https://doi.org/10.47822/bn.v12i2.498
ISSN 2526-6349 *On-line version*
ISSN 2175-1943 *Print version*

Review article

Use of anabolic steroids in physical exercise: a systematic review

Uso de esteroides anabolizantes no exercício físico: uma revisão sistemática

Rander Rafael Silva e Victor[1], Pedro Henrique Oliveira Gomes[1] e Marcelo José da Silva de Magalhães[1,2,3].

[1]*University Center of Northern Minas, Montes Claros-MG, Brazil.*
[2]*Department of Neurosurgery of the Hospital Aroldo Tourinho, Montes Claros-MG, Brazil.*
[3]*Department of Neurosurgery of the Hospital Vila da Serra, Nova Lima-MG, Brazil.*

Resumo

Objetivo: descrever os principaisefeitos anabólicos e colaterais provenientes do uso de esteroides anabolizantes (EA) nos praticantes de exercício físico. **Materiais e Métodos:** trata-se de uma revisão sistemática. A identificação dos trabalhos científicos foi realizada a partir dos seguintesdescritores: agentes anabolizantes, testosterona, exercício físico, efeito adverso.Também foram pesquisados esses termos nos idiomas inglês e espanhol. O processo de seleção excluiu artigos duplicados, a partir da leitura dos títulos e resumos. Após a seleção, no processo de elegibilidade foram excluídos artigos com problema no desenho, no seguimento e intervenção inadequada. Assim, foram selecionados apenas artigos que passaram no processo de análise qualitativa, se for esse o caso. **Resultados:** dentre 125 artigos identificados, apenas 14 artigos foram selecionados, somando-se 26131 indivíduosenvolvidos nos estudos. A maior parte dos estudos foi do tipo transversal cujos dados foram obtidos por meio da aplicação de questionários. O uso de EA variou entre 2,3% e 31% do público estudado. Nota-se ampla predominância do sexo masculino, representando 87% dos casos. O uso de EA predominou entre pessoas com idade entre 20 a 29 anos (42,8%), com ensinomédio completo (46,7%) e mais de três anos na prática de musculação (44,1%). A acne foi identificada em 42,9% e 63,4% dos usuários, oscilação na libido entre 14,3%, e 48,7% disfunção sexual 24,6%, variações de humor em até 42,8% dos usuários. Entre os EAs mais utilizados, destacara-se Deca Durabolin®, Hemogenin®, Testosteron®, Estanozolol® e Durateston®. **Conclusão:**a prevalência do uso de EAs é maior entre pessoas de 20 a 29 anos com ensino médio completo e com mais de 3 anos na prática de musculação. Dentre os efeitos colaterais, identificou-se a acne, oscilação na libido, com usuários declarando um aumento no desejo sexual.
Palavras-chave: Esteroides anabolizantes. Testosterona. Exercício Físico.

Abstract

Objective: to describe the main anabolic and side effects resulting from the use of anabolic steroids (AS) in physical exercise practitioners. **Materials and Methods:** this is a systematic review. Scientific articles were identified using the following descriptors: anabolic agents, testosterone, physical exercise, adverse effects. These terms were also searched in English and Spanish languages. The selection process excluded duplicate articles based on title and abstract reading. After the selection, articles with design problems, inadequate follow-up, and intervention were excluded in the eligibility process. Thus, only articles that passed the qualitative analysis process, if applicable, were selected. **Results:** among 125 identified articles, only 14 articles were selected, totaling 26,131 individuals involved in the studies. The majority of the studies were cross-sectional, obtaining data through questionnaire application. AS use ranged from 2.3% to 31% of the studied population. A significant predominance of males was observed, representing 87% of the cases. AS use was most prevalent among individuals aged 20 to 29 (42.8%), with completed high school education (46.7%), and more than three years of weight lifting practice (44.1%). Acne was identified in 42.9% and 63.4% of users, libido fluctuations in 14.3%, and sexual dysfunction in 24.6%, mood swings in up to 42.8% of users. Among the most used AS, DecaDurabolin®, Hemogenin®, Testosterone®, Stanozolol®, and Durateston® stood out. **Conclusion:** it was evident that the prevalence of AS use is higher among individuals aged 20 to 29 with completed high school education and more than 3 years of weight lifting practice. Among the identified side effects were acne, libido fluctuations, with users reporting an increase in sexual desire.
Key-words: Anabolic steroid. Testosterone. Exercise.

Corresponding author: Marcelo José da Silva de Magalhães | marcelo7779@yahoo.com.br
Received in: 09|20|2022. **Approved in:** 10|30|2023. **How to cite this article:** Victor RRS, Gomes PHO, Magalhães MJS. Use of anabolic steroids in physical exercise: a systematic review. Revista Bionorte. 2023 jul-dec; 12(2):468-79. https://doi.org/10.47822/bn.v12i2.498

Introduction

Anabolic steroids (AS) are synthetic substances that simulate the effects of androgenic hormones, being derived mainly from testosterone[1]. Initially, these drugs were produced for therapeutic purposes, such as for the treatment of large burns, patients recovering from major surgeries or with muscular atrophies[2,3]. However, because it also has anabolic effects by stimulating increase in muscle protein synthesis, AS attracted interests of groups practicing physical exercise, especially bodybuilding, since, because they are substances of ergogenic character, improve the performance and results of practitioners of high intensity physical exercises, when used in supraphysiological doses[1].

The search for the "perfect body", linked to the popularization of bodybuilding academies and the influence of the media on the need to fit the standards of beauty, caused the demand for AS to increase exponentially, especially in the young population, in the XXI Century[2,4,5]. Consequently, there was also an increase in side effects generated by these substances, since the vast majority of its users do it incorrectly and without specialized professional monitoring, which generates more harm than the benefits expected[2].

Because it is a drug that generates a dose-dependent effect, many AS users use it in supraphysiological doses for greater gain in strength and muscle mass. However, not only will the beneficial effects of the medication increase, but also its side effects. Among the most common, we highlight gynecomastia, sexual impotence, hypogonadism, altered libido, acne, alopecia, systemic arterial hypertension, left ventricular hypertrophy, hepatopathies, and increased risk for various types of cancer and psychiatric changes, as mood swings and increased aggressiveness[2]. Other symptoms have also been described, such as hoarseness and hypetricosis[6]. In rats, there is evidence that the use of AS can cause systemic hepatic and renal changes, however without an influence on hematological function in bone marrow[5,7].

The use of AS leads to a set of favorable adaptations to gain strength and muscle mass, as they stimulate the increase of androgenic receptors, generating a greater interaction of the hormone-receptor complex[1]. This complex for the cell nucleus binds in specific DNA sequences, stimulating the synthesis of RNA polymerase with messenger RNA formation, initiating protein synthesis as a consequence of this reaction[1].

However, it is important to note that patients using supraphysiological doses of AS tend to inhibit the hypothalamic-pituitary-gonadal axis (HPG), making levels of luteinizing hormones (LH) and follicle stimulating hormone (FSH) extremely low, in addition to endogenous testosterone. This is due to the physiology of testosterone production, which has about 95% of its synthesis performed

from the Leydig cells present in the testes. Its secretion initially depends on the hypothalamus for the production of gonadotropin-releasing hormone (GnRH), which stimulates adenohypophysis to produce LH and FSH, which act on the testes inducing differentiation and maturation of Leydig cells and consequent, production of testosterona[1]. When testosterone levels are high, their production tends to be decreased by negative feedback on the HPG axis, by reducing the production of LH and FSH, generating much of the side effects of these substances[2].

This study aims to describe the main anabolic effects from the use of anabolic steroids in physical exercise practitioners and check the adverse effects caused by anabolic steroids.

Materials and Methods

The type of research used was a systematic review and used articles searched in the databases Scielo, PubMed, Virtual Health Library, LILACS, SCOPUS, GOOGLE, Embase, Web of Science, Open Grey. The identification of scientific papers was carried out by means of research of the following terms: anabolic agents, testosterone, physical exercise, adverse effect. For the search in the English language, we used: anabolic agents, testosterone, exercise, adverse effects. For the search in the Spanish language, it was used: *agents*, *testosterone*, exercise, adverse effects.

The guiding question defined was: what is the prevalence of the use of AS among practitioners of physical exercise and what are the most identified side effects?

The population studied in this review was the group of individuals practicing physical exercise. The intervention group was characterized by the group that uses AS and practices physical exercise. The control group was the group of individuals who did not use AS and practice physical exercise. In the outcome, we considered the adverse effects identified in the use of AS in the group, as well as the prevalence of its use.

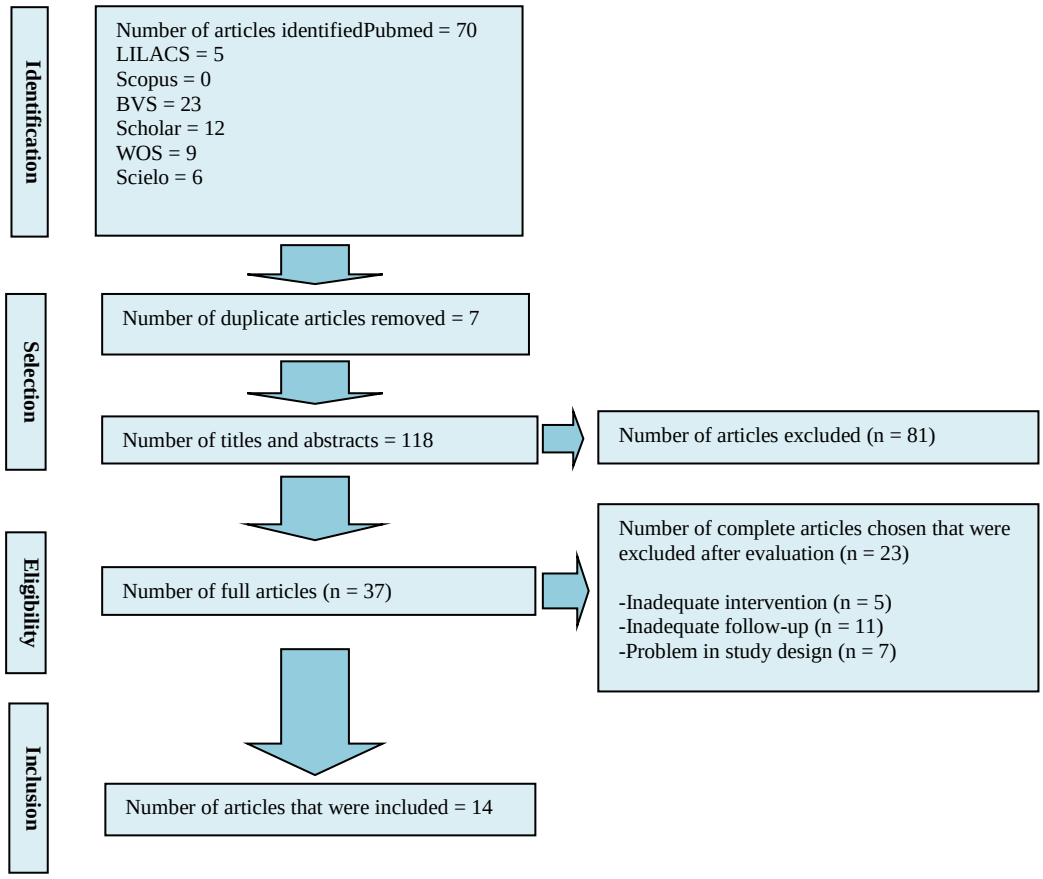
Two researchers independently searched the articles in the aforementioned databases, and subsequently a third researcher evaluated which articles were selected simultaneously by the other two researchers, based on the pre-defined criteria established. After the identification of the articles in the databases, the selection was made from the reading of the titles and abstracts of the works, and those that were duplicated were removed.

After searching through the aforementioned descriptors, 125 articles were identified in the databases PUBMED, Scielo, BVS, LILACS and Web of Science. After reading the titles and abstracts, 7 duplicate articles were removed and 81 were excluded because they did not meet the inclusion criteria. After reading the articles in full, 23 articles were excluded because they had

methodological problems in the follow-up, intervention or study design. Finally, 14 studies were included in this systematic review.

Figure 1 shows the follow-up of the selection in order to obtain the necessary inputs for the purpose of this review.

Figure 1. Flowchart of the process of screening articles for review.



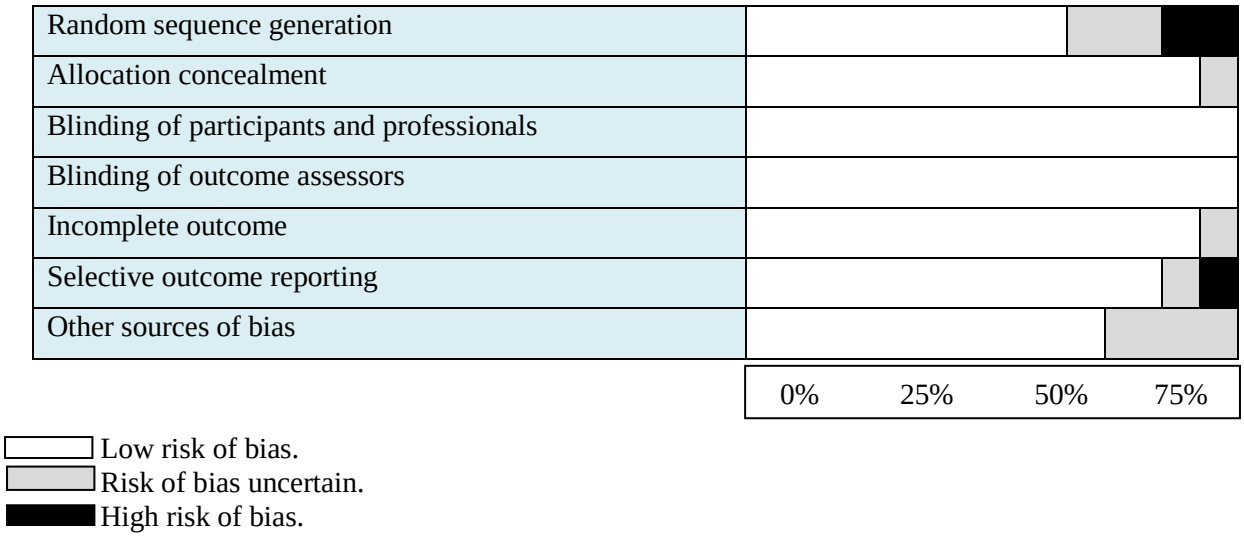
After selection, the risk of bias of the articles was assessed with the help of the RevMan analysis tool (Chart 1 and Figure 2)[8]. For greater assertiveness, the evaluation was made individually by the two authors who, through a consensus meeting, aligned the divergences.

Chart 1. Summary of the risk of bias of the articles selected for the preparation of the systematic review on the use of anabolic steroids in physical exercise.

Assessed bias	Venâncio et al (2010)	Severo et al (2011)	Porello et al (2017)	Pereira et al (2019)	Parkinson, Evans (2015)	Oliveira, Neto (2018)	Nogueira et al (2018)	Montanher et al (2015)	Luijkx et al (2011)	Leite et al (2020)	Hauger et al (2011)	Hakansson et al (2002)	Araújo et al (2002)	Abrahin et al (2013)
Random sequence generation	+	-	?	+	+	-	+	?	+	+	+	+	+	?
Allocation Concealment	+	+	+	+	+	+	+	+	+	?	+	+	+	+
Blinding of participants and professionals	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Blinding of outcome assessors	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Incomplete outcome	+	+	+	+	?	+	+	+	+	+	+	+	+	+
Selective outcome reporting	+	-	+	+	?	+	+	+	+	+	+	+	+	+
Other sources of bias	+	?	?	+	+	+	+	?	+	+	+	+	+	?

Source: https://training.cochrane.org/online-learning/core-software/revman

Figure 2. Graph of the risk of bias of the articles selected for the preparation of the systematic review on the use of anabolic steroids in physical exercise.



Source: https://training.cochrane.org/online-learning/core-software/revman

Results

The main information about the selected articles is summarized in Chart 2. In addition, studies were found that report psychological changes generated by the use of AS, such as irritability, aggressiveness, impulsiveness and low empathy, as well as cardiovascular problems.

Chart 2. Studies used to prepare the systematic review on the use of anabolic steroids in physical exercise.

Year/author	Objective	Methodology	N	Results
Araújo *et al.*, 2002[15]	Evaluate the use of supplements and anabolic in bodybuilders of gyms in Goiânia.	Cross-sectional study using a questionnaire	183	24% of respondents consumed creatine and 21% Deca-Durabolin®. 74% of the substance consumption occurred in individuals aged between 18 and 26 and average level of education (66%).
Parkinson *et al.*, 2005[11]	Identify consumption habits of AAS.	Cross-sectional study using a questionnaire	500	Most consumers of AAS were non-competitive bodybuilders and not athletes. Most respondents self-administered injectable drugs. 13% used to reuse needles and share bottles and needles.
Venâncio *et al.*, 2010[16]	Evaluate the laboratory profile of 61 volunteer users and non-users of AAS.	Experimental cross-sectional study	61	Increased level of creatine quinasse in groups that exercised in a resisted manner. Reduction of LH, FSH and estradiol elevation of the AAS user group.
Luijkx *et al.*, 2011[13]	To evaluate the effect of resistance training and the use of AAS in cardiac function by means of Magnetic Resonance	Cross-sectional study	156	Endurance sports athletes who used AAS had significantly higher heart ventricular muscle volumes and masses than endurance sports and sedentary athletes who did not use AAS.
Severo *et al.*, 2011[14]	Evaluate blood markers of atherosclerosis between users and non-users of AAS	Cross-sectional study	22	Users of AAS had the following characteristics: greater body weight, blood pressure, platelet count and C-reactive protein, lower level of HDL-cholesterol and suppressed level of follicle stimulating hormones.
Hakansson *et al.*, 2011[9]	Analyze use of AAS on male population in general from Sweden	Cross-sectional study using a questionnaire	14647	The use of AAS was associated with: use of illicit drugs, misuse of prescribed drugs, physical training and lower education.
Abrahin *et al.*, 2013[2]	To analyze the prevalence of the use and knowledge of AAS by students and physical education teachers in Belém-Brasil	Cross-sectional study using a questionnaire	117	Approximately one third of the participants reported using AAS. The average age of the participants in the study was approximately 28 years. The most used drugs were: Durateston®, Deca-Durabolin® and Oxandrolone/Winstrol®. The effects described were: acne, thickening of the voice and aggressiveness.
Nogueira *et al.*, 2015[17]	Investigate prevalence the use of Food	Cross-sectional study using a	510	A quarter of the interviewees used AAS and half of the participants used FS. The

	Supplements (FSs) and AAS. among bodybuilders in the city by João Pessoa.	questionnaire		users were mostly men, young, with little education and who had been training for more than four years, five times a week.
Porello *et al.*, 2017[18]	To evaluate the acute response of muscular sympathetic nerve activity, blood flow of the forearm, blood pressure among users and non-users of AAS.	Experimental cross-sectional study	57	The responses are of blood flow of the forearm and acute response of the muscular sympathetic nerve activity during the exercise were similar between the two groups. During mental stress, the AAS user group showed the acute muscle sympathetic nerve activity significantly higher.
Oliveira *et al.*, 2018[10]	Identify the frequency and epidemiological profile use of AAS by bodybuilders.	Cross-sectional study using a questionnaire	100	It was evidenced a risk about twice as high for the use of anabolic steroids among subjects with one year of bodybuilding.
Montanher, 2018[19]	Analyze appreciation of the use of AAS among practitioners of physical activity in academies of Presidente Prudente - Brazil	Cross-sectional study using a questionnaire	120	It is noted that 10% make use of AAS, 22.5% thermogenic and 44.2% dietary supplements, understandability for males. The use of AAS was more frequent among young and male students.
Pereira *et al.*, 2019[20]	To verify the prevalence and profile of AAS users among resistance training practitioners.	Cross-sectional study using a questionnaire	5773	It was noted that 9.1% made use of AAS, 3.4% use and 4.3% intended to use. There was a redominion of use among men, food between 30 and 44 years. Beginners were not interested in using AAS, however individuals who trained longer had higher prevalence of FS use.
Leite *et al.*, 2020[21]	To identify the factors associated with the use of AAS by practitioners of physical exercises in gyms in São Luís - Brazil	Cross-sectional study using a questionnaire	723	1/10 of the interviewees reported having used AAS. Of these, 97.4% reported having knowledge of adverse somethings caused by its use. The use of AAS was associated with the male sex, being aged between 20 and 29 years, consuming dietary supplements and practicing physical activity for more than a year.
Hauger *et al.*, 2021[22]	To evaluate factors related to aggression and interpersonal violence, such as personality traits, substance use and dysfunctional behavioral regulation.	Cross-sectional study using a questionnaire	139	The results show that AAS dependents reported significantly higher levels of aggressiveness compared to those not dependent on AAS.

Source: Elaborated by the authors. AAS: Anabolic Androgenic Steroids.

Of the selected studies, 78.5% worked with the cross-sectional design methodology, obtaining the data through the application of questionnaires. The others were studies with clinical analysis. Altogether, 26,131 people were part of the studies selected in this study, and the research with the largest study group contained 14,647 patients[9]. Regarding the occurrence of side effects, acne[10,11], changes in libid[2,12], psychological dysfunctions[26] and cardiovascular problemspredominated[13,14].

Discussion

Anabolic steroids have been developed for therapeutic purposes, but in recent years these substances have been used, especially in sports, in order to improve physical fitness, since they possess reduced androgenic effect and great anabolic property.

Therefore, it is important to note that there are consequences in the body resulting from the use of anabolic steroids, such as liver problems, acute or chronic, cardiovascular diseases and allergic effects, and the effect of these substances is dependent on each organism, varying according to factors such as dosage, type of use (injectable, oral and transdermal patch) age, sex, and others[1]. Nogueira *et al.*[17] also mention an even more worrying group, individuals who report consumption of steroids for veterinary use, representing a percentage of 2.3% of the studied public, when compared to those found by Araújo *et al.*[15] in academies of Goiânia (GO), where 31% of AS users claimed the use of these substances.

Regarding the characteristics of the groups studied, there is a predominance of males, representing 87% (23,108) of the total participants, while women, 13% (3,023), which empirically may seem to reflect the reality in the steroid use scenario, however, studies, such as Oliveira *et al.*[10], attest that women who are inserted in the middle of bodybuilding have increasingly resorted to the use of substances that are commonly linked only to the male public. The aforementioned study found that of the members, 52.2% of women were or had already used anabolic steroids, a more significant number than men in the same situation (47.8%).

Still on the profile of the studied, it was evidenced that the prevalence of the use of AS is higher among people from 20 to 29 years (42.8%) with complete high school education (46.7%) and more than three years in the practice of bodybuilding (44.1%). Hauger *et al.*[22] associate, in their study, the dependence of steroids with the use of narcotic substances, such as opioids, cannabis and cocaine, pointing out that the use of these substances frequently increases about 97% among steroid users who self-declared dependent in relation to the non-dependent. It is noteworthy that the majority of steroid use occurs through self-prescription (41.3%), as demonstrated by Leite *et al.*[22] and in almost all cases (97.8%) without medical accompaniment10.

Therefore, the incidence of effects collaterals is, in its majority, a consequence of the imprudent use of AS that, due to its toxic and androgenic properties, can cause the most diverse disorders in the body, from dermatological to cardiovascular problems.

Oliveira, Neto[10] and Parkinson, Evans[11]cite acne as one of the predominant side effects related to steroid use with 42.9% and 63.4% incidence, respectively. There is also an oscillation in libido, with users declaring an increase in sexual desire (14.3%) while others manifest some degree of sexual dysfunction (24.6%), a factor that is mainly due to the increase in testosterone levels in the body at the beginning of anabolic administration, which at first generates a positive change in libido, but to reach a certain level, the body tends to inhibit the production of this hormone, leading to a considerable decrease in sexual performance[16]. Arahant *et al.*[2] show similar results with 48.7% of participants reporting loss of libido versus 32.4% who claim improved libido.

Hauger *et al.*[22] addresses psychological changes generated by the use of AE, such as irritability, aggressiveness, impulsiveness and low empathy. The study shows that at least 6 out of 10 users self-reported as steroid addicts have some kind of psychological alteration. Parkinson and Evans[11] are against this scenario, showing that 42.8% of the users evaluated presented mood swings during the use of steroids. Oliveira *et al.*[10] have a divergent result, with only 3.6% of psychological changes reported.

Luijkx *et al.*[13] and Severo *et al.*[14] emphasize cardiovascular problems that can be caused by the use of AS, such as endothelial and ventricular dysfunction, in addition to increased blood pressure levels. Both studies indicate that steroid users have significantly different cardiac dimensions than people who do not practice bodybuilding and even athletes who do not use anabolic steroids.

According to Araújo *et al.*[15], the most used anabolic are Deca-Durabolin®, Hemogenin® and Testosteron®, present in the report of 66% of the individuals in the studied group. There is a convergence with the data indicated by Nogueira *et al.*[17]com 81.1% and Oliveira *et al.*[10]which recorded a percentage of 79.2%, also showing the use of steroids, such as Estanozolol® (6.5%) and Durateston® (6.5%). Among the names mentioned above, only the Hemogenin® appears as an option of use entirely oral, and the Estanozolol® found in oral formulation and injectable the others, injectable.

Among the objectives pursued by steroid users, hypertrophy for aesthetic purposes stands out, pointed out as the main motivation, with an average of 79.4% of the individuals questioned[2,10,15,20], which refers to the existence of an ideal body concept engendered by society, stimulating an incessant yearning for perfection, which ultimately leads some people to use these ergogenic resources.

It is important to point out that studies of this kind have a limitation regarding the collection of data related to the number of users of AS, since its use, is in its majority, off label and which may

cause some individuals to feel intimidated in reporting the consumption of such substances, a factor minimized by the anonymity characteristic present in most articles, but which, nevertheless, should be considered. In addition, the generation of random group sequences in most selected studies (71.4%) occurred in similar environments, prevailing gyms and sports training center, which can be understood as a form of bias.

Conclusion

It was evidenced that the prevalence of AS use varied among the studies investigated, with a higher frequency in the age group between 20 and 29, with complete high school education and with more than three years of bodybuilding practice. Among the side effects of AS use, acne, cardiac changes, mood changes and oscillation in libido were identified.

Author's contribution

The authors approved the final version of the manuscript and declared themselves responsible for all aspects of the work, including ensuring its accuracy and completeness.

Conflict of interest

The authors declare no conflicts of interest.

References

1. Boff SR. Esteróides anabólicos e exercício: Ação e efeitoscolaterais. R. Bras. Ci. eMov 2010;18(1):81-88. Available from: https://portalrevistas.ucb.br/index.php/RBCM/article/view/1316

2. Abrahin OSC, Sousa EC. Esteroides anabolizantes androgênicos e seusefeitoscolaterais: umarevisão crítico-científica. Revista de educação física. 2013;24(4): 669-679.Availablefrom: https://doi.org/10.4025/reveducfis.v24.4.17580

3. Rocha FL, Roque FR, Oliveira EM. Esteróides anabolizantes: mecanismos de ação e efeitos sobre o sistema cardiovascular. O mundo da saúde, São Paulo. 2007;31(4).Availablefrom: https://bvsms.saude.gov.br/bvs/periodicos/mundo_saude_artigos/esteroides.pdf

4. American College of Sports Medicine. PosicionamentoOficial - O uso de esteroidesanabolizantesnosesportes. 1998; 4(1): 31-36. Available from: https://doi.org/10.1590/S1517-86921998000100010.

5. Cecchetto F, Moraes DR, Farias PS. Distintos enfoques sobre esteroides anabolizantes: riscos para a saúde e hipermasculinidade. Interface - Comunic. Saude Educ. 2012;16(41):369-82. Available from: https://doi.org/10.1590/S1414-32832012005000008

6. Machado EP, Fraga AB. Anabolizantes nagraduação em educação física: um dilema ético-sanitário entre estudantes que praticam fisiculturismo. Revista de educação física. 2020; 31:e3166. Availablefrom:https://doi.org/10.4025/jphyseduc.v31i1.3166

7. Martins DB, Lopes STA, Oliveira LZ,Maciel RM, Lancini AR, Olsson*etal*.Decanoato de nandrolona no hemograma e nas células mononucleares da medula óssea de ratos Wistarhígidos. Ciência Rural. 2010;40(1)95-101. Available from: https://doi.org/10.1590/S0103-84782010000100016

8. Review Manager (RevMan). Available from: https://training.cochrane.org/online-learning/core-software/revman

9. Hakansson A, Mickelsson K, Wallin C, Berglund M. Anabolic Androgenic Steroids in the General Population: User Characteristics and Associations with Substance Use. European Addiction Research. 2012;18(2):83-90. Available from: https://doi.org/10.1159/000333037

10. Oliveira LL, CavalcanteNeto JL. Fatores sociodemográficos, perfil dos usuários e motivação para o uso de esteroides anabolizantes entre jovens adultos. Revista Brasileira de Ciências do Esporte.2018 jul;40(3):309-17. Availablefrom: https://doi.org/10.1016/j.rbce.2018.03.015

11. Parkinson AB, Evans NA. Anabolic Androgenic Steroids. Medicine & Science in Sports & Exercise.2006 abr;38(4):644-51. Available from: https://journals.lww.com/acsm-msse/Fulltext/2006/04000/Anabolic_Androgenic_Steroids__A_Survey_of_500.6.aspx

12. Venâncio DP, Nobrega ACL, Tufik S, Mello MT.Avaliaçãodescritiva sobre o uso de esteroides anabolizantes e seuefeito sobre as variáveis bioquímicas e neuroendócrinas em indivíduos que praticamexercício resistido. Revista Brasileira de Medicina do Esporte. 2010; 16(3): 191-195. Availablefrom: https://doi.org/10.1590/S1517-86922010000300007

13. Luijkx T, Velthuis BK, Backx FJ, Buckens CF, Prakken NH, Rienks R, Mali WP, Cramer MJ. Anabolic androgenic steroid use is associated with ventricular dysfunction on cardiac MRI in strength trained athletes. International Journal of Cardiology. 2013;167(3):664-8. Available from: https://doi.org/10.1016/j.ijcard.2012.03.072

14. Severo CB, Ribeiro JP, Umpierre D, Da Silveira AD, Padilha MC, De Aquino Neto FR, Stein R. Increased atherothrombotic markers and endothelial dysfunction in steroid users. European Journal of Preventive Cardiology.2013 Abr; 20(2):195-201. Available from: https://pubmed.ncbi.nlm.nih.gov/22345686/

15. Araujo LR, Andreolo J, Silva MS. Utilizaçäo de suplemento alimentar e anabolizante por praticantes de musculação nas academias de Goiânia-GO / Use ofalimentarysupplementand anabolizante forapprenticesof muscular activity in theacademiesof Goiânia-GO. Revista Brasileira de Ciencia e Movimento. 2002;10(3):13-8. Availablefrom: https://portalrevistas.ucb.br/index.php/RBCM/article/view/457

16. Venâncio DP, Nobrega ACL, Tufik S, Mello MT.Avaliaçãodescritiva sobre o uso de esteroides anabolizantes e seuefeito sobre as variáveis bioquímicas e neuroendócrinas em indivíduos que praticamexercício resistido. Revista Brasileira de Medicina do Esporte. 2010; 16(3): 191-195. Availablefrom: https://www.scielo.br/j/rbme/a/mgJ3bhdwSpCKGJTtH9nfbnh/?lang=pt

17. Nogueira FR, Brito AD, Vieira TI, Oliveira CV, Gouveia RL. Prevalência de uso de recursos ergogênicos em praticantes de musculaçãonacidade de João Pessoa, Paraíba. Revista Brasileira de Ciências do Esporte.2015;37(1):56-64. Availablefrom: https://doi.org/10.1016/j.rbce.2013.12.001

18. Porello RA, Dos Santos MR, DE Souza FR, DA Fonseca GW, Sayegh AL, DE Oliveira TF, Akiho CA, Yonamine M, Pereira RM, Negrão CE, Alves MJ. Neurovascular Response during Exercise and Mental

Stress in Anabolic Steroid Users. Medicine & Science in Sports & Exercise. 2018;50(3):596-602. Available from: https://doi.org/10.1249/mss.0000000000001456

19. Montanher RD, Castoldi RC, Filho CA, JunqueiraA.Consumo de esteroides anabolizantes por praticantes de exercícios físicos em academias de Presidente Prudente. Colloquium vitae. 2018;10(1):16-21.Available from: https://www.researchgate.net/publication/325665860_CONSUMO_DE_ESTEROIDES_ANABOLIZANTES_POR_PRATICANTES_DE_EXERCICIOS_FISICOS_EM_ACADEMIAS_DE_PRESIDENTE_PRUDENTE

20. Pereira E, Moyses SJ, Ignácio SA, Mendes DK, Silva DS, Carneiro E, Hardy AM, Rosa EA, Bettega PV, Johann AC. Prevalence and profile of users and non-users of anabolic steroids among resistance training practitioners. BMC Public Health. 2019; 19(1):1650. Available from:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6902556/

21. Leite DC, Sousa RML, Costa Junior ALR,Veloso HJF. Fatores Associadosao uso de esteroides anabolizantes por praticantes de exercício físico. Revista Brasileira de Medicina do Esporte .2020; 26(4): 294-297. Availablefrom: https://doi.org/10.1590/1517-869220202604178249

22. Hauger LE, Havnes IA, Jørstad ML, Bjørnebekk A. Anabolic androgenic steroids, antisocial personality traits, aggression and violence. Drug and Alcohol Dependence. 2021 abr; 221:108604. Available from: https://doi.org/10.1016/j.drugalcdep.2021.108604