

## DOPING-RELATED KNOWLEDGE AMONG ADOLESCENTS: DIFFERENCES BY SEX AND EDUCATION SYSTEM

### CONHECIMENTO SOBRE DOPING ENTRE ADOLESCENTES: DIFERENÇAS ENTRE SEXOS E SISTEMAS EDUCACIONAIS

### CONOCIMIENTO SOBRE EL DOPAJE EN ADOLESCENTES: DIFERENCIAS SEGÚN EL SEXO Y EL SISTEMA EDUCATIVO

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**ABSTRACT:** This article aimed to investigate the level of doping-related knowledge among high school students and examine differences according to sex and school type. A cross-sectional observational study was conducted with 589 high school students (50.9% girls; mean age = 16.17 years) from public (state and federal) and private schools. Doping-related knowledge was assessed using the Knowledge domain of a structured questionnaire addressing knowledge, perceptions, and attitudes. Analyses were performed using a  $3 \times 2$  factorial ANOVA followed by Tukey's post hoc test. Adolescents demonstrated a moderate level of knowledge on the topic. The ANOVA indicated higher knowledge levels among boys from federal schools and lower levels among girls from state schools ( $p < 0.05$ ). It is concluded that doping-related knowledge among adolescents varies according to educational context and sex, highlighting the need for targeted anti-doping education strategies within the school setting.

**Keywords:** Doping. Adolescents. Health knowledge. Schools. Health education.

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**RESUMO:** Esse artigo buscou investigar o nível de conhecimento sobre doping entre estudantes do ensino médio e examinar diferenças de acordo com o sexo e o tipo de escola. Trata-se de um estudo observacional transversal realizado com 589 estudantes do ensino médio (50,9% meninas; idade média = 16,17 anos), provenientes de escolas públicas (estaduais e federais) e privadas. O conhecimento relacionado ao doping foi avaliado por meio do domínio de Conhecimento de um questionário estruturado que aborda conhecimentos, percepções e atitudes. As análises foram conduzidas por meio de ANOVA fatorial  $3 \times 2$ , seguida do teste post hoc de Tukey. Os resultados indicaram que os adolescentes apresentaram nível moderado de conhecimento sobre o tema. Observou-se diferença significativa entre os grupos, com maiores níveis de conhecimento entre meninos de escolas federais e menores níveis entre meninas de escolas estaduais ( $p < 0,05$ ). Conclui-se que o conhecimento sobre doping entre adolescentes varia conforme o contexto educacional e o sexo, destacando a necessidade de estratégias de educação antidoping direcionadas no ambiente escolar.

**Palavras-chave:** Dopagem. Adolescentes. Conhecimento em saúde. Escolas. Educação em saúde.

**RESUMEN:** Este artículo tuvo como objetivo investigar el nivel de conocimiento relacionado con el dopaje entre estudiantes de educación secundaria y examinar las diferencias según el sexo y el tipo de escuela. Se realizó un estudio observacional transversal con 589 estudiantes de educación secundaria (50,9% mujeres; edad media = 16,17 años) provenientes de escuelas públicas (estatales y federales) y privadas. El conocimiento sobre dopaje fue evaluado mediante el dominio de Conocimiento de un cuestionario estructurado que aborda conocimientos, percepciones y actitudes. Los análisis se realizaron mediante ANOVA factorial  $3 \times 2$ , seguido de la prueba post hoc de Tukey. Los adolescentes mostraron un nivel moderado de conocimiento sobre el tema. El ANOVA indicó niveles más altos de conocimiento entre los varones de escuelas federales y niveles más bajos entre las mujeres de escuelas estatales ( $p < 0,05$ ). Se concluye que el conocimiento sobre dopaje entre adolescentes varía según el contexto educativo y el sexo, lo que pone de relieve la necesidad de estrategias de educación antidopaje dirigidas en el entorno escolar.

**Palabras clave:** Dopaje. Adolescentes. Conocimiento en salud. Escuelas. Educación en salud.

## I. INTRODUCTION

Doping represents a serious problem for both sport and public health, being present not only among elite athletes but also among amateur and recreational practitioners of different ages and contexts. The use of substances to enhance physical performance has also been reported among adolescents (NAGATA *et al*, 2020; SCHNEIDER *et al*, 2020; SVEDSÄTER *et al*, 2021), which heightens concerns, given that this population is particularly vulnerable to such behavior (GIRELLI *et al*, 2020).

In addition to ethical implications, doping involves adverse health effects, both physical and psychological. In a longitudinal follow-up study with adolescent athletes, hepatic alterations, musculoskeletal diseases, hormonal suppression, infertility, depression, and anxiety were identified, with effects that may persist even after cessation (BERGER *et al*, 2024).

Recent literature also highlights limited and insufficient knowledge about doping among adolescents, both athletes and non-athletes (PÖPPEL, 2021; TSIVITANIDOU *et al*, 2023), with lack of knowledge being a determining factor not only for the use of prohibited substances but also for the irresponsible use of legal and easily accessible substances. For example, the consumption of dietary supplements without proper professional guidance may result in inefficacy or even overdose (BARRETTO *et al*, 2024).

Considering the harms associated with doping for health and the integrity of sport, preventive education about its risks is essential for the development of informed youth (GALLI *et al*, 2023). The school setting constitutes a relevant space for investigation and intervention. However, studies investigating the level of knowledge about doping among school adolescents remain scarce, especially in Brazil.

In this context, this study aimed to investigate the level of knowledge about doping in sport among high school adolescents from different educational systems (state, federal, and private). The study sought to fill a gap by analyzing possible disparities in knowledge about the topic among students of different sexes and educational contexts.

## 2. METHODS

### 2.1 Study design and setting

This is an observational, cross-sectional study with a descriptive-analytical design (THOMAS *et al*, 2012), conducted in school settings in a city in the interior of the state of Rio Grande do Sul.

The sample consisted of 589 students (50.9% girls), aged between 13 and 19 years ( $M_{age} = 16.17$ ,  $SD = 1.09$ ), regularly enrolled in the 1st, 2nd, and 3rd years of Brazilian high school, of both sexes, from institutions in the state, federal, and private education systems. Participants were selected through intentional convenience sampling, including schools from different educational systems and regions of the municipality in order to ensure the representation of distinct educational contexts. The selection of institutions was influenced by accessibility and the availability of collaborating teachers, which facilitated the logistical feasibility of data collection.

Adolescents who were duly enrolled in high school and voluntarily agreed to participate in the study were included upon signing the Assent Form, with authorization from their legal guardians through the Informed Consent Form (ICF). Students who did not adequately complete the questionnaire or who were absent on the day of data collection were excluded from the analysis.

Data collection was conducted in the school setting, at times previously scheduled with the administration and pedagogical coordination of each institution. Students individually completed the research instrument in the classroom, under the supervision of the responsible researchers. Prior to completion, a brief explanation of the instrument used in the study and its objectives was provided, ensuring the confidentiality of the information and voluntary participation.

The study was conducted in accordance with the principles of the Declaration of Helsinki and Resolution 466/12 of the Brazilian Ministry of Health, which regulates research involving human subjects in Brazil, and was approved by the Human Research Ethics Committee, under CAAE No. 68762223.3.0000.5346 and approval No. 6.071.427.

## 2.2 Instruments

To assess the variables of interest, a questionnaire specifically developed for this study was used, based on previously published instrument (ÁLVAREZ *et al.*, 2017) and on educational content derived from the World Anti-Doping Agency (WADA) Play True Quiz (WORLD ANTI-DOPING AGENCY, s.d.). The questionnaire consisted of 35 items that investigated dimensions related to the level of knowledge, perceptions, and attitudes regarding doping in sport. For the present analysis, only the Knowledge Domain (KD) of the instrument was considered, comprising 12 items in this study. Each item was assessed dichotomously, assigning

1 point for “yes/agree” responses and 0 points for “no/disagree” or “do not know/maybe” responses. Thus, the total score for the domain ranged from 0 to 12 points, reflecting the sum of positive (“agree”) responses related to knowledge.

For interpretative purposes, a classification adjusted to the possible scores of this reduced domain was adopted, defining the following ranges: low (0 to 3 points), moderate (4 to 8 points), and high (9 to 12 points). This adaptation aimed to preserve consistency with the categories of the original instrument while considering the reduced scale applied in this study.

This methodological decision was grounded in the need to maintain the internal comparability of the results and the sensitivity of the instrument in detecting distinct knowledge profiles regarding doping among adolescents, without compromising the conceptual validity of the domain.

### 2.3 Data analyses

Sex (male and female) and type of education system (state, federal, and private) were considered independent variables. The knowledge Domain (KD) regarding doping was considered the dependent variable.

To analyze differences in the level of knowledge among high school adolescents, considering the factors sex (female and male) and education system (state, federal, and private), a two-way factorial ANOVA (3×2) was conducted, an appropriate model for investigating main and interaction effects of categorical independent variables on a continuous variable. The normality of the residuals was assessed using a Q-Q plot, and the assumption of homogeneity of variance was tested using Levene’s test. Post hoc analyses for the main and interaction effects (sex × education system) were performed using Tukey’s test. All analyses were conducted using JASP (Just Another Statistical Program), version 0.95.14.0, adopting a significance level of .05.

## 3. RESULTS

Table 1 presents the characterization of the sample, including the distribution of participants according to sex, type of education system, and mean age.

**Table 1** - Distribution of participants according to sex, education system, and age (n = 589)

Variable	Category	N	%
Sex	Female	300	50.9%

Variable	Category	N	%
	Male	289	49.1%
Education system	State	117	19.9%
	Federal	343	58.2%
	Private	129	21.9%
Age (years)	Mean (SD)	16.17 ( $\pm$ 1.09)	—

Values are presented as absolute frequency (n) and percentage (%), unless otherwise indicated. Age is presented as mean  $\pm$  standard deviation (SD).

Source: AUTHORS, 2016

Before presenting the inferential results, a descriptive analysis of the sample’s level of knowledge was conducted using the classifications “low” (0–3 points), “moderate” (4–8 points), and “high” (9–12 points). Observed means were used to reflect the distribution of scores in the sample.

Overall, the mean level of knowledge about doping among participants was “moderate”, with an average score of 4.75 points. Adolescents from the state education system presented a mean level close to “low” (3.93 points), whereas those from the federal and private systems showed “moderate” knowledge (5.09 and 4.60 points, respectively). Regarding sex, both groups demonstrated “moderate” knowledge, with means of 4.11 points among female adolescents and 5.42 points among male adolescents.

Subsequently, to analyze the effects of sex and education system and their interaction, marginal means derived from the factorial ANOVA were used. The assumptions required for the application of the factorial ANOVA were verified. The Q–Q plot and Levene’s test confirmed normality and homogeneity of variance (Levene’s  $F(5, 583) = 1.996, p < .77$ ).

Table 2 presents the marginal means of knowledge about doping according to sex and education system.

**Table 2** - Marginal means, 95% confidence intervals, and standard errors for main effects and their Interaction

Main Effect	Group	Marginal Mean	95% CI (Lower–Upper)	SE
Education System	State	4.178	3.710 – 4.646	0.238

Main Effect	Group	Marginal Mean	95% CI (Lower–Upper)	SE
	Federal	5.067	4.806 – 5.328	0.133
	Private	4.580	4.153 – 5.007	0.218
<b>Sex</b>	Female	4.039	3.732 – 4.347	0.156
	Male	5.177	4.839 – 5.515	0.172
<b>Interaction</b>				
<b>(Education System vs Group Sex)</b>		<b>Marginal Mean</b>	<b>95% CI (Lower–Upper)</b>	<b>SE</b>
	Female (State)	3.355	2.801 – 3.909	0.282
	Female (Federal)	4.349	3.975 – 4.724	0.191
	Female (Private)	4.414	3.780 – 5.048	0.323
	Male (State)	5.000	4.246 – 5.754	0.384
	Male (Federal)	5.785	5.422 – 6.148	0.185
	Male (Private)	4.746	4.173 – 5.320	0.292

Values represent marginal means estimated from the factorial ANOVA. CI = 7  
confidence interval; SE = standard error. Higher scores indicate greater knowledge about doping.

Source: AUTHORS, 2016

Overall, the highest marginal means were observed among male adolescents from the federal education system, whereas the lowest means were identified among female adolescents from the state education system.

The ANOVA results demonstrated a statistically significant effect for education system ( $F(2, 583) = 5.948, p < .003, \text{partial } \omega^2 = .017$ ) and for sex ( $F(1, 583) = 23.926, p < .001, \text{partial } \omega^2 = .037$ ), with no statistically significant interaction between these two variables ( $F(2, 583) = 2.805, p < .061, \text{partial } \omega^2 = .006$ ).

Post hoc analyses (Tukey's test; Table 3) showed that students from the federal education system scored higher than those from the state system, with no other differences between systems. Male adolescents presented higher levels of knowledge about doping than females.

In the interaction analysis, males scored higher than females in the state and federal systems, with no sex differences in the private system. Among females, students from the state system scored lower than those from the federal and private systems, with no difference between the latter. Among males, a difference was observed only between the federal and private systems (Table 3).

**Table 3** - Multiple comparisons (Tukey's post hoc test) for main effects and their interaction

Main Effect	Compared Groups	Mean Difference	Cohen's d	
<b>Education System</b>	State vs. Federal	-0.890**	-.362	
	State vs. Private	-0.403 (n.s)	-.164	
	Federal vs. Private	0.487 (n.s)	.198	
<b>Sex</b>	Female vs. Male	-1.138***	-.463	
Interaction (Education System vs Sex)	Compared Groups	Mean Difference	Cohen's d	
<b>State</b>	Female vs. Male	-1.645***	-.669	
	<b>Federal</b>	Female vs. Male	-1.436***	-.584
	<b>Private</b>	Female vs. Male	-0.333 (n.s)	-.135
<b>Female</b>	State vs. Federal	-0.994*	-.404	
	State vs. Private	-1.059*	-.431	
	Federal vs. Private	-0.064 (n.s)	-.026	
<b>Male</b>	State vs. Federal	-0.785 (n.s)	-.319	
	State vs. Private	0.254 (n.s)	.103	
	Federal vs. Private	1.039**	.423	

Values represent mean differences between groups. Cohen's d indicates effect size. n.s. = not significant; \*p < .05, \*\*p < .01, \*\*\*p < .001.

Source: AUTHORS, 2016

#### 4. DISCUSSION

The findings of the present study indicate that, on average, adolescents exhibit a moderate level of knowledge about doping in sport. Although differences between education systems and between sexes were statistically significant, the effect sizes were small. According to the interpretation criteria proposed by Cohen (2009), the partial  $\omega^2$  values found (.017 for education system and .037 for sex) fall within the small effect size category, indicating limited practical relevance. This suggests that factors external to the analyzed model may better explain variations in doping-related knowledge among students.

The differences found between the federal and state systems in the level of knowledge about doping may reflect curricular and infrastructural inequalities between schools. Although greater health promotion in the school environment has been reported in private institutions (HORTA *et al*, 2017), the pattern observed in both studies points in the same direction: institutions with better material resources and health promotion policies tend to favor positive health indicators among youth. In this sense, the influence of the school physical environment on different health behaviors among students becomes evident, particularly regarding dietary habits and physical activity, as well as improved physical and socioemotional well-being (HAWKINS *et al*, 2023).

Furthermore, the disparities observed between sexes in knowledge about doping, especially in schools from the federal and state systems, reinforce previous findings indicating greater interest in athletic performance and in the use of performance-enhancing substances among male adolescents (NAGATA *et al*, 2020). In the present study, this disparity was not observed in the private system, which may indicate the impact of socioeconomic context on access to health-related content. The literature shows that male adolescents tend to exhibit greater body dissatisfaction associated with muscularity and excessive physical exercise, whereas female adolescents tend to present body dissatisfaction primarily related to weight loss (RIVA *et al*, 2023). Such sociocultural distinctions may directly influence access to, understanding of, and interest in health-related content and the use of performance-enhancing substances.

The school-based program “Goodform” constitutes an example of an intervention aimed at improving body image among adolescents (YAGER *et al*, 2023). The study included male adolescents, focusing on changes in body image related to muscularity and on attitudes toward the use of anabolic-androgenic steroids. Although no changes in these variables were

reported following the interventions, theoretically grounded educational programs may contribute to the development of well-designed lessons on body image, even without statistically significant results (YAGER, 2024).

The uncritical and irresponsible use of social media also exacerbates inequalities and risk behaviors. In a study conducted by Cox *et al* (2024), major social media platforms facilitate access to and distribution of anabolic-androgenic steroids to users, with disproportionate impacts among adolescents due to their limited knowledge and increased vulnerability. This reinforces the role of education and schools in countering the spread of misinformation and the normalization of doping substances, highlighting the need to incorporate critical reflections on the use of digital media into anti-doping education initiatives.

In a media literacy intervention based on fostering greater critical awareness of the discourses and aesthetic ideals reinforced by media, as well as on identifying accurate information about the use of performance-enhancing substances, a reduction in adolescents' positive attitudes toward the use of prohibited doping substances was observed, along with a decrease in the use of legal performance-enhancing substances (LUCIDI *et al*, 2017).

Considering the inequalities in access to and understanding of information about doping among adolescents, health education and preventive anti-doping actions constitute relevant approaches to addressing knowledge gaps among more vulnerable groups, who tend to exhibit lower levels of knowledge on the topic. Recent literature highlights that anti-doping educational interventions may be more effective when they are sensitive to sociocultural differences associated with sex and context, employ participatory methodologies, and are theoretically grounded in behavior change theories (PÖPPEL, 2021; DAHER *et al*, 2021).

A review of anti-doping education initiatives highlights that the mere provision of information does not guarantee behavioral change or prevention and may, paradoxically, arouse interest in prohibited substances, especially among adolescents (WOOLF, 2020). It is emphasized that anti-doping education should go beyond simply presenting “what is prohibited,” incorporating health promotion and the ethical principles of clean sport. Thus, encouraging healthy dietary habits and safe physical training is essential for younger individuals. As recognized by the World Anti-Doping Agency – WADA (2016), there is a distinction between informing—transmitting knowledge—and educating, which involves behavior change.

The review also emphasizes logistical challenges in implementing anti-doping

education programs, particularly in the school setting, where there is reliance on already overburdened teachers to carry out the activities (WOOLF, 2020). This structural difficulty may partly explain the disparities observed between different education systems in this study, especially regarding the level of knowledge and the assimilation of health-related content, as these challenges manifest unevenly across schools with different realities.

Furthermore, contrasting perspectives can be observed in anti-doping strategies. In a review analyzing the knowledge, beliefs, and attitudes of elite athletes regarding doping, these athletes were found to be increasingly familiar with anti-doping rules; however, a knowledge gap persists that needs to be addressed through appropriate educational programs (MORENTE-SÁNCHEZ; ZABALA, 2013). There is also a lack of information about dietary supplements and the side effects of performance-enhancing substances. Therefore, information and prevention are essential and should be directed at athletes and other stakeholders in order to establish and maintain appropriate attitudes toward doping.

The findings of the present study may support the development and refinement of educational policies aimed at anti-doping education in the school context. The identification of differences in knowledge levels between sexes and education systems highlights the need for contextualized interventions that consider educational and sociocultural inequalities in the design of pedagogical strategies. In this sense, the data contribute to advancing the state of the art by providing empirical evidence to guide the development of educational programs that are more context-sensitive, with the potential to enhance health education and promote an ethical sports culture. Additionally, the importance of integrating anti-doping education content into the school curriculum is reinforced, linking it with practices that foster critical thinking, media literacy, and reflection on the use of performance-enhancing substances, especially among more vulnerable groups.

Some aspects, however, warrant attention when interpreting the results of the present study. First, there was an imbalance in sample size across education systems: the federal system included a considerably larger number of participants ( $n = 343$ ) than the private ( $n = 129$ ) and state ( $n = 117$ ) systems. Although the statistical model used (factorial ANOVA) accounts for independent groups and its assumptions of normality and homogeneity were met, such disproportion may have limited the detection of more subtle differences. In addition, the instrument used was specifically developed for this study, without the application of formal psychometric validation procedures, which may limit the precision and generalizability of the

measurement of knowledge across different contexts. Finally, it is important to note that the data are self-reported, which may involve potential social desirability bias.

For future investigations, a longitudinal design is recommended as a methodological approach, as it allows for a better understanding of changes in knowledge and attitudes over time. It would also be valuable to expand the analysis by exploring mediating and moderating factors—such as socioeconomic status, involvement in different sports modalities, and school curricula—which may provide a better understanding of the observed differences.

## 5. CONCLUSIONS

The level of knowledge about doping among the adolescents investigated was moderate. The results indicated a significant effect of both education system and sex, with higher levels of knowledge among male adolescents from the federal system and lower mean scores among female adolescents from the state system. The findings suggest that unequal knowledge about doping among adolescents reflects complex educational disparities and social expectations linked to sex, highlighting the importance of intersectoral policies that integrate health education into the school curriculum.

Anti-doping education constitutes an important tool for fostering individuals who are aware of the risks associated with the use of doping substances, contributing to the development of a culture of health and ethical sport among adolescents. It is essential that schools incorporate preventive strategies targeting risk behaviors into their curricula, establishing health education as a foundational element in youth development. Otherwise, the school—an essential space for equalizing educational opportunities and democratizing knowledge—will fail to fulfill its role and will contribute to the perpetuation of educational inequalities regarding health competencies, especially among adolescents belonging to more vulnerable groups.

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