Methodology

This investigation was conducted as a systematic literature review, following the methodological framework proposed by Arksey and O'Malley (2005) and adhering to the PRISMA extension for scoping reviews (Page et al., 2021). This review process enables a comprehensive and analytical evaluation of the literature (Levac et al., 2010). The following sections provide a detailed account of the scoping review methodology employed.

Identification of the research question

Given the broad scope of the topic, this section required three essential components: population, outcomes, and intervention (Arksey & O'Malley, 2005). The research question guiding this review was formulated as follows: To evaluate the potential association between anabolic steroid use and prostate cancer within a theoretical framework.

Eligibility criteria

The following filters were applied to the selection criteria: "Article," "Systematic Review," "Humans," "English," "Spanish," and "Portuguese." Documents employing quantitative, qualitative, mixed-methods, case study, bibliometric, or novel systematic approaches were considered for inclusion. Table 1 presents the selection criteria established to ensure that only the most relevant publications were considered.

Table 1. *Inclusion and exclusion criteria*

Inclusion criteria	Exclusion criteria
Articles published between 2007 and 2025	Articles outside the established publication period
Research articles examining the relationship between anabolic steroids and conditions such as prostate cancer prevalence	Articles unrelated to the study variables
Publications in English, Spanish, or Portuguese	Publications in languages other than those selected
Publications with available access (open access and free)	Publications with limited or restricted access

Information sources and search strategies

Relevant publications were identified through searches in the SCOPUS and PubMed databases. Using the Boolean operators "AND" and "OR," the selected keywords were combined. Additionally, a similar exploratory approach was employed to thoroughly examine the titles, abstracts, and keywords of the identified studies.

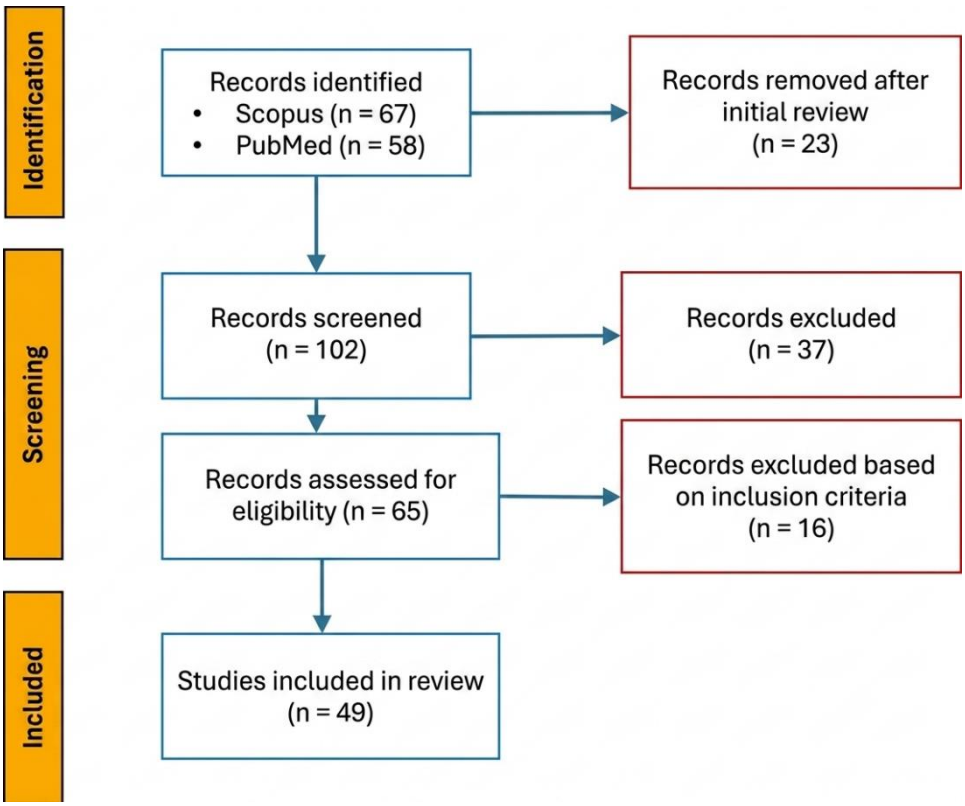
Table 2. *Sources and search strategies*

Database	Boolean search operators	Publication year
SCOPUS	(“effects of prolonged use”) AND (“anabolic steroid”), (“risk of prostate cancer”) OR (“anabolic steroids”) AND (“prostate cancer”).	2007-2025
PubMed	(“effects of prolonged use”) AND (“anabolic steroid”), (“risk of prostate cancer”) OR (“anabolic steroids”) AND (“prostate cancer”).	2007-2025

Data charting

Following the review process, articles meeting the inclusion criteria (n = 49) were selected from the collected publications (**Figure 1**). In accordance with the recommendation of Arksey and O'Malley (2005), all articles were categorized using a narrative or thematic approach to present an accessible account of the research. This approach is consistent with scoping review methodology, which typically summarizes and logically explains theoretical or conceptual positions, themes, and author findings (Levac et al., 2010).

Figure 1
PRISMA flow diagram of the literature search and review process



Results and discussion

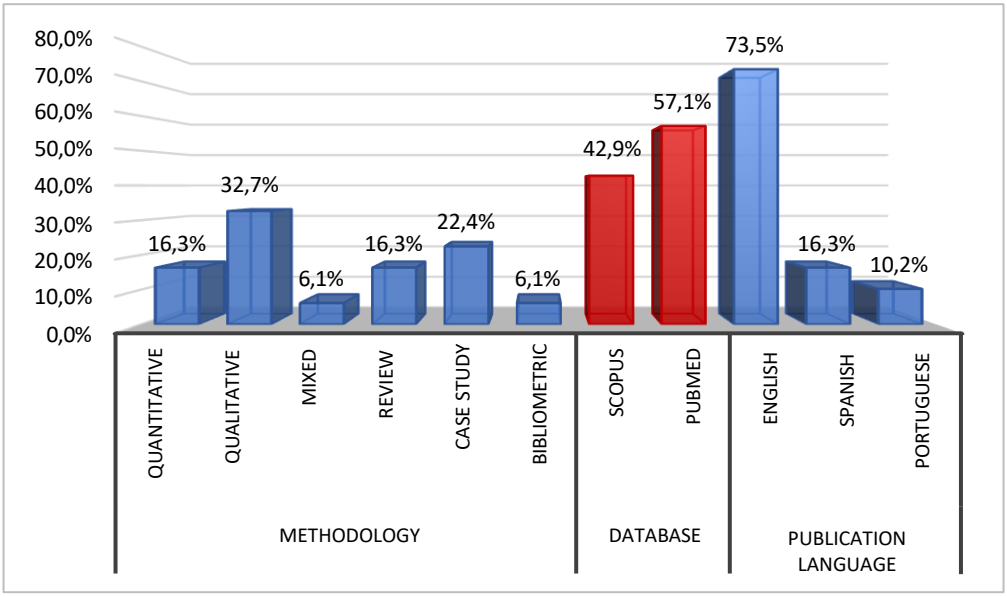
As shown in Figure 2, studies examining the potential link between prolonged anabolic steroid use and prostate cancer employ diverse methodologies. Qualitative approaches (32.7%) and case studies (22.4%) predominate, reflecting a greater emphasis on personal accounts or clinical observations than on statistical analyses. Quantitative studies represent only 16.3% of the total, confirming the scarcity of robust empirical evidence for drawing definitive conclusions. Bibliometric analyses (6.1%) and systematic reviews (16.3%) further reinforce the notion that this remains a relatively nascent field with still-fragmented evidence.

Regarding article provenance, the majority originate from established databases such as SCOPUS (42.9%) and PubMed (57.1%), lending credibility to the identified literature. However, this also suggests that countries with greater representation in these platforms exert a more significant influence on knowledge trends in this area.

With respect to publication language, English predominates (73.5%), facilitating international dissemination of findings. Nevertheless, the presence of articles in Portuguese (10.2%) and Spanish (16.3%) reflects growing interest in Lusophone and Hispanophone regions.

Collectively, the available evidence on methodologies, sources, and publication languages indicates that despite the abundance of research on steroids, there remains insufficient conclusive evidence to affirm a relationship between prolonged use and increased prostate cancer risk. This underscores the need for larger-scale, more rigorous quantitative studies to enable more robust conclusions.

Figure 2
Article distribution by methodology, database, and language.



Between 2007 and 2025, scientific production on this relationship has shown relatively consistent interest. In 2007, 2008, 2010, and 2018, annual production represented 10.2% per year (Figure 3). The years 2020 (14.3%) and 2022 (12.2%) stand out with notable publication peaks, reflecting renewed interest in the topic. Despite observed fluctuations —as in 2021, 2025, and 2009— the overall trend is upward.

Figure 3
Article publication by year.

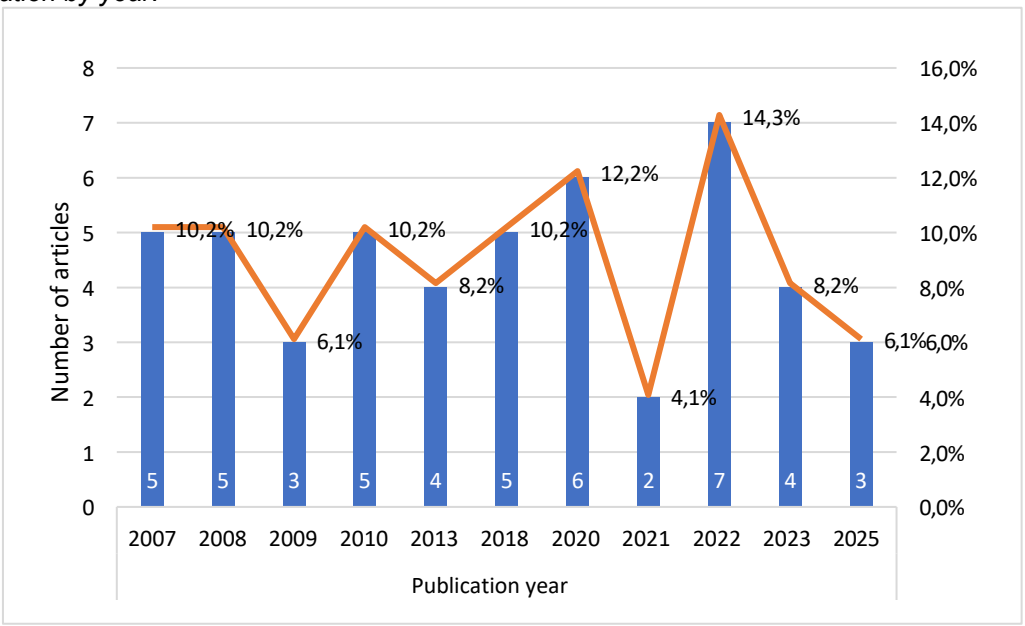
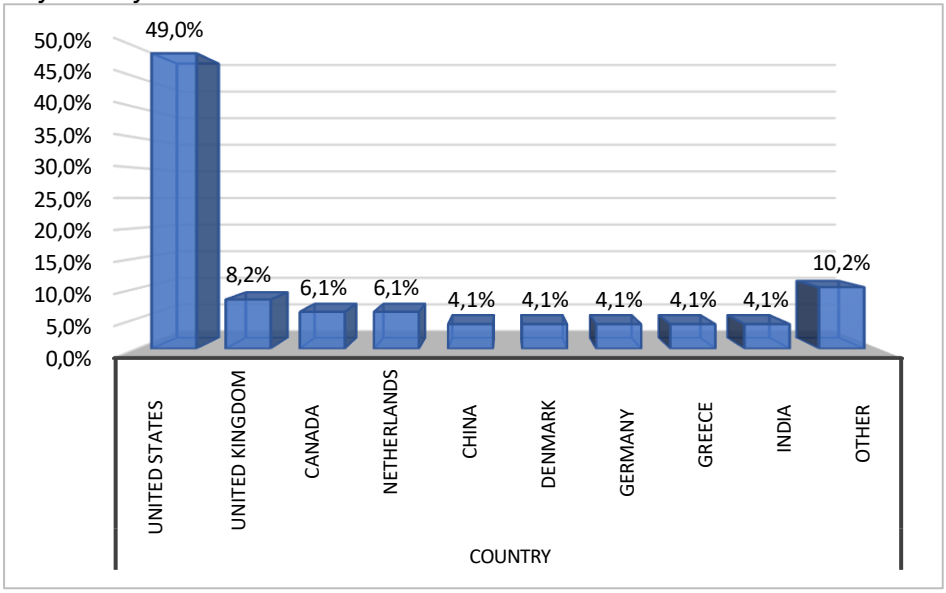


Figure 4 shows that the United States accounts for 49.0% of studies, followed by the United Kingdom (8.2%), Canada (6.2%), and the Netherlands (6.1%). Countries such as India, Greece, China, Denmark, and Germany each contribute 4.1%, while the remaining 10.2% is grouped under "Other." Although production is dominated by a few nations, the interest is global.

Figure 4
Article publication by country.



In this context, Table 3 synthesizes evidence indicating that, in the short to medium term, androgen use does not appear to significantly increase cancer risk in men, particularly prostate cancer. However, small sample sizes and limited follow-up periods make it difficult to rule out long-term risks, underscoring the importance of monitoring these compounds.

Conversely, it is well documented that anabolic-androgenic steroids (AAS) produce multisystemic adverse effects —cardiovascular, hepatic, renal, endocrine, behavioral, and psychological— some of which may be permanent and severely impact quality of life.

In summary, the current literature supports the need for awareness campaigns, medical monitoring, sales regulations, and support programs to mitigate the risks associated with AAS use.

Table 3 *Matrix of relevant studies*

Authors/Year	Objective	Method	Conclusions
Wirén et al. (2007)	To evaluate the association between plasma androgens and prostate cancer risk.	Prospective cohort study: 392 cases and 392 matched controls from a non-screened population.	None of the hormones examined (total or free testosterone, A-diol-G, or SHBG) showed a significant association with prostate cancer risk.
Hernández et al. (2017)	To analyze the adverse effects arising from anabolic–androgenic steroid use in athletes.	Literature review.	Multiple adverse effects are documented across cardiovascular, psychological, hepatic, reproductive, neurocognitive, genetic, and musculoskeletal domains, many of which are irreversible. The authors emphasize that such use constitutes a public health concern and call for further research to deepen understanding of the issue.

Rodríguez et al. (2020)	To examine the medical repercussions of the indiscriminate use of anabolic–androgenic steroids for athletic performance enhancement.	Narrative literature review covering anabolic–androgenic steroids (AAS), their effects, physiological profiles, mechanisms, and clinical risks.	Indiscriminate AAS use represents a global public health problem. Numerous clinical adverse effects are documented (cardiovascular, hepatic, renal, endocrine, among others). These substances impose a substantial burden on healthcare systems and also carry negative consequences within the sporting domain.
Barbosa et al. (2024)	To review the adverse effects of the anabolic steroid Anadrol on multiple human body systems, along with associated risks and prevention strategies.	Integrative literature review.	Prolonged and indiscriminate use of AAS is associated with lipid profile alterations, myocardial hypertrophy, reduced cardiac function, increased risk of atherosclerosis, myocardial infarction, sudden cardiac death, and damage to multiple organs. The authors stress the need for prevention and medical supervision to mitigate these risks.
Castillo et al. (2019)	To propose an evidence-based legislative initiative to regulate the prescription and sale of anabolic–androgenic steroids (AAS).	Descriptive cross-sectional study.	The study found that 25% of gym users in Xalapa consume AAS, primarily for aesthetic reasons and without medical oversight. In light of the lack of regulation and the associated health risks, the authors propose amending the General Health Law to control prescription and sale, alongside the implementation of preventive and educational campaigns.
Nunes et al. (2024)	To analyze the impact of indiscriminate AAS use for body performance purposes and to clarify alterations in multiple organs, behavior, and quality of life.	Integrative literature review across PubMed, UpToDate, ScientiaMedica, and archives of the Brazilian Society of Endocrinology and Metabolism.	Indiscriminate AAS use for aesthetic or performance goals is associated with multiple adverse effects, including alterations in various organs, elevated health risks, and reduced quality of life. Greater regulation, education, and medical supervision are needed.
Leite et al. (2024)	To investigate AAS use and its potential adverse effects among physically active individuals and athletes.	Mixed-methods study with descriptive data analysis.	Approximately 36.73% of participants reported AAS use, with higher prevalence among men. Adverse effects (e.g., mood disturbances, hair loss) emerged rapidly. Although users were aware of the risks, this awareness did not deter many from using or considering use.

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Ríos & González (2025)	To analyze AAS use as a "shortcut" to achieving an ideal physique within the context of gym culture and social media, and to expose the associated health risks.	Review/reflection piece.	The use of AAS as a shortcut to an ideal physique poses a serious health risk, driven by unrealistic expectations promoted in gym and social media environments. The authors advocate for educational and preventive efforts to counter such behaviors.
Heerfordt et al. (2025)	To investigate cancer incidence rates (particularly prostate and breast cancer) in male androgen users compared with a control group.	Mixed-methods study with descriptive data analysis.	Male androgen users did not show increased cancer incidence during the follow-up period, with risks similar to those of the general population. However, given the small number of cases, the participants' young age, and limited follow-up duration, a potential long-term risk cannot be ruled out.

The review of the research reveals conflicting and limited evidence regarding the impact of long-term anabolic steroid use on prostate cancer risk. Heerfordt et al. (2025) conducted a Danish cohort study comparing androgen users with controls over an average follow-up of eleven years. The results indicated that no prostate cancer was found in the user group, whereas cases did occur in the control group; however, there was no statistically significant increase in risk based on incidence rates. This study was limited by its youthful age distribution, short follow-up period (which may have missed later-onset prostate tumors), and inadequate sample size (which could have overlooked rare changes).

Complementing these findings, the prospective study by Wiren et al. (2007) also demonstrates a link between higher androgen levels and prostate cancer, establishing a firm precedent for the oncological risks of prolonged AAS exposure. Although Wiren's research supports epidemiological findings, its geographically confined population and exclusive focus on the prostate limit its applicability to understanding the systemic effects of AAS.

In this context, the literature review by Barbosa et al. (2024) focuses on the far-reaching effects of anabolic steroids. The authors detail changes in the cardiovascular system, liver, metabolism, and mental health, along with strategies to mitigate these consequences. Through this comprehensive approach, it becomes evident that AAS impact overall well-being beyond cancer predisposition. Similarly, Nunes et al. (2024) and Leite et al. (2024) investigate athletes, documenting negative impacts on hormonal function, musculoskeletal integrity, and psychological flourishing. Although these studies are more specific and based on clinical observations, they nevertheless provide concrete evidence of the risks these substances pose to vulnerable populations, particularly athletes and young people.

In contrast, Hernández et al. (2017) and Rodríguez et al. (2020) have compiled data on the adverse consequences of AAS in athletics, highlighting changes in hormone levels, cardiovascular health, and mental health. Their review emphasizes the importance of considering the multidimensional nature of risks, including social and physiological aspects. Castillo et al. (2019) present the regulatory perspective, highlighting how accessibility and lack of oversight in AAS prescriptions contribute to their misuse. This regulatory strategy, which complements clinical data, suggests that prevention requires not only medical monitoring but also effective regulatory frameworks.

Ríos and González (2025) discuss the sociological dimensions of steroid use, noting that anabolic steroids are marketed as "shortcuts" to the perfect body, leading to increased consumption among athletes and youth. According to their findings, one of the most important ways to curb reckless use is through heightened public awareness and education. This perspective offers a comprehensive view of the diverse factors sustaining AAS risk by integrating regulatory and clinical evidence.

Thus, AAS represent a multifaceted and complex threat. Clinical and observational assessments show immediate systemic effects in athletes, while prospective and cohort studies provide robust evidence of long-term dangers, particularly carcinogenic implications. Addressing this problem successfully requires integrating education and regulation. This demonstrates that a multidisciplinary strategy involving health, sports, and policy is necessary to prevent the dangers associated with AAS.

In synthesis, although many research gaps remain, the current evidence suggests that long-term anabolic steroid use may not carry a particularly high risk of prostate cancer. To better understand the potential effects of various steroids and their metabolites on prostate carcinogenesis, large-scale cohort studies tracking AAS users over extended periods and robust in-depth investigations are needed. Therefore, although AAS have not been demonstrated to cause negative health impacts, it remains prudent to exercise caution in their use.

Conclusions

The literature review demonstrates that although studies on the potential relationship between prolonged anabolic steroid use and prostate cancer have increased in recent years, the available evidence remains limited. The scarcity of robust quantitative studies and the predominance of qualitative designs or case studies hinder the establishment of firm conclusions regarding the association between steroid use and prostate cancer risk. Nonetheless, scientific production has shown an upward trend, with concentrated but globally distributed interest, led primarily by the United States, followed by countries such as Canada, the Netherlands, and the United Kingdom.

Although current data suggest that androgen use does not substantially increase prostate cancer risk in the short to medium term, methodological limitations —particularly small sample sizes and reduced follow-up periods— preclude ruling out potential long-term risks. Concurrently, it is extensively documented that anabolic-androgenic steroids produce harmful effects across multiple body systems and may cause permanent sequelae compromising physical and mental well-being.

Consequently, from the perspective of public health and preventive medicine, the absence of conclusive evidence should not be interpreted as evidence of absence of risk. Rather, there is a pressing need to develop large-scale longitudinal studies, strengthen regulations governing AAS access and use, and implement educational, monitoring, and supervisory programs that protect consumer health and safety.

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