

Use of chemicals to improve sports performance in Physical Education students at a public university

Uso de substâncias químicas para aprimorar o desempenho esportivo em alunos de Educação Física de uma universidade pública

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ABSTRACT

The indiscriminate consumption of performance-enhancing chemicals in sport has become a cause for concern by putting the athlete's well-being and life at risk. Considering the relevance of understanding the determinants that lead individuals to the use of chemical compounds with ergogenic properties, the purpose of this research was to evaluate the prevalence and characteristics associated with the use of chemical substances for sports improvement among university students enrolled in the Physical Education course of a public higher education institution. The sample of the present study consisted of 230 participants who were submitted to a questionnaire based on scientific papers that address the prevalence and use of supplements and performance enhancers. It was found that the most frequently adopted supplements were those containing proteins and amino acids as major components, while anabolic-androgenic steroids are the most commonly used enhancers. The most cited prescription for the use of supplements and enhancers was by self-prescription. The presence of side effects from the use of chemicals has been reported. Logistic regression with independent variables showed an association of the use of supplements with the variables: sex OR = 2.4 (95% CI: 1.4 - 4.4), type of undergraduate degree OR = 2.6 (95% CI: 1.4 - 4.8) and age OR = 3.1 (95% CI: 1.4 - 7.0). The indiscriminate consumption of these products points to the need to alert the population to health risks, making further studies in the area necessary.

Keywords: Anabolic steroids. Nutritional supplements. Physical education and training.

RESUMO

O consumo indiscriminado de substâncias químicas que melhoram o desempenho no esporte se tornou motivo de preocupação ao colocar o bem-estar e a vida do atleta em risco. Considerando a relevância do entendimento dos determinantes que conduzem os indivíduos à utilização de compostos químicos com propriedades ergogênicas, o propósito desta pesquisa consistiu em avaliar a prevalência e as características associadas ao uso de substâncias químicas para aprimoramento esportivo entre os estudantes universitários matriculados no Curso de Educação Física de uma instituição de Ensino Superior pública. A amostra do presente estudo foi composta por 230 participantes, os quais foram submetidos a um questionário, embasado em artigos científicos que abordam a prevalência e a utilização de suplementos e anabolizantes. Verificou-se que os suplementos mais frequentemente adotados foram aqueles contendo proteínas e aminoácidos como componentes principais, enquanto os esteroides anabólicos androgênicos são os anabolizantes mais usados. A prescrição mais citada para o uso de suplementos e anabolizantes foi por indicação própria. Foi relatada a presença de efeitos colaterais advindos do uso das substâncias químicas. A regressão logística com as variáveis independentes mostrou associação entre a utilização de suplementos com as variáveis: sexo OR = 2,4 (IC 95%: 1,4 - 4,4), tipo de graduação OR = 2,6 (IC 95%: 1,4 - 4,8) e idade OR = 3,1 (IC95%: 1,4 - 7,0). O consumo desses produtos, de forma indiscriminada, aponta a necessidade de alertar a população quanto aos riscos à saúde, de maneira que se fazem necessários mais estudos na área.

Palavras-chave: Anabolizantes. Educação física e treinamento. Suplementos nutricionais.

INTRODUCTION

Currently, the practice of physical activity has been increasingly common, driven by the pursuit of several goals, such as improving physical fitness, aesthetic improvement, weight reduction, increasing muscle strength and promoting a healthy lifestyle (Fayh et al., 2013). It is important to clarify, however, that this trend is not uniform worldwide, since WHO data does not point to a widespread increase in physical activity. In addition, it is crucial to distinguish between physical activity, physical exercise and sports practice in order to provide clarity to the reader on the context addressed (Tapavički et al., 2022). Concomitantly, there is an increase in the prevalence of the use of chemical compounds such as dietary and anabolic supplements by some practitioners in an attempt to achieve their goals more quickly (Hall & Noonan, 2023).

Food supplements are products of oral administration, formulated in different pharmaceutical presentations, containing vitamins, minerals, extracts, amino acids or combinations of these components, with the purpose of complementing the diet of healthy individuals, providing additional nutrients (Brazil, 2018), and are not considered conventional foods in a diet. Worldwide data state that 40% to 80% of athletes use these substances to

improve gains, and their use is also significant in the non-athlete population (Fayh et al., 2013).

Anabolic agents are substances composed of hormones that stimulate protein synthesis, with the objective of promoting the increase of muscle mass, aiming at improvements in physical performance and skeletal muscle development. These substances include testosterone and its analogues (Bird, Goebel, Burke & Greaves, 2016; McCullough et al., 2021). It is important to note that these substances are consumed not only by professional athletes, but also by non-professional individuals, with the aspiration to achieve gains in strength and performance (Bird et al., 2016; McCullough et al., 2021).

The use of anabolic steroids and dietary supplements can lead to adverse health consequences for individuals who choose to use them, ranging from minor effects to irreversible damage, as evidenced in studies (Pope, Kanayama & Hudson, 2012; Sagoe, Molde, Andreassen, Torsheim & Pallesen, 2014). A study conducted in the United States with users of estrogen-based anabolic steroids revealed that 25% of participants had some type of mood disorder, such as manic episodes, bipolar disorder or depression (Inácio, Costa, Barros & Granjeiro, 2008).

According to the specialized literature, which includes contributions from members of sports medicine and exercise science, therapy-based studies have established associations between the use of anabolic steroids and side effects that affect the liver, cardiovascular system, reproductive system and psychological state (Kanayama, Hudson & Pope, 2009; Pope et al., 2012).

The use of chemical substances is a public health problem that needs to be studied and included in prevention programs in the areas of health and nutritional education (Nogueira, Souza & Brito, 2013). An alarming factor is the inappropriate orientation to these consumers. It is common for beginners in the practice of physical exercise to acquire some type of chemical substance, based on self-prescription, without the guidance of a nutrition professional or physician (American College of Sports Medicine [ACMS], 2013; Hackett & Johnson, 2014). The absence of strict regulations restricting the indiscriminate marketing of these products, combined with the attractive marketing strategies prevailing in the current context, results in an increase in inappropriate consumption (Reis, Camargos, Oliveira & Domingues, 2017).

In the university context, which marks the beginning of a period of significant transformations and adaptations in the lives of many young people, it is observed that Physical Education students are the most prevalent in the use of anabolic-androgenic steroids (Sagoe et al., 2014). In addition, there are variations in the intensity of consumption of these substances according to the sports modality practiced (Ropelato & Ravazzani, 2011; Reis et al., 2017). Physical Education professionals are responsible for interacting directly with physical activity practitioners and athletes. The consumption of chemical substances by these professionals increases the likelihood that they will recommend the use of these substances to their students, even without having the proper training for such (Felício, Barroso, Cavalcante & Brandão, 2014; Silva et al., 2016).

The scientific literature presents a lack of studies addressing the consumption of dietary and anabolic supplements among Physical Education students, and it is important to know the consumption profile of the student in training in order to act in the awareness of these future professionals during their academic training. Therefore, the purpose of this study was to investigate the prevalence and characteristics of chemical substance consumption, with the purpose of improving sports performance, among students enrolled in the Physical Education course of a public university located in the southern region of Brazil.

MATERIAL AND METHODS

Quantitative cross-sectional study, of the exploratory descriptive type, with the application of a questionnaire based on the prevalence and characteristics of the consumption of chemical substances for sports among students of the Physical Education course of a public higher education institution, enrolled in the 2019 school year. The sample consisted of 230 students who were enrolled in the course, from all periods, and were willing to answer the questionnaire. Among them, both bachelor's and licentiate degree students of the Physical Education course. The standard questionnaire was based on literature papers on the prevalence and use of supplements and anabolic steroids.

After authorization from the coordination of the Physical Education course, the application of the instrument occurred through visits to the classrooms, with the permission of the governing teacher. The number of individuals present was one of the requirements for the application of the questionnaires, being carried out in periods that covered a greater number of

participating students. Study participants received guidance on the objectives and preservation of the anonymity of the research, and those who agreed to participate provided their signature on the Informed Consent Form (ICF) in accordance with Resolutions 196/96 and 466/12 of the Ethics Council. The research was submitted to and approved by the institution's Ethics Committee (CAAE No.12076719.5.0000.0104, report No. 3.430.374).

Data were compiled into Microsoft Excel® spreadsheets, in which simple descriptive statistics were performed. Statistical analyses of the comparison between variables were performed using Stata Statistical Software: Release 14®, meeting the confidence interval (95% level) and significance level with $p < 0.05$. For the interpretation of the data, the univariate analysis was performed first, and the variables with $p < 0.05$ were adopted using the chi-square test. After this step, multivariate analysis was performed. For this, the logistic regression model was used, with calculation of crude and adjusted Odds Ratio (OR). Only variables that were associated with the endpoint ($p \leq 0.10$) in the multivariate analysis were included in the model.

Odds Ratio (OR) is a statistical test widely used in the analysis of data from epidemiological studies, and in other areas, such as medicine, to evaluate the association between two categorical variables, used to measure the strength of the association between exposure (a risk factor) and the outcome (an event or outcome) of interest (Francisco et al., 2008). Univariate analysis is used when examining the association between two variables without considering other factors, while multivariate analysis takes into account the influence of confounding variables to assess the association between exposure and outcome in a more controlled and adjusted way (Grigolo, Fioreze, Denardi & Vacari, 2018).

RESULTS AND DISCUSSION

A total of 124 licentiate degree students and 106 bachelor's degree students in Physical Education were interviewed, 47.2% of whom were female and 52.8% male. The mean age of the bachelor's degree students was 20.6 years, and for licentiate students it was 21.3 years. The profile of the students interviewed is described in Table 1.

The results show that students were mostly men, with an average age of 21.0 ± 3.3 , which corroborates with other studies involving Physical Education undergraduates (Miarka, Luiz, Interdonato & Vecchio, 2007; Felício et al., 2014).

Based on the physical activities mentioned by the participants, weight training (34.4%) and running (16.9%) were the most frequent, as shown in Figure 1. Studies show that users of chemical substances for sport are mostly practitioners of the modality most mentioned in the Figure 1 (Linhares & Lima, 2013; Vargas, Fernandes & Lupion, 2015).

It was observed that 131 (56.9%) participants used dietary supplements. In relation to sex, 35.8% of users were women and 64.1% were men ($p < 0.05$). Students were also asked about the classes of supplements they used. Among 131 students, 58 (44.2%) reported using only one class; 50.4% reported using two or three classes, and seven of them (5.3%) use four or more classes. The most used supplements were classified in Group S1 – proteins and amino acids (42.3%) and S2 – protein metabolites (26.1%), as shown in Table 2.

Regarding the consumption of anabolic steroids, among the 230 students, eight participants reported its use, all users were men, and the most used anabolic steroids were class A1 – anabolic-androgenic steroids (corresponding to 60.0%, as indicated in Table 2).

Table 1

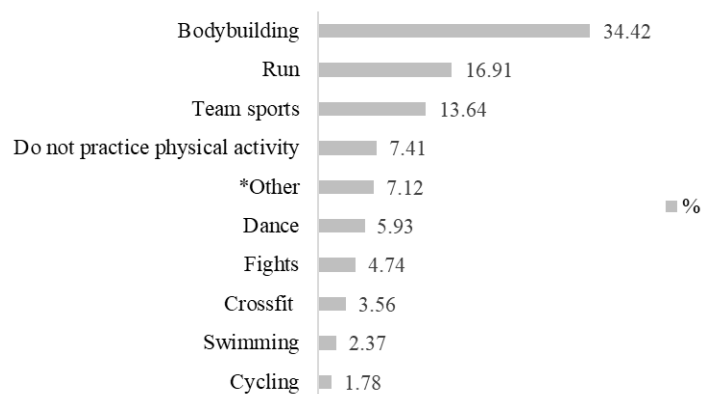
Profile of students of the Physical Education course, enrolled in the academic year 2019.

	Bachelor's degree	Licentiate	Total
Sex			
Male	58 (54.7%)	64 (51.6 %)	122 (53.1%)
Female	48 (45.3%)	60 (48.4%)	108 (46.9%)
Age			
Mean ± standard deviation	20.6±2.9	21.3±3.5	21.0±3.3
Course year			
1st year	22 (20.4%)	30 (25.2%)	52 (22.6%)
2nd year	34 (31.5%)	31 (24.4%)	65 (28.3%)
3rd year	39 (37.0%)	11 (8.7%)	50 (21.7%)
4th year	11 (11.1%)	33 (26.0%)	44 (19.1%)
5th year	0	19 (15.7%)	19 (8.3%)

Source: The authors.

Figure 1

Physical activities reported by the interviewed students of the Physical Education course.



Source: The authors.

Note: *Others: Tennis, gymnastics, functional, jump.

Table 2

Nutritional and anabolic sources used by students of the Physical Education course, enrolled in the academic year of 2019.

Supplements	N (%)
S1 – Proteins and amino acids	102 (42.3%)
S2 – Protein metabolites	63 (26.1%)
S3 – Vitamins and minerals	34 (14.1%)
S4 – Extracts, botanicals and herbs	27 (11.2%)
S5 – Mixed	11 (4.6%)
S6 – Others	4 (1.6%)
Anabolics cited	
A1 – Anabolic-androgenic steroids	6 (60.0%)
A2 – Growth hormone	2 (20.0%)
A3 – Others	2 (20.0%)

Source: The authors.

The prevalence of males was significant for the use of supplements and anabolic steroids. Similar data were seen in other studies carried out in Brazil with gym-goers and Physical Education students (Fayh et al., 2013; Felício et al., 2014; Vargas et al., 2015). According to Linhares and Lima (2010), the male prevalence can be explained by the fact that men are more

concerned with their physical appearance, strength and muscles, while, for women, it is more about a thin appearance.

The vast majority of interviewees reported using dietary supplements in the S1 (proteins and amino acids) and S2 (protein metabolites) groups. These groups are also the most reported in other studies involving Physical Education students and bodybuilders (Araújo, Andreolo & Silva, 2002; Miarka et al., 2007). Half of consumers stated that they use two or three different classes of supplements. According to Fayh et al. (2013), generally only one class of supplements is used by gym-goers in Porto Alegre, southern Brazil.

The World Health Organization, one of the great references in nutritional recommendations, warns that a safe level of protein intake is expressed in g/kg of body mass, but many diets exceed these values, leading to exacerbated protein intake (Rocha & Pereira, 1998). Excessive protein intake, beyond the established recommendations, does not result in an additional significant increase in muscle mass, since there is a limit to protein accumulation in tissues (Hernandez & Nahas, 2009). On the other hand, at high levels of consumption, excessive protein intake can trigger adverse effects, such as the occurrence of ketosis, gout and renal overload (Araújo et al., 2002).

The use of anabolic steroids was mentioned by a small percentage of the students when compared to other studies involving students in the same area (Palma, Abreu & Cunha, 2007). The most cited class was A1 (anabolic-androgenic steroids), which is also reported in other studies as the most consumed by practitioners of physical activity (Araújo et al., 2002; Abrahin, Souza, Sousa, Moreira & Nascimento, 2013).

Chemical substances were indicated by numerous means, since the consumption of supplements was indicated more frequently by self-prescription or by nutritionists, whereas, for anabolic steroids, the responses showed a tendency towards self-prescription and friends (Table 3).

Table 3

Source of guidance for students of the Physical Education course for the use of chemical substances for sport.

Sources of Guidance	Supplements N (%)	Anabolics N (%)
Self-prescribing	58 (32.04%)	5 (50.00%)
Nutritionist	41 (22.65%)	-
Professor	36 (20.44%)	1 (10.00%)
Friend	24 (13.26)	2 (20.00%)
Doctor	10 (6.07%)	2 (20.00%)
Shop Salesperson	6 (3.31%)	-
Pharmacy	4 (2.21%)	-

Source: The authors.

Although few students reported using anabolic steroids, it is worrying that the use of these substances is done on their own initiative (self-prescription). Other studies involving Physical Education students have observed that the indication of the use of chemical substances is usually made by unqualified professionals, such as teachers or gym instructors (Miarka et al., 2007; Felício et al., 2014).

In another Brazilian study, a high prevalence of anabolic steroid use was observed among students and physical education teachers, who are trained individuals with a certain level of knowledge, which may result in the encouragement of the use of these substances by their students (Abrahin et al., 2013).

In the context of the prescription of anabolic and food supplements, the legislation establishes that the nutritionist is the professional qualified to carry out such prescriptions,

considering the individual nutritional needs of each practitioner and their personal goals. In addition, the nutritionist must observe the maximum safety limits regulated by the National Health Surveillance Agency (Anvisa, 2006; Costa, Rocha & Quintão, 2013).

Only physicians or dentists, duly registered with professional councils, are authorized to issue prescriptions for anabolic steroids, and this prescription should be retained at the pharmacy at the time of dispensing these substances (Brazil, 2000).

Regarding side effects related to the consumption of chemical substances, of the 131 supplement consumers, 12 (9.1%) university students reported the presence of undesirable effects such as gastric discomfort, water retention, acne, insomnia and tachycardia.

When compared to the anabolic steroid, among eight students, four (50.0%) had side effects after using the product. The symptoms reported were: dizziness, dilatation of the airways, increased oiliness of the skin, stress, and decrease in testicular size. Similar data were seen in a study carried out in two cities in Vale do Aço, in which 17.6% of gym-goers who used supplementation pointed out undesirable effects after consuming the product (Costa et al., 2013).

According to Reis et al. (2017), the use of anabolic steroids can be indicated for clinical purposes, such as hormone replacement or treatment of certain diseases. However, outside of therapeutic doses, these products can lead to serious consequences, for example, psychopathologies, prostate cancer, coronary heart disease and sterility.

Regarding the statistical analysis and the characteristics of the study participants who consume chemical substances for sports (Table 4), a statistically significant OR of 2.8 (1.6 – 4.9) was observed for men regarding the consumption of supplements, compared to women.

Regarding the analysis of the association between the variables, it was possible to observe that there is a relationship between the use of supplements and the variables gender, type of degree and age. The results obtained in the study corroborate the findings of other authors, who found that males and younger individuals are more frequently variable in the use of supplements (Goston & Correia, 2010; Fayh et al., 2013; Felício et al., 2014; Vargas et al., 2015).

Bachelor's degree students had a higher frequency (64.6%) regarding the use of supplements, compared to licentiate degree students, with an OR of 2.1 (1.3 – 3.7). The age variable showed that students aged 21 years or younger had a higher frequency of supplement use than older ones, with an OR of 3.3 (1.5 – 7.0).

Students who practice physical activity three to five days (OR = 4.8; 95% CI: 1.7 – 12.8), or more days a week (OR = 11.8 95% CI 2.9 – 47.5), had a higher frequency of using supplements, compared to students who practiced it fewer days or not at all.

Regarding the food classification variable, students who reported eating poorly had a higher frequency of use of supplements when compared to participants who reported excellent diets, with an OR of 5.8 (1.3 – 26.5).

For the use of anabolic steroids, the independent variables (gender, age, type of degree, frequency of physical activity, and dietary classification) did not show a significant association ($p < 0.05$) with the outcome variable.

Through the results obtained in the univariate analysis, it was possible to construct the logistic regression model with the independent variables, and those that showed association for the use of supplements were: gender OR = 2.4 (95% CI: 1.4 - 4.4),

type of graduation OR = 2.6 (95% CI: 1.4 - 4.8) and age OR = 3.1 (95% CI: 1.4 - 7.0).

The present study shows that men use supplements 140% more often than women, that young people under the age of 21 use supplements 210% more often than older people. Data obtained in the study by Goston & Correia (2010) showed that the male population used supplements 100% more often (OR = 2.0; 95% CI: 1.6 – 2.6) than the female population. With regard to age, participants under 30 years of age used supplements 73% more often (OR = 1.73 95% CI: 1.2 – 2.5) than older age groups.

Table 4

Relationship between the use of dietary supplements for sports among the variables.

Variable	Use of supplements		Univariate analysis ²		Multivariate analysis ³	
	Yes	No	OR (95% CI)	p-value	OR (95% CI)	p-value
Sex						
Female.	47 (36.4%)	61 (61.2%)	1	-	1	
Male.	84 (63.6%)	38 (38.8%)	2.8 (1.6 - 4.9)	<0.001	2.4 (1.4 - 4.4)	<0.01
Type of degree						
Licentiate.	35 (34.9%)	71 (54.5%)	1	-	1	
Bachelor's degree.	64 (64.6%)	60 (45.8%)	2.1 (1.3 - 3.7)	0.005	2.6 (1.4 - 4.8)	<0.01
Age						
≤21	79 (60.3%)	81 (81.8%)	3.3 (1.5 - 7.0)	0.001	3.1 (1.4 - 7.0)	<0.01
22 - 25	36 (27.4%)	11 (11.1%)	1	-		
26 - 30	12 (9.1%)	6 (6.0%)	2.0 (0.7 - 5.7)	0.171	2.6 (0.8 - 7.8)	0.079
≥31	1 (3.0%)	4 (1.0%)	4.1 (0.4 - 37.5)	0.211	4.9 (0.4 - 51.0)	0.178
Frequency of physical activity						
Does not practice.	7 (2.9%)	19 (8.1%)	1		*	*
Less than three days.	16 (6.8%)	34 (14.5%)	1.3 (0.4 - 3.7)	0.650	*	*
Between three to five days.	74 (31.5%)	42 (17.8%)	4.8 (1.7 - 12.8)	<0.001	*	*
More than five days.	35 (14.9%)	8 (3.4%)	11.8 (2.9 - 47.5)	<0.001	*	*
Food Classification¹						
Spacious.	23 (17.42%)	24 (23.30%)	1		*	*
Good.	93 (70.45%)	73 (70.87%)	0.7 (0.4 - 1.4)	0.390	*	*
Great.	15 (11.36%)	2 (1.94%)	5.8 (1.3 - 26.5)	0.021	*	*

Source: The authors.

Note:¹Self-reported;²analysis, considering the variables individually, without considering the effect of the other variables on the model;³analysis considering the effects of the variables on each other * $p < 0.05$; CR = odds ratio; CI = confidence interval.

Regarding the type of degree variable, the results of this study showed that bachelor's degree students use supplements 160% more often than licentiate students. However, to date, there is no availability of publications related to the theme "use of supplements" and the variable "type of degree". Thus, this is one of the limitations of this study, as it was difficult to find current references that addressed the use of chemical substances for sports by Brazilian students, and this may have hindered the

discussion of the findings of this study.

Despite the limitations, this study involves a population of Physical Education students, addressed by few Brazilian studies. It is important to know what the consumption profile of these academics is like, since, when they become professionals, they will influence the consumption of chemical substances for sports by other athletes or practitioners of physical activity.

CONCLUSION

This study showed that most of the respondent students use chemical substances for sports, most of them use food supplements to improve performance, and few use anabolic steroids. However, the indication of the substances consumed is not made by qualified professionals, and half of the anabolic steroid users have side effects that may be related to the use of these substances. Therefore, further studies are necessary for the follow-up of students over longer periods, also evaluating other possible risks that may be inherent to the use of chemical substances without proper knowledge or even without the monitoring of professionals trained to instruct on the correct way to utilize these compounds, thus contributing to the development of educational policies for this population.

COMPETING INTERESTS

The authors declare that there are no conflicts of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization: S. A. G. M. *Data curation:* S. A. G. M. *Formal analysis:* R. G. A., R. S. L., J. J. V. T. *Investigation:* T. R. F. *Methodology:* S. A. G. M. *Project administration:* S. A. G. M. *Supervision:* S. A. G. M. *Validation:* J. J. V. T. *Visualization:* R. G. A., R. S. L., J. J. V. T. *Writing the initial draft:* T. R. F. *Revision and editing of writing:* R. G. A., R. S. L., J. J. V. T., S. A. G. M.

PEER REVIEW

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