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Association between alcohol drinking, tobacco smoking and physical activity in South American school adolescents

Associação entre consumo de álcool, tabagismo e atividade física em adolescentes escolares sul-americanos

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ABSTRACT

Objective: To investigate the association between alcohol drinking, tobacco smoking and physical activity (PA) in South American school adolescents. Methods: The cross-sectional design study used national surveys from nine South American countries: Argentina (2018), Bolivia (2018), Chile (2013), Guyana (2010), Paraguay (2017), Peru (2010), Suriname (2016), and Uruguay (2012), obtained from the Global School-based Student Health Survey. Data from Brazil came from the National Adolescent School Health Survey (2015). PA, consumption of alcohol at least once in a lifetime, alcohol consumption at least once in the past 30 days, drunk from alcohol consumption, and tobacco use at least once in their lifetime were assessed. Additionally, gender, age, and food insecurity were used as adjustment variables for logistic regression analysis. We conducted a random-effects meta-analysis for logistic parameters. **Results:** Our results reveal that adolescents who have consumed alcohol in their lifetime had a 24% higher chance (95% CI: 1.16; 1.33) of being insufficiently active, while those who consumed alcohol in the last 30 days had a 25% higher chance (95% CI: 1.16; 1.35), and those who have been drunk due to alcohol consumption had a 15% higher chance (95% CI: 1.07; 1.23) of being insufficiently active. Regarding cigarette use, no clear pattern of association was found. **Conclusion**: Alcohol consumption is associated with being insufficiently physically active, while the association between smoking and PA is inconsistent.

Keywords: Alcohol intake; Cigarette smoking; Students.

RESUMO

***Objetivo*:** *Investigar a associação entre consumo de álcool, tabagismo e atividade física (AF) em adolescentes escolares da América do Sul.* ***Métodos*:** *O estudo de delineamento transversal utilizou levantamentos nacionais de nove países sul-americanos: Argentina (2018), Bolívia (2018), Chile (2013), Guiana (2010), Paraguai (2017), Peru (2010), Suriname (2016) e Uruguai (2012), obtidos da Global School-based Student Health Survey. Os dados do Brasil foram provenientes da Pesquisa Nacional de Saúde do Escolar (2015). Foram avaliados o nível de AF, consumo de álcool pelo menos uma vez na vida, consumo de álcool pelo menos uma vez nos últimos 30 dias, embriaguez devido ao consumo de álcool e uso de tabaco pelo menos uma vez na vida. Além disso, gênero, idade e insegurança alimentar foram utilizados como variáveis de ajuste para a análise de regressão logística. Foi realizada uma meta-análise de efeitos aleatórios para os parâmetros logísticos.* ***Resultados*:** *Nossos resultados mostram que adolescentes que já consumiram álcool ao longo da vida tiveram 24% a mais de chances (IC 95%: 1,16; 1,33) de serem insuficientemente ativos, enquanto aqueles que consumiram álcool nos últimos 30 dias tiveram 25% a mais de chances (IC 95%: 1,16; 1,35). Aqueles que ficaram embriagados devido ao consumo de álcool apresentaram 15% a mais de chances (IC 95%: 1,07; 1,23) de serem insuficientemente ativos. Em relação ao uso de cigarro, não foi identificado um padrão claro de associação.* ***Conclusão*:** *O consumo de álcool está associado à AF insuficiente, enquanto a associação entre o tabagismo e a AF é inconsistente.*

Palavras-chave: *Ingestão de álcool; Tabagismo; Estudantes.*

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Introduction

Alcohol and tobacco use (including smoking, second-hand exposure, and chewing) accounted for 2.44 and 8.71 million deaths worldwide in 2019, respectively[1]. Among adolescents aged 10–19 years, alcohol use ranked as the second leading risk factor for disability-adjusted life years[1]. South American countries are among those with the highest rates of harmful drinking and current tobacco use among adolescents and young adults worldwide[2,3]. Specifically, the prevalence of smoking tobacco among males and females in this region was 31.3% and 23.3%, respectively (for individuals aged ≥15 years), while the prevalence of excessive alcohol consumption was also 31.3% for males and 23.3% for females (for individuals aged 15–39 years)[2,3]. Considering gender differences, Chile exhibited one of the highest global prevalences of tobacco use among females aged 15 and older, whereas Brazil showed the largest reductions in tobacco smoking prevalence among both males and females aged 15 and older (72.5% and 74.7%, respectively)[3]. Alcohol and tobacco use in adolescents has been associated with several high-risk behaviors, including unprotected gender, drug use, aggressive behaviors, and suicidal tendencies[4]. These behaviors are also linked to increased risks of addiction, mental health disorders, and chronic diseases in adulthood[5–8]. Therefore, health systems, governments, and communities in South America must focus on implementing effective preventive strategies to address this critical public health issue.

In Argentina, national surveys indicate a decrease in smoking and alcohol consumption among adolescents over the past decade[9]. In Brazil, national data report lower prevalence rates of smoking and alcohol consumption (8.9% and 28.7%, respectively) among adolescents[10]. However, previous studies involving Brazilian adolescents have estimated high prevalence rates for experimentation with tobacco (18.6%)[11] and alcohol consumption (21.2%)[12]. In Peru, 9.3% and 19.1% of adolescents reported smoking and alcohol consumption, respectively. Despite the legal prohibition of sales of these substances to minors, these rates remain high. Additionally, in Peru, these behaviors are not associated with physical activity (PA) levels among adolescents[13]. In contrast, a Brazilian study found that tobacco smoking was negatively associated with overall PA, whereas alcohol use was positively associated with total PA in an adolescent sample[14].

While the literature provides insight into trends in tobacco use and alcohol consumption among adolescents[14], most studies have not comprehensively covered all South American countries and regions. Furthermore, the association between these behaviors and PA levels warrants more population-based research in low- and middle-income countries[15,16]. Future studies should address these gaps, enabling more comprehensive regional comparisons and a deeper understanding of the cultural and socioeconomic factors influencing these behaviors among adolescents. Therefore, the present study aims to investigate the association between alcohol drinking, tobacco smoking and PA in South American school adolescents.

Methods

This cross-sectional study is based on national adolescent surveys (age range: 11-19 years) from nine South American countries (Argentina, Bolivia, Brazil, Chile, Guyana, Paraguay, Peru, Suriname, and Uruguay). Data from Argentina (2018), Bolivia (2018), Chile (2013), Guyana (2010), Paraguay (2017), Peru (2010), Suriname (2016), and Uruguay (2012) were obtained from the Global School-based Student Health Survey (GSHS)[17]. The GSHS uses self-administered questionnaires to assess and monitor risk and protective behaviors among adolescents aged 13 to 17[17]. Data from Brazil were from sample 2 of the 2015 National Adolescent School-based Health Survey (*Pesquisa Nacional de Saúde do Escolar* - PeNSE)[18]. Ethics committees in each respective country approved all surveys. Supplementary Material 1 provides additional information on sampling procedures, while Supplementary Table 1 and 2 contains further details on missing values.

Physical activity levels

Total habitual PA was assessed with the question: "During the past 7 days, how many days were you physically active for at least 60 minutes per day?" The possible responses were: a) no days, b) one day, c) two days, d) three days, e) four days, f) five days, g) six days, h) seven days. Respondents who engaged in at least 60 minutes of PA per day over the past seven days were classified as "active"[19–21].

Cigarette use

Cigarette use was assessed for the countries using the GSHS questionnaire with the question: "How old were you when you first tried a cigarette?"[22] The possible responses were: a) I have never smoked; b) 7 years old or

younger; c) 8 to 9 years old; d) 10 to 11 years old; e) 12 to 13 years old; f) 14 to 15 years old; g) 16 years old or older. For data analysis, this variable was recategorized: participants who reported having smoked at least once in their lifetime were classified as 'yes,' and those who reported "I have never smoked" were classified as "no." In PeNSE (2015), the question was: "Have you ever smoked a cigarette, even just one or two puffs?" with responses as yes or no.

Alcohol consumption

Alcohol consumption was assessed using the questions: "How old were you when you had your first drink of alcohol beyond just a few sips?"[23], The possible responses were: a) I have never drunk alcoholic beverages; b) 7 years old or younger; c) 8 to 9 years old; d) 10 to 11 years old; e) 12 to 13 years old; f) 14 to 15 years old; g) 16 years old or older. The frequency of alcohol consumption was assessed with the question: "During the past 30 days, on how many days did you have at least one drink containing alcohol?"[24] The possible responses were: a) no days; b) 1 or 2 days; c) 3 to 5 days; d) 6 to 9 days; e) 10 to 19 days; f) 20 to 29 days; g) all 30 days. The experience of getting drunk was analyzed with the question: "In your life, how many times have you drunk so much alcohol that you were really drunk?"[25], the possible responses were: a) never; b) 1 or 2 times; c) 3 to 9 times; d) 10 or more times. Alcohol consumption variables were then recategorized: individuals who reported having consumed alcohol at least once in their lifetime, had at least one drink in the past 30 days, or had been drunk at least once were classified as 'yes,' while those who reported 'I have never drunk alcoholic beverages,' did not consume alcohol on 'no days' in the past 30 days, and had never been drunk were classified as 'no.'"

Covariates

Gender (male/female) and age (11 years, 12 years, 13 years, 14 years, 15 years, 16 years, 17 years, 18 years, 19 years) were used as adjustment variables. For descriptive analysis, age was recategorized into (11 to 13 years, 14 to 15 years, 16 and years or older). The question on food insecurity, used in this study as a proxy for socioeconomic level[26], was assessed with the question: "During the past 30 days, how often did you go hungry because there was not enough food in your home?" This variable was coded as "never/rarely" (food secure) and "sometimes/most of the time/always" (food insecure)[26].

Statistical Analysis

Descriptive statistics were conducted using absolute and relative frequencies with their respective 95% con-

Table 1 – Characteristics of the sample by gender, age, food insecurity, physical activity, alcohol, drunk, alcohol consumption in the last 30 days and cigarette (n = 76,611).

Countries	Gender	Age			Food insecurity	Physical activity	Alcohol	Drunk	Alcohol consumption in the last 30 days	Cigarette
	Girls	11-13y	14-15y	>16y	Yes	Active	Yes	Yes	Yes	Yes
Argentina	52.4 (51.0; 53.9)	20.3 (18.7; 21.8)	46.8 (45.7; 47.9)	32.9 (31.2; 34.6)	11.1 (10.2; 12.1)	16.4 (15.7; 17.2)	76.3 (75.1; 77.6)	38.7 (36.9; 40.6)	55.2 (53.9; 56.5)	38.9 (37.0; 40.8)
Bolívia	51.2 (46.7; 55.7)	11.0 (9.5; 12.6)	38,4 (35.8; 41.0)	50.6 (47.2; 53.9)	19.8 (18.8; 20.9)	11.8 (10.8; 12.8)	44.7 (41.8; 47.6)	24.2 (24.1; 28.3)	28.1 (25.5; 30.8)	-
Brazil	49.1 (47.4; 50.7)	10.4 (9.5; 11.2)	33.8 (32.4; 35.2)	55.8 (54.3; 88.4)	12.8 (11.6; 14.1)	7.3 (6.5; 8.1)	63.6 (62.4; 64.8)	48.3 (46.7; 49.9)	48.7 (47.3; 50.2)	37.1 (35.5; 38.7)
Chile	50,8 (43.9; 57.7)	21.5 (15.2; 27.8)	33.9 (26.7; 41.1)	44.6 (37.7; 51.5)	8.1 (6.6; 9.6)	13.6 (11.3; 15.8)	60.1 (56.3; 63.9)	28.6 (24.0; 33.1)	36.5 (32.4; 40.6)	53.1 (49.2; 57.0)
Guyana	51,8 (48.9; 54.7)	23.6 (19.3; 27.9)	60.3 (55.9; 64.8)	16.1 (11.2; 20.8)	31.3 (25.2; 37.3)	16.0 (12.7; 19.1)	69.1 (65.6; 72.6)	31.6 (28.1; 35.0)	41.5 (38.3; 44.7)	30.7 (27.4; 33.9)
Paraguay	52.0 (49.8; 54.1)	20.8 (14.7; 26.9)	40.9 (37.5; 44.3)	38.3 (30.4; 46.1)	11.5 (9.8; 13.2)	16.9 (14.9; 18.9)	60.4 (56.9; 63.9)	23.3 (20.3; 26.3)	36.3 (32.7; 39.8)	-
Peru	49.6 (44.0; 55.3)	20.5 (16.3; 2 4.8)	63.3 (59.2; 67.4)	16.2 (13.1; 19.1)	18.4 (16.3; 20.4)	15.4 (13.7; 17.1)	50.3 (45.9; 54.8)	17.2 (14.6; 19.8)	31.1 (27.8; 34.4)	35.0 (31.8; 38.2)
Suriname	51.5 (42.7; 60.3)	24.7 (19.5; 30.0)	44.1 (40.3; 47.9)	31.2 (23.9; 38.4)	32.5 (27.8; 37.3)	19.5 (17.2; 21.8)	64.0 (59.7; 68.3)	25.6 (22.2; 28.9)	40.7 (36.6; 44.8)	30.8 (27.4; 34.2)
Uruguay	54.6 (52.7; 56.4)	22.2 (19.1; 25.3)	60.7 (58.9; 62.5)	17.1 (14.0; 20.1)	7.2 (6.1; 8.3)	15.7 (13.9; 17.4)	70.5 (68.3; 72.6)	30.2 (28.1; 32.2)	48.7 (46.4; 51.1)	29.8 (27.4; 32.3)

Data are presented as prevalence estimates (%) and their 95% confidence intervals.

fidence intervals. Logistic regression models were used to identify the associations of alcohol drinking and tobacco smoking variables with PA, reporting odds ratios. We performed a random-effects meta-analysis for logistic parameters using the "metafor" package. All analyses included sample weighting for each country and were conducted using R version 4.3.3.

Results

The initial sample had 97,590, after excluding the missing (details of this exclusion are available in supplementary table 1), the final sample included 76,611 adolescents from different countries in South America, including Argentina (n = 49,566), Bolivia (n = 6,100), Brazil (n = 7,281), Chile (n = 1,823), Guyana (n = 1,918), Paraguay (n = 2,695), Peru (n = 2,385), Suriname (n = 1,788), and Uruguay (n = 3,055).

Table 1 presents the sample characteristics. Suriname (19.5%; 95% CI: 17.2; 21.8), Paraguay (16.9%; 95% CI: 14.9; 18.9), and Argentina (16.4%; 95% CI: 15.7; 17.2) showed the highest prevalence of active adolescents. Argentina (76.3%; 95% CI: 75.1; 77.6) and Uruguay (70.5%; 95% CI: 68.3; 72.6) had the highest prevalences of adolescents who have consumed alcohol, while Bolivia had the lowest prevalence (44.7%; 95% CI: 41.8; 47.6). Brazil had the highest prevalence of adolescents who have been drunk (48.3%; 95% CI: 46.7; 49.9). Adolescents from Chile (53.1%; 95% CI: 49.2; 57.0), Argentina (38.9%; 95% CI: 37.0; 40.8), and Peru (35.0%; 95% CI: 31.8; 38.2) had the highest prevalences of cigarette consumption.

Figure 1 presents the harmonized meta-analysis of the associations between variables related to alcohol consumption and PA. Although the association between PA and alcohol consumption was not significant in all countries, adolescents who have ever consumed alcohol in their lifetime had 24% higher odds (OR = 1.24; 95% CI: 1.16; 1.33) of being insufficiently active, with stronger association in Argentina (OR = 1.48; 95% CI: 1.33; 1.65). Adolescents who consumed alcohol in the past 30 days had 25% higher odds (OR = 1.25; 95% CI: 1.16; 1.35) of being insufficiently active, with statistically significant associations observed in Argentina (OR = 1.41; 95% CI: 1.25; 1.59), Chile (OR = 1.46; 95% CI: 1.01; 2.10) and Paraguay (OR = 1.43; 95% CI: 1.09; 1.88). Adolescents who have been drunk due to alcohol consumption had 15% higher odds (OR = 1.15; 95% CI: 1.07; 1.23) of being insufficiently active, with statistically significant associations observed in Argentina (OR = 1.21; 95% CI: 1.09; 1.33) and Paraguay (OR = 1.58; 95% CI: 1.17; 2.13).

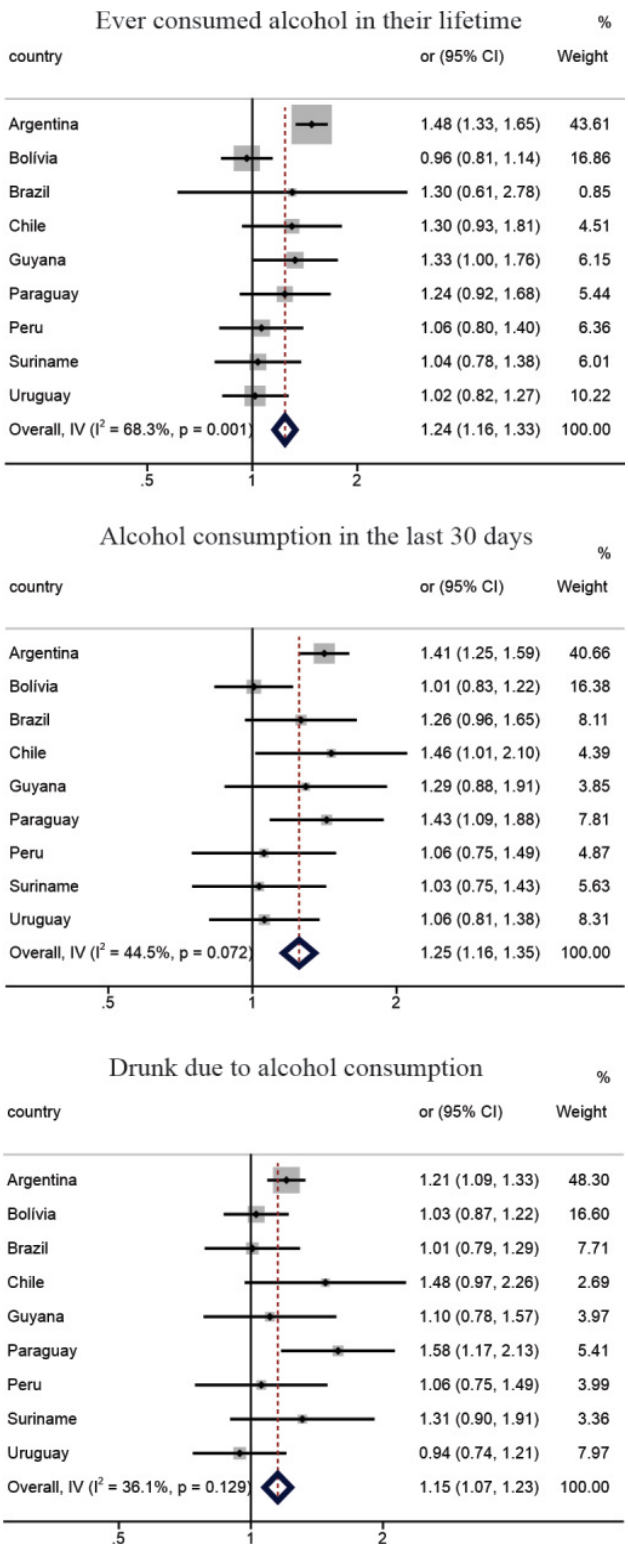

Figure 1 – Harmonized meta-analysis of the associations between variables related to alcohol consumption and physical activity, adjusted for gender, age, and food insecurity.

Figure 2 presents specific and pooled associations between cigarette smoking and PA. There was no significant association for the pooled analysis (OR = 1.04; 95% CI: 0.97; 1.11). In Suriname, adolescents who reported smoking cigarettes had 30% lower odds (OR = 0.70; 95% CI: 0.52; 0.94) of being insufficiently active.

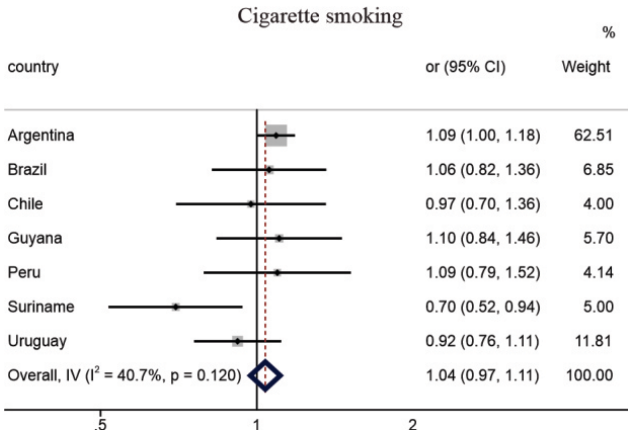

Figure 2 – Harmonized meta-analysis of the associations between cigarette smoking and physical activity, adjusted for gender, age, and food insecurity.

Discussion

The present study aimed to investigate the association between alcohol consumption, tobacco smoking, and PA in South American school adolescents. Our findings reveal that alcohol consumption among South American adolescents is associated with higher odds of being insufficiently active, particularly in Argentina, Chile, and Paraguay. In contrast, no significant association was found between tobacco smoking and insufficient PA.

Previous studies have shown inconsistent results (i.e., positive, negative, or no statistical association) regarding the relationship between smoking and PA in adolescents[27–29]. These inconsistencies could be due to contextual differences and/or methodological variations in measuring and operationalizing smoking and PA[30,31]. For instance, further investigations are needed into how sports events or health policies address alcohol and tobacco in different countries[32]. Brazil is a success story in reducing tobacco smoking in recent years[33,34], however, alcohol has high social acceptability, and alcoholic beverage advertising is common at sports events[32].

Our results showed some inconsistencies between countries; in Argentina, there was a marginal positive association between smoking and PA, while in Suriname, a negative association was found (adolescents who reported smoking had lower odds of physical inactivity), but most countries showed no association between smoking and PA. Considering our data are harmonized, we speculate that specific contexts could influence the results. The literature has indicated that negative behaviors, such as smoking and alcohol consumption, can cluster and could be associated with physical inactivity[35,36]. In Argentina, for example, all alcohol variables (i.e., alcohol consumption, alcohol consumption in the last 30 days, and drunkenness) increased the odds of being insufficiently active, which could indicate an additive interaction between there behaviors and physical inactivity.

The strengths of this study include the use of a large sample from nine South American countries and the application of comparable instruments to assess all variables in this study. However, some limitations should be noted: a) Our results should be interpreted with caution, as we had many missing values in the alcohol and tobacco consumption variables. Additionally, the sample from Argentina is much larger than those from the other countries, which could impact the meta-analysis results; b) PA was assessed through self-administered questionnaires, which may lead to recall bias; c) Self-reported alcohol consumption and tobacco smoking may be subject to social desirability bias; d) The GSHS and PeNSE questionnaires are surveys that only analyze adolescents who are in school, so we cannot generalize the results to the broader adolescent population; e) Studies on the reliability and validity of the questions used are not available in the countries analyzed; and f) The questionnaires do not include a variable on e-cigarette use, which is a highly relevant issue today. The questionnaires need to be updated to include this variable; g) Even using the most recent databases from most countries, there is considerable variability in the periods when these data were collected, which can introduce bias, especially due to cultural changes that may have occurred over time; h) Brazil was the only country where we did not use the most recent survey, since the 2019 PeNSE did not include the question on PA required for the study. Additionally, the 2015 PeNSE (sample 2) was methodologically designed to allow comparisons with the GSHS[37]; i) Another possible limitation is the use of different variables to measure alcohol consumption. However, it is important to note that these variables have been widely used and compared in the literature[23–25].

Based on the findings of the present study, as practical applications, health promotion strategies are needed to increase PA levels in adolescents in South

American countries (the highest prevalence of PA was 20% observed, in Suriname). Intervention should also focus on strategies to reduce alcohol consumption and smoking in adolescents, as in addition to high prevalence of these lifestyle habits, especially alcohol consumption was associated with a higher odd of being insufficiently active. As a suggestion for future studies, we highlight two points: a) school and family environments can be two settings for health promotion strategies to be considered; b) determining the minimum amount of PA necessary to have a protective effect (e.g., 1, 2, or 3 days) in conjunction with alcohol and tobacco consumption is a point to be addressed.

Thus, we concluded that adolescents who consume alcohol are more likely to be insufficiently active. The association between smoking and PA is not consistent.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Ywgne J: Conceptualization; Methodology; Validation; Formal analysis; Investigation; Data curation; Project administration; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version. Werneck AO: Methodology; Formal analysis; Writing – original draft; Writing – review & editing; Approval of the final version. Bizzozero-Peroni B: Conceptualization; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version. Christófaro DGD: Conceptualization; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Monteiro FC: Methodology; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Pinheiro IKAS: Conceptualization; Methodology; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Sadarangani KP: Methodology; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Tassitano RM: Conceptualization; Methodology; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Silva DRP: Conceptualization; Validation; Formal analysis; Data curation; Supervision; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

The authors did not use artificial intelligence tools for preparation of the manuscript.

Availability of research data and other materials

The contents are already available.

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Supplementary material 1

Global School Health Survey (GSHS)

The Global School-based Student Health Survey (GSHS) was designed to provide accurate data on health behaviors and protective factors among students to help countries develop school health programs and public health policies. Additionally, the data obtained from the GSHS allow international agencies and countries to compare the prevalence of health behaviors and protective factors. This enables the establishment of trends in the prevalence of health behaviors and protective factors by country, which can be used in evaluating school health and promoting youth health.

The GSHS is a school-based survey conducted primarily among students aged 13 to 17 using a standardized scientific sample selection process, a common school-based methodology, and a self-administered questionnaire that can be completed during a regular class period. Countries develop their specific questionnaires using standardized core and expanded core questions, to which they can add country-specific questions. The questions are translated into the appropriate language of instruction for the students and pilot tested for comprehension.

The GSHS was developed by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) in collaboration with UNICEF, UNESCO, and UNAIDS[1]. The GSHS used a two-stage sample design: 1) schools, selected with a probability proportional to enrollment size, represent the first level; 2) classrooms, which were randomly selected, and all students in the selected classes were eligible to participate. In our study, considering the exclusion of missing data, the final sample using the GSHS was composed of students from Argentina (n = 49,566), Bolivia (n = 6,100), Chile (n = 1,823), Guyana (n = 1,918), Paraguay (n = 2,695), Peru (n = 2,385), Suriname (n = 1,788), and Uruguay (n = 3,055)

National School Health Survey (*Pesquisa Nacional de Saúde do Escolar* – PeNSE)

PeNSE aims to assess health risk factors among students enrolled in public and private schools in Brazil. In brief, data were collected by the Brazilian Institute of Geography and Statistics, the Ministry of Health, and the Ministry of Education2. PeNSE 2015 adopted a cluster sampling procedure that included schools from the 26 state capitals, the Federal District, and 26 other municipalities, resulting in 53 strata. In the capitals, schools constituted the first level, while classrooms were the second level. In non-capital municipalities, three stages were used, with municipalities as the primary level, schools as the second, and classrooms as the third level. PeNSE is composed of two datasets (Sample 1 and Sample 2). We used Sample 2 because it was designed to enable comparison, considering the ages of the students, with GSHS data. The initial sample comprised 16,556 subjects, and after excluding missing data, the final sample included 7,281 adolescents.

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Supplementary Table 1 – Characteristics of the samples separated by variable.

Countries	Sample size	Missing by variable							
		Age	Gender	Food insecurity	Physical activity	Alcohol	Alcohol consumption in the last 30 days	Drunk	Cigarette
Argentina	56,981	108	536	499	1,430	3,643	2,143	2,004	1,167
Bolívia	7,931	95	154	70	455	1,388	474	460	-
Brazil	16,556	0	0	30	110	4,757	9,223	9,221	4,723
Chile	2,049	1	16	10	11	146	73	51	42
Guyana	2,392	12	30	16	52	252	136	131	151
Paraguay	3,149	48	62	36	83	291	109	71	-
Peru	2,882	15	18	0	15	368	150	30	133
Suriname	2,126	7	14	21	30	240	165	73	42
Uruguay	3,524	36	36	39	26	253	186	121	50

Supplementary Table 2 – Characteristics of the samples.

Countries	Sample size	Missing	Final sample
Argentina	56,981	7,415	49,566
Bolívia	7,931	1,831	6,100
Brasil	16,556	9,275	7,281
Chile	2,049	226	1,823
Guyana	2,392	474	1,918
Paraguay	3,149	454	2,695
Peru	2,882	497	2,385
Suriname	2,126	338	1,788
Uruguay	3,524	469	3,055

Reviewers' assessment

The reviews of this article were originally conducted in Portuguese. This version has been translated using ChatGPT and subsequently reviewed by the Chief Editors.

Reviewer A

Anonimous

Article title

- I suggest changing to "Association between alcohol drinking, tobacco smoking and physical activity in South American school adolescents/Associação entre consumo de álcool, uso de tabaco e atividade física em adolescentes escolares da América do Sul"

Format

- "Does the article meet the manuscript preparation guidelines for submission to the Brazilian Journal of Physical Activity and Health?
  Yes
- The manuscript is well-structured, containing the sections: introduction, methods, results, and discussion (conclusion as part of the discussion)?
  Yes
- Is the language appropriate, is the text clear, precise, and objective?
  Partially
- Was any indication of plagiarism observed in the manuscript?
  No

Suggestions/Comments:

- Replace the term "alcohol and cigarette consumption" throughout the text with "alcohol drinking and tobacco smoking".
- I suggest sending the text for detailed English language review.

Abstract

- Is the abstract adequate (including: objective, information about study participants, variables studied, main results, and a conclusion) and do they reflect the manuscript's content?
  Partially

Suggestions/Comments:

- Abstract: To present more detailed data on the results found through the use of random-effects meta-analysis for logistic parameters.
- Keywords: remove terms that appear in the manuscript title.

Introduction

- Was the research problem clearly stated and defined?
  Yes
- Is the research problem adequately contextualized in relation to the current knowledge, moving from general to specific?
  Yes
- Are the reasons justifying (including the authors' assumptions about the problem) the need for the study well established in the writing?
  Partially
- Are the references used to support the presentation of the research problem current and relevant to the topic?
  Partially
- Was the aim clearly stated?
  Partially

Suggestions/Comments:

- Introduction: remove prevalence data from the adult population. The manuscript refers specifically to the adolescent population.
- Objective: adjust for ".... the association between alcohol drinking, tobacco smoking and physical activity in South American school adolescents."

Methods

- Are the methods appropriate for studying the research problem?
  Partially
- Are the methods sufficiently detailed?
  No
- Was the selection and recruitment appropriate and adequately described?
  Not applicable
- Were the inclusion and/or exclusion criteria for sample participants described and appropriate for the study?
  Partially
- Information about the instruments used in data collection, their psychometric qualities (e.g., reproducibility, internal consistency, and validity), and, when relevant, the operational definition of variables, were provided?

Partially
- Is the data analysis plan appropriate and adequately described?
  Yes
- Did the authors provide clarification on the ethical procedures adopted for conducting the research?
  Yes

Suggestions/Comments:
- (a) If the GSHS and PeNSE selected students aged 13 to 17, how did the current study recruit students aged 11 to 19?
- (b) Why was the most recent version of PeNSE/2019 not used?
- (c) PeNSE classifies as "active" those who achieved 60 min/day of physical activity in the past five days, and not in the past seven days. This needs to be adjusted.
- (d) Differences in the formulation of questions about tobacco smoking (GSHS versus PeNSE) is a strong limitation of the study. I would like to hear the authors' position on this topic.
- (e) Are the GSHS and PeNSE questions about alcohol drinking "the same" or "similar"? This should be clarified in the manuscript.
- (f) The PeNSE does not provide the question "During the past 30 days, how often did you go hungry because there was not enough food in your home?" How was food insecurity treated among Brazilian school adolescents?

Results

- Is the use of tables and figures appropriate and does it facilitate the communication of the results?
  Yes
- Is the number of illustrations in the article in accordance with what is established by the journal's manuscript submission guidelines?
  yes
- Are the number of participants at each stage of the study, as well as the number and reasons for losses and refusals, presented in the manuscript?
  Not applicable
- Are the characteristics of the participants presented and are they sufficient?
  Partially
- Are the results presented adequately, highlighting the main findings and avoiding unnecessary repetitions?
  Partially

Suggestions/Comments:
- (a) The prevalence rate of physically active Brazilian adolescent students shown in Table 1 (7.3%) does not match the data from Reference 20 (13-15 years: 20%; 16-17 years: 19.25). (b) Also in Table 1, if the GSHS and PeNSE selected students aged 13 to 17, how was the group aged 11 to 13 identified?
- Important, very important: the comments equivalent to the results presented are based on the data provided in References 19 (GSHS) and 20 (PeNSE). If these data come from other sources, it must be included in the manuscript.

Discussion

- The main findings of the study are presented?
  Yes
- Are the limitations and strengths of the study presented and discussed?
  Yes
- Are the results discussed in light of the study's limitations and the existing knowledge on the subject?
  Partially
- Do the authors discuss the potential contributions of the main findings to scientific development, innovation, or practice?
  Partially

Suggestions/Comments:
- (a) I believe it is necessary to detail more specifically the cultural differences that may influence the relationship between physical activity and alcohol drinking among school adolescents in South American countries.
- (b) If the data on tobacco smoking and physical activity were collected from the same project (GSHS), it seems not possible to attribute the inconsistencies in the tobacco smoking-physical activity association due to contextual differences and/or methodological variations in measuring and operationalizing both variables.

Conclusion

- Was the conclusion of the study adequately presented and consistent with the study's objective?
  Partially
- A conclusão do estudo é original? The conclusion of the study is original
  Partially

Suggestions/Comments:
- Observations noted above may modify the study's conclusions.

References

- Are the references up-to-date and sufficient?
  Yes
- Is the majority composed of references to original articles?
  Yes
- Do the references comply with the RBAFS guidelines [quantity and format]?
  Yes
- Is the in-text citation appropriate, meaning the statements in the text cite references that actually substantiate those statements?
  No
- Suggestions/Comments:
- Data attributed to reference 20 (PeNSE) does not correspond to the original (methodology and results).
  Comments to the author:
- The subject of the study is relevant and there is a component of originality in the research topic. However, I believe that there are important limitations in the study methodology and in the data analysis which should be considered in more detail by the study authors. Attached I send my comments item-by-item.

Decision

- Major revisions

Reviewer B

Did not autorized.

Reviewer C

Breno Farah
Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brasil.

Format

- "Does the article meet the manuscript preparation guidelines for submission to the Brazilian Journal of Physical Activity and Health?
  Yes
- The manuscript is well-structured, containing the sections: introduction, methods, results, and discussion (conclusion as part of the discussion)?
  Yes
- Is the language appropriate, is the text clear, precise, and objective?
- yes
- Was any indication of plagiarism observed in the manuscript?
  No
  Suggestions/Comments:
  No

Abstract

- Is the abstract adequate (including: objective, information about study participants, variables studied, main results, and a conclusion) and do they reflect the manuscript's content?
  Partially
  Suggestions/Comments:
- The authors need to present the OR and the respective confidence intervals of the main associations.

Introduction

- Was the research problem clearly stated and defined?
  Yes
- Is the research problem adequately contextualized in relation to the current knowledge, moving from general to specific?
  Yes
- Are the reasons justifying (including the authors' assumptions about the problem) the need for the study well established in the writing?
- yes
- Are the references used to support the presentation of the research problem current and relevant to the topic?
- yes
- Was the aim clearly stated?
- yes
  Suggestions/Comments:
- 1º Para – The authors stated: "Among adolescents aged 10-24 years, alcohol use was the second leading attributable risk factor for disability-adjusted life years". However, this age range includes young adults, extending beyond what is typically considered adolescence (10-19 years). It is recommended to revise the statement to accurately reflect the correct definition of adolescence."

Methods

- Are the methods appropriate for studying the research problem?
  Yes
- Are the methods sufficiently detailed?
  Partially

- Was the selection and recruitment appropriate and adequately described?
  No
- Were the inclusion and/or exclusion criteria for sample participants described and appropriate for the study?
  No
- Information about the instruments used in data collection, their psychometric qualities (e.g., reproducibility, internal consistency, and validity), and, when relevant, the operational definition of variables, were provided?
  Partially
- Is the data analysis plan appropriate and adequately described?
  Partially
- Did the authors provide clarification on the ethical procedures adopted for conducting the research?
  Yes

Suggestions/Comments:

- It is not clear what the criterion for 'active' is—does it mean 7 days a week or 5 days?
- Present the relevance of each measure used for alcohol and smoking
- The authors need to justify the selected confounding factors. What is the rationale behind food insecurity? This needs to be clear.

Results

- Is the use of tables and figures appropriate and does it facilitate the communication of the results?
  Yes
- Is the number of illustrations in the article in accordance with what is established by the journal's manuscript submission guidelines?
  Yes
- Are the number of participants at each stage of the study, as well as the number and reasons for losses and refusals, presented in the manuscript?
  Yes
- Are the characteristics of the participants presented and are they sufficient?
  Yes
- Are the results presented adequately, highlighting the main findings and avoiding unnecessary repetitions?
  Yes

Suggestions/Comments:

- The authors should exclude individual country analyses. At no point in the text was this presented. The most relevant information would be the combination of all data.

Discussion

- The main findings of the study are presented?
  Yes
- Are the limitations and strengths of the study presented and discussed?
  Partially
- Are the results discussed in light of the study's limitations and the existing knowledge on the subject?
  Partially
- Do the authors discuss the potential contributions of the main findings to scientific development, innovation, or practice?
  Partially

Suggestions/Comments:

- "Therefore, life period and cultural differences may influence the relationship between physical activity and alcohol consumption. During adolescence, alcohol consumption appears to be inversely associated with physical activity, suggesting a potential clustering of unhealthy behaviors." - This statement needs citations to support it
- Given that these studies are based on older surveys, cultural changes could be an important factor. However, this was not addressed by the authors. Additionally, the data presented may be less useful today, considering the increased exposure to electronic cigarettes, which the studies did not evaluate. These points definitely need to be addressed by the authors
- The different measures of alcohol consumption are not justified or discussed in the study.

Conclusion

- Was the conclusion of the study adequately presented and consistent with the study's objective?
  Yes
- A conclusão do estudo é original? The conclusion of the study is original
  Yes

Sugestões/comentários:

No

References

- Are the references up-to-date and sufficient?
  Yes

- Is the majority composed of references to original articles?
  Yes
- Do the references comply with the RBAFS guidelines [quantity and format]?
  Yes
- Is the in-text citation appropriate, meaning the statements in the text cite references that actually substantiate those statements?
  No

Suggestions/Comments:

- Citations 4 and 5 have errors:
- 4. Department of Error. The Lancet 2021; 397: 2336.
- 5. Department of Error. The Lancet 2022; 400: 358.

Comments to the author:

- General
- The authors aimed to investigate the association between physical activity and alcohol consumption and smoking among South American adolescents. To this end, they grouped national surveys with similar methodologies. The results showed that not meeting the recommendations was associated with a higher likelihood of alcohol consumption, while smoking was not associated. The sample size is certainly the main aspect of the study (more than 75,000 adolescents)."
- The term 'physically inactive' is incorrect and should be replaced with 'insufficiently active' (those who do not meet the physical activity recommendations)
- his needs to be reconsidered
- With the sample size presented, could the authors demonstrate the minimum amount of physical activity necessary to have a protective effect (e.g., 1, 2, 3 days)? Is it really necessary to reach 300 minutes? This analysis needs to be conducted.

Decision

- Major revisions