Ciência & Saúde Coletiva
cienciaesaudecoletiva.com.br
ISSN 1413-8123. v.29, n.5
DOI: 10.1590/1413-81232024295.06882023EN

Factors associated with concurrent alcohol, tobacco and illicit drug use: 2019 National School-Based Health Survey

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Abstract *The aim of this study was to analyze the factors associated with concurrent alcohol, tobacco and illicit drug use among Brazilian schoolchildren aged 13-17. We conducted a cross-sectional study using data from the 2019 National School-Based Health Survey. The outcome was use of the three substances during the last 30 days. Hierarchical multiple logistic regression was carried out with independent variables grouped into four blocks: sociodemographic characteristics; family context; behavioral aspects; and stressors. Variables with p<0.05 were retained in the final model. The prevalence of concurrent substance use was 3.3%. Being male, living in the Midwest, South and Southeast, skipping school without parent permission, parents not knowing what their children do in their free time, having parents who smoke, having experienced physical aggression from parents, feeling that life is not worth living, trying drinking and illicit drugs before the age of 13, and having friends who drink alcohol, smoke and use drugs in their presence remained associated with the outcome in the final model. The findings reveal high prevalence of concurrent alcohol, cigarette and illicit drug use among adolescents and that poly use is associated with sociodemographic, family, and behavioral factors and stressors.*

Key words *Adolescent, Students, Illicit Drugs, Risk Factors*

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Introduction

Psychoactive substance use is one of the most common risk behaviors in adolescents, being particularly worrying in youth who engage in concurrent use of drugs, a pattern known as polysubstance use[1]. Polysubstance use is defined as the use of *more than one* type of non-prescribed licit or illicit psychoactive substance concurrently – the use of two or more substances on different occasions within a month, year or other period of time – or simultaneously – involving the use of two or more substances at the same time[2].

Epidemiological data from different countries show that polysubstance use prevalence rates in school-age youth vary according to sample size, study period and definition of polysubstance use. Cross-sectional studies found prevalence rates of 18.0% in Canada between 2018 and 2019[3], 13.9% in Spain in 2011[4] and 5.1% in Malaysia in 2017[5].

Recent studies on polysubstance use among adolescents in Brazil used latent class analysis to identify groups of adolescents according to patterns of use. One of these studies performed a latent transition analysis of data from a longitudinal study with 6,391 students in six cities between 2014 and 2015, revealing three distinct patterns of drug use behavior: abstainers/low users (81.54% at baseline, 70.61% after 21 months), alcohol users/binge drinkers (16.65% at baseline, 21.45% after 21 months) and polydrug users (1.80% at baseline, 7.92% after 21 months)[6]. Another study using data from 5,213 school-age youth in three cities collected in 2019 and employing the same type of latent class analysis identified three classes of users: abstainers/low users (63.4%), alcohol users/binge drinkers (29.5%) and polydrug users (7.1%)[7].

Despite studies of polysubstance use among adolescents in Brazil[6,7], national data remains scarce. None of the editions of the National School-Based Health Survey (PeNSE), the main survey in Brazil addressing risk and protective factors for chronic diseases among schoolchildren[8-11], present a detailed analysis of polysubstance use, which is the proposal of the present study.

From a health care perspective, understanding the factors that influence polydrug use among adolescents is essential given the well-known social and health impacts, including risky sexual behavior[12], academic failure[13], delinquency[12], increased risk of suicide[14] and fatal and non-fatal overdose[15].

Studies with representative samples of adolescents are therefore essential to construct epidemiological profiles and guide the formulation of drug prevention policies targeting this group. The aim of this study was therefore to analyze the factors associated with concurrent alcohol, cigarette and illicit drug use among Brazilian schoolchildren aged between 13 and 17 who participated in the 2019 National School-Based Health Survey (PeNSE).

Methods

We conducted an analytical cross-sectional study using data from the fourth edition of the 2019 PeNSE on schoolchildren aged 13-17 years from 6,612 classes (seventh year of junior high school to the third year of high school) distributed throughout 4,242 public and private schools, including technical colleges. The sample is representative of Brazil, its five regions, states, capital cities and the Federal District[11]. Further details on the sample can be found in a previous publication[11] and the data are publicly available on the website of the Brazilian Institute of Geography and Statistics (IBGE) (www.ibge.gov.br).

For the purposes of this study, we selected only students who replied "yes" or "no" to questions about current alcohol, cigarette and illicit drug use, resulting in a sample loss rate of 4.2%.

The PeNSE data were collected in 2019 using a questionnaire answered by the students using a smartphone. The data used in the present study were obtained in August 2022 from the IBGE website (https://biblioteca.ibge.gov.br).

The outcome was "concurrent alcohol, cigarette and illicit drug use". Adolescents who replied "yes" to the questions about use of the three substances in the past 30 days were deemed to be poly users. Use was assessed and categorized using the following indicators:

- Drinking – measured using the question "During the last 30 days, on how many days did you have at least one alcoholic drink?" – (yes, no).
- Smoking – (1) "During the last 30 days, on how many days did you smoke cigarettes?" – (yes, no); (2) "During the last 30 days, which of the following tabaco products did you use – water pipe?" (yes, no); (3) "During the last 30 days, which of the following tabaco products did you use – electronic cigarettes (e-cigarette)?" (yes, no); (4) "During the last 30 days, which of the following tabaco products did you use – clove cig-

arettes (Bali cigarettes)?" (yes, no); (5) "During the last 30 days, which of the following tabaco products did you use – roll-up cigarettes?" (yes, no); (6) "During the last 30 days, which of the following tabaco products did you use – other?" (yes, no). The following filter questions were used for this indicator: "Have you ever tried a water pipe?"; "Have you ever tried electronic cigarettes (e-cigarettes)?"; "Have you ever tried other tabaco products besides a water pipe and electronic cigarettes?".

• Illicit drug use – "During the last 30 days, on how many days did you use drugs?" (yes, no).

To assess associated factors, the independent variables were grouped into four blocks: 1) Sociodemographic characteristics; 2) Family context; 3) Stressors; and 4) Behavioral aspects (Figure 1).

1) Sociodemographic characteristics (Model 1): Age; Sex; Race/skin color; Maternal education level; Type of school (public or private); School location (urban or rural); Region.

2) Family context (Model 2): Living with their mother; Living with their father; Skipping school without parent/guardian permission (during the past 30 days); Parents/guardians knew what their children were doing in their free time (during the past 30 days); Parents/guardians smoke; Parents/guardians drink; Experienced physical aggression from parents/guardians (during the past 12 months).

3) Stressors (Model 3): Has been touched, manipulated, kissed or had parts of their body exposed against their will (at least once in their life); Has been threatened, intimidated or forced to have sex or perform any other type of sexual act against their will (at least once in their life); Has been bullied (during the past 30 days); Has felt that life is not worth living (during the past 30 days); Has felt that no one cares about them (during the past 30 days).

4) Behavioral aspects (Model 4): First tried cigarette smoking before the age of 13; First tried drinking before the age of 13; First tried drugs before the age of 13; Friends have drunk in their presence (during the past 30 days); Friends have smoked in their presence (during the past 30 days); Friends have used drugs in their presence (during the past 30 days).

The variables were described using frequencies (percentages and 95% confidence intervals - 95%CI) and associations were assessed. Prevalence of polysubstance use was calculated by dividing the number of students who replied "yes" to concurrent alcohol, cigarette and illicit drug use by the total number of students who answered the questions, excluding those who did not reply to at least one of the questions.

The analysis of the factors associated with prevalence of concurrent alcohol, cigarette and illicit drug use was performed using a four-block hierarchical model (first block, sociodemographic characteristics; second block, family context; third block, stressors; and fourth block, behavioral aspects) (Figure 1).

The Wald chi-squared test was used to identify the factors associated with polysubstance use. All variables that obtained a p-value of<0.20 in the bivariate analysis were retained in the multivariate model. The effect measure was the prevalence ratio with 95% confidence interval (95%CI), calculated using Poisson's regression. The reference categories were the lowest polysubstance use prevalence rates. Variables with a p-value of>0.05 were removed one by one from the hierarchical models including variables from the same block using the backward elimination method, resulting in four regression models.

In Model 1, the variables from block 1 were adjusted separately, retaining those that were statistically significant (p-value<0.05); in Model 2, the variables from block 2 were adjusted against each other and the statistically significant variables from Model 1; in Model 3, the variables from block 3 were adjusted against each other and the statistically significant variables from Model 2 (p-value<0.05); in Model 4 (the final model), the variables were adjusted against each other and the variables from block 3, retaining those that were statistically significant (p-value<0.05).

The statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) 20.0, considering the design effect for complex samples.

Ethical considerations

The 2019 PeNSE was approved by the National Research Ethics Committee (Conep - reference number 3.249.268, de 08.04.2019).

Results

A total of 124,654 students responded the questions about alcohol, cigarette and illicit drug use. A total of 4,110 adolescents (3.3%) reported using the three substances during the past 30 days, without distinction as whether use was concurrent or simultaneous (Table 1).

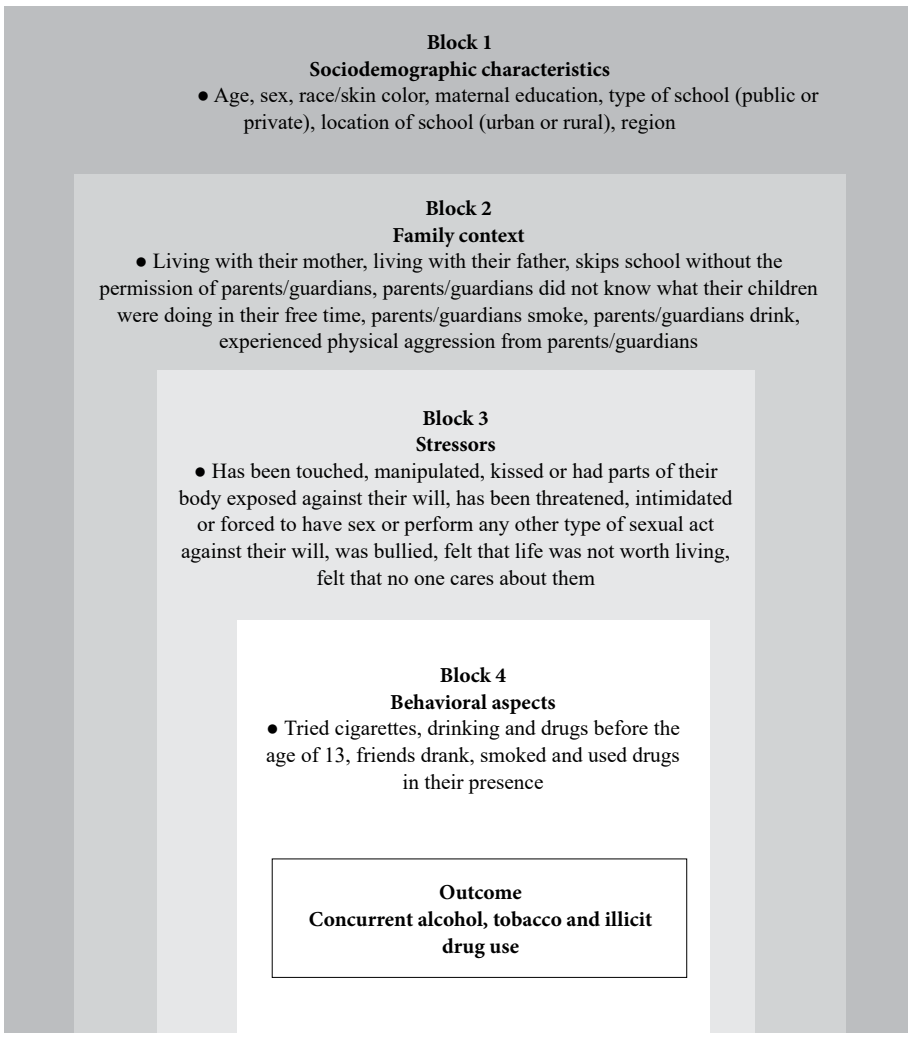

Figure 1. Hierarchical model used to determine concurrent alcohol, cigarette and illicit drug use among Brazilian schoolchildren.

Source: Authors.

Table 1 shows the crude prevalence rates, revealing that prevalence of concurrent alcohol, cigarette and illicit drug use was highest in the following groups: adolescents aged 16 and 17 years (PR=2.71; 95%CI: 2.55-2.88); boys (PR=1.19; 95%CI: 1.13-1.27); black schoolchildren (PR=1.50; 95%CI: 1.37-1.65); adolescents whose mothers did not have any schooling (PR=1.24; 95%CI: 1.04-1.47); students form public schools (PR=1.25; 95%CI: 1.17-1.33); students from urban schools (PR=1.72; 95%CI: 1.44-2.06); and students living in the South (PR=2.36; 95%CI: 2.15-2.60), Southeast (PR=2.09; 95%CI: 1.92-2.29) and Midwest (PR=1.92; 95%CI: 1.75-2.11).

Table 2 shows the associations found for family variables. Not living with their mother or father increased the prevalence of polysubstance use by 62% and 63%, respectively. The following variables also showed a significant association ($p<0.001$) with concurrent alcohol, cigarette and illicit drug use: adolescents who reported skipping classes/school at least once without parent permission (PR=3.22; 95%CI: 3.03-3.43); those whose parents did not know what they were doing in their free time (PR=2.09; 95%CI: 1.92-

2.29); those whose parents/guardians smoked (PR=2.05; 95%CI: 1.92-2.18); those whose parents/guardians drank (PR=1.65; 95%CI: 1.54-1.77); and those whose experienced physical aggression from their parents/guardians (PR=1.87; 95%CI: 1.76-1.99).

Table 3 shows the associations found for stressors. Prevalence of polysubstance use was higher in adolescents who had been touched, manipulated, kissed or had parts of their body exposed against their will and who had been threatened, intimidated or forced to have sex or perform any other type of sexual act against their will than in those who had not (PR=2.54; 95%CI: 2.38-2.71 and PR=3.11; 95%CI: 2.87-3.36, respectively). In addition, the prevalence of polysubstance use was higher among adolescents who were bullied (PR=1.19; 95%CI: 1.12-1.27), felt no one cared about them (PR=1.78; 95%CI: 1.67-1.90) and felt that life was not worth living (PR=2.20; 95%CI: 2.08-2.34).

With regard to behavioral aspects, there was a significant association between concurrent alcohol, cigarette and illicit drug use (p<0.001) and

Table 1. Crude association between concurrent alcohol, cigarette and illicit drug use and sociodemographic variables among Brazilian schoolchildren, 2019.

Variables	No n (%)	Yes* n (%)	PR**	95%CI	p***
Age (n=124,654)					
13-5 years	80,507 (97.6)	1,714 (2.4)	1		<0.001
16-17 years	40,037 (93.7)	2,396 (6.5)	2.71	(2.55-2.88)	
Sex (n=124,366)					
Male	59,094 (95.3)	2,205 (4.7)	1.19	(1.13-1.27)	<0.001
Female	61,174 (96.3)	1,893 (3.7)	1		
Race/skin color (n=122,138)					
White	45,790 (95.1)	1,631 (4.9)	1.19	(1.12-1.28)	<0.001
Black	12,922 (94.7)	583 (5.3)	1.50	(1.37-1.65)	
Brown	51,788 (96.6)	1,531 (3.4)	1		
Yellow	4,239 (96.4)	154 (3.6)	1.22	(1.04-1.44)	
Indigenous	3,392 (95.6)	108 (4.4)	1.07	(0.88-1.30)	
Maternal education level (n=104,899)					
No schooling	3,136 (96.6)	138 (3.4)	1.24	(1.04-1.47)	0.014
Did not complete middle school	14,324 (96.0)	485 (4.0)	0.96	(0.87-1.07)	
Completed middle school	5,621 (95.9)	202 (4.1)	1.02	(0.88-1.18)	
Did not complete high school	7,384 (95.9)	266 (4.1)	1.02	(0.90-1.16)	
Completed high school	23,625 (95.8)	788 (4.2)	0.95	(0.87-1.03)	
Did not complete higher education	8,670 (94.3)	350 (5.7)	1.14	(1.02-1.28)	
Has not completed higher education	38,551 (95.6)	1,359 (4.4)	1		
Type of school (n=124,654)					
Public	62,527 (95.7)	2,365 (4.3)	1.25	(1.17-1.33)	<0.001
Private	58,017 (96.2)	1,745 (3.8)	1		
School location (n=124,654)					
Urban	114,417(95.7)	3,988 (4.3)	1.72	(1.44-2.06)	<0.001
Rural	6,127 (98.1)	122 (1.9)	1		
Region (n=124,654)					
North	27,468 (97.6)	720 (2.4)	1.17	(1.07-1.29)	<0.001
Northeast	41,958 (97.9)	934 (2.1)	1		
Southeast	21,519 (94.4)	1,029 (5.6)	2.09	(1.92-2.29)	
South	12,726 (94.9)	691 (5.1)	2.36	(2.15-2.60)	
Midwest	16,873 (95.8)	736 (4.2)	1.92	(1.75-2.11)	

*Poly users: n=4,110; **PR = Prevalence Ratio; ***p-value = Wald chi-squared test.

Source: Authors.

trying drinking and drugs before the age of 13 (Table 3). Prevalence of polysubstance use was also higher among adolescents who reported having friends who drank (PR=22.29; 95%CI: 19.61-25.25), smoked (PR=21.80; 95%CI: 19.88-23.92) and used illicit drugs (PR=51.98; 95%CI: 46.85-57.66) in their presence.

Table 4 shows the results of the hierarchical analysis. The following variables remained associated with polysubstance use in the final model: being male; living in the Midwest, South and Southeast; skipping school without parent/guardian permission; parents/guardians not knowing what children do in their free time; having parents/guardians who smoked; experiencing physical aggression from parents/guardians; feeling that life is not worth living; trying drinking and drugs before the age of 13; and having friends who drank, smoked and used drugs in their presence. The variables in the final model with the highest PR were adolescents whose friends used drugs (PR=3.94; 95%CI 3.50-4.43) and drank (PR=2.22; 95%CI 1.93-2.54) in their presence.

Discussion

Prevalence of concurrent alcohol, cigarette and illicit drug use was highest among boys and adolescents living in the Midwest, South, Southeast and North, who slip school without parent/guardian permission, whose parents/guardians did not know what they were doing in their free time, whose parents/guardians smoke, and who experienced physical aggression from parents/guardians. Other factors associated with polysubstance were feeling that life is not worth living, trying drinking and illicit drugs before the age of 13, and having friends who drink, smoke and use illicit drugs in their presence. These find-

Table 2. Crude association between concurrent alcohol, cigarette and illicit drug use and family context among Brazilian schoolchildren, 2019.

Variables	No n (%)	Yes n (%)	PR*	95%CI	p**
Living with their mother (n=124,613)					
Yes	107,347(96.1)	3,414 (3.9)	1		<0.001
No	13,157 (93.4)	695 (6.6)	1.62	(1.50-1.76)	
Living with their father (n=124,570)					
Yes	76,383 (96.5)	2,101 (3.5)	1		<0.001
No	44,078 (94.7)	2,008 (5.3)	1.63	(1.53-1.73)	
Skipping school without parent/guardian permission (during the past 30 days) (n=124,376)					
Yes	18,108 (91.0)	1,545 (9.0)	3.22	(3.03-3.43)	<0.001
No	102,169 (97.0)	2,554 (3.0)	1		
Parents/guardians knew what their children were doing in their free time (during the past 30 days) (n=124,193)					
Yes	112,237 (96.1)	3,551 (3.9)	1		<0.001
No	7,864 (92.7)	541 (7.3)	2.09	(1.92-2.29)	
Parents/guardians smoke (n=124,514)					
Yes	22,485 (93.5)	1,342 (6.5)	2.05	(1.92-2.18)	<0.001
No	97,919 (96.5)	2,768 (3.5)	1		
Parents/guardians drink (n=124,450)					
Yes	76,173 (95.1)	3,052 (4.9)	1.65	(1.54-1.77)	<0.001
No	44,172 (96.9)	1,053 (3.1)	1		
Experienced physical aggression from parents/guardians (during the past 12 months) (n=123,524)					
Yes	25,765 (92.7)	1,403 (7.3)	1.87	(1.76-1.99)	<0.001
No	93,703 (96.6)	2,653 (3.4)	1		

*PR = Prevalence Ratio; **p-value = Wald chi-squared test.

Source: Authors.

Table 3. Crude association between concurrent alcohol, cigarette and illicit drug use and stressors and behavioral aspects among Brazilian schoolchildren, 2019.

Variáveis	No n (%)	Yes n (%)	PR*	95%CI	p**
Stressors					
Has been touched, manipulated, kissed or had parts of their body exposed against their will (at least once in their life) (n=123,880)					
Yes	18,131 (91.2)	1,311 (8.8)	2.54	(2.38-2.71)	<0.001
No	101,670 (96.6)	2,768 (3.4)	1		
Has been threatened, intimidated or forced to have sex or perform any other type of sexual act against their will (at least once in their life) (n=123,852)					
Yes	6,844 (88.3)	682 (11.7)	3.11	(2.87-3.36)	<0.001
No	112,933 (96.3)	3,393 (3.7)	1		
Has been bullied (during the past 30 days) (n=124,213)					
Yes	47,165 (95.0)	1,790 (5.0)	1.19	(1.12-1.27)	<0.001
No	72,955 (96.3)	2,303 (3.7)	1		
Has felt that life is not worth living (during the past 30 days) (n=124,054)					
Yes	42,792 (93.6)	2,280 (6.4)	2.20	(2.08-2.34)	<0.001
No	77,170 (97.2)	1,812 (2.8)	1		
Has felt that no one cares about them (during the past 30 days) (n=124,177)					
Yes	56,056 (97.0)	1,332 (3.0)	1		<0.001
No	64,025 (94.8)	2,764 (5.2)	1.78	(1.67-1.90)	
Behavioral aspects					
First tried cigarette smoking before the age of 13 (n=25,011)					
Yes	6,422 (85.4)	1,027 (14.6)	1		0.213
No	15,035 (84.8)	2,527 (15.2)	1.04	(0.97-1.12)	
First tried drinking before the age of 13 (n=77,217)					
Yes	25,433 (91.0)	1,928 (9.0)	1.61	(1.52-1.71)	<0.001
No	47,676 (94.9)	2,180 (5.1)	1		
First tried drugs before the age of 13 (n=14,781)					
Yes	1,476 (13.0)	772 (36.1)	1.29	(1.21-1.37)	<0.001
No	9,200 (72.1)	3,333 (27.9)	1		
Friends drunk in their presence (during the past 30 days) (n=124,476)					
Yes	47,553 (91.4)	3,860 (8.6)	22.29	(19.61-5.25)	<0.001
No	72,817 (99.5)	246 (0.5)	1		
Friends smoked in their presence (during the past 30 days) (n=124,490)					
Yes	27,280 (87.9)	3,605 (12.1)	21.80	(19.88-3.92)	<0.001
No	93,104 (99.2)	501 (0.8)	1		
Friends used drugs in their presence (during the past 30 days) (n=124,654)					
Yes	15,787 (79.9)	3,721 (20.1)	51.98	(46.85-7.66)	<0.001
No	104,535 (99.5)	385 (0.5)	1		

*PR = Prevalence Ratio; **p-value = Wald chi-squared test.

Source: Authors.

ings indicate that polysubstance use is multifactorial and requires close attention from a public health perspective. In this sense, understanding patterns of adolescent substance use is essential

to develop effective prevention and harm reduction strategies.

Prevalence of concurrent alcohol, cigarette and illicit drug use in the present study (3.3%) was similar to the rate found by a national study investigating the association between peer victimization and polysubstance use and violent behavior carried out in 2012, in which 3.1% of adolescents reported using three substances[16]. In addition, the findings of the III national drug use survey conducted in 2015 showed that more than one million adolescents drank and smoked during the 12 months prior to the survey and almost 400,000 drank and used at least one illicit substance[17]. These data are worrying given that concurrent substance use among adolescents leads to increased risk for negative health and social consequences[1].

Table 4. Analysis of factors associated with concurrent alcohol. cigarette and illicit drug use among Brazilian schoolchildren. 2019.

Variables	Model 1	Model 2	Model 3	Model 4
	*PRaj (95%CI)	*PRaj (95%CI)	*PRaj (95%CI)	*PRaj (95%CI)
Age				
13-15 years	1	1	1	
16-17 years	2.69 (2.53-2.87)	2.63 (2.47-2.80)	2.45 (2.30-2.62)	
Sex				
Male	1.17 (1.10-1.24)	1.18 (1.12-1.26)	1.55 (1.45-1.65)	1.17 (1.11-1.23)**
Female	1	1	1	1
Race/skin color				
White	1.06 (0.98-1.14)	1.09 (1.01-1.17)	1.00 (0.82-1.21)	
Black	1.36 (1.25-1.06)	1.19 (1.09-1.31)	1.17 (1.00-1.38)	
Yellow	1.46 (1.24-1.49)	1.16 (0.99-1.35)	1.20 (1.09-1.32)	
Brown	1	1	1	
Indigenous	1.18 (0.98-1.44)	1.05 (0.86-1.27)	1.10 (1.03-1.18)	
Type of school				
Public	1.16 (1.09-1.24)			
Private	1			
School location				
Urban	1.50 (1.24-1.80)	1.42 (1.18-1.72)	1.38 (1.15-1.67)	
Rural	1	1	1	
Region				
North	1.20 (1.09-1.33)	1.19 (1.08-1.32)	1.12 (1.02-1.24)	1.09 (1.00-1.18)
Northeast	1	1	1	1
Southeast	2.09 (1.92-2.28)	1.93 (1.77-2.11)	1.92 (1.75-2.09)	1.11 (1.03-1.19)
South	2.41 (2.18-2.66)	2.27 (2.06-2.51)	2.26 (2.04-2.49)	1.15 (1.06-1.25)
Midwest	1.94 (1.76-2.13)	1.88 (1.70-2.06)	1.86 (1.69-2.04)	1.18 (1.09-1.28)

it continues

Table 4. Analysis of factors associated with concurrent alcohol, cigarette and illicit drug use among Brazilian schoolchildren, 2019.

Variables	Model 1	Model 2	Model 3	Model 4
	*PRaj (95%CI)	*PRaj (95%CI)	*PRaj (95%CI)	*PRaj (95%CI)
Living with their mother				
Yes		1	1	
No		1.28 (1.17-1.39)	1.23 (1.13-1.33)	
Living with their father				
Yes		1	1	
No		1.30 (1.22-1.39)	1.25 (1.13-1.33)	
Skipping school without parent/guardian permission (during the past 30 days)				
Yes		2.45 (2.30-2.62)	2.22 (2.08-2.37)	1.16 (1.11-1.23)**
No		1	1	1
Parents/guardians knew what their children were doing in their free time (during the past 30 days)				
Yes		1	1	1
No		1.89 (1.73-2.07)	1.68 (1.53-1.84)	1.11 (1.03-1.20)
Parents/guardians smoke				
Yes		1.49 (1.39-1.59)	1.42 (1.33-1.52)	1.08 (1.02-1.14)
No		1	1	1
Parents/guardians drink				
Yes		1.42 (1.32-1.53)	1.40 (1.30-1.50)	
No		1	1	
Experienced physical aggression from parents/ guardians (during the past 12 months)				
Yes		1.74 (1.63-1.86)	1.48 (1.39-1.59)	1.06 (1.00-1.12)
No		1	1	1
Has been touched. manipulated. kissed or had parts of their body exposed against their will. (at least once in their life)				
Yes			1.67 (1.55-1.80)	
No			1	
Has been threatened. intimidated or forced to have sex or perform any other type of sexual act against their will (at least once in their life)				
Yes			1.51 (1.38-1.66)	
No			1	
Has been bullied (during the past 30 days)				
Yes			1.10 (1.04-1.17)	
No			1	

it continues

Table 4. Analysis of factors associated with concurrent alcohol. cigarette and illicit drug use among Brazilian schoolchildren. 2019.

Variables	Model 1 *PRaj (95%CI)	Model 2 *PRaj (95%CI)	Model 3 *PRaj (95%CI)	Model 4 *PRaj (95%CI)
Has felt that life is not worth living (during the past 30 days)				
Yes			1.59 (1.48-1.72)	1.13 (1.07-1.19)**
No			1	1
Has felt that no one cares about them (during the past 30 days)				
Yes			1	
No			1.22 (1.13-1.32)	
First tried drinking before the age of 13				
Yes				1.09 (1.03-1.15)
No				1
First tried drugs before the age of 13				
Yes				1.09 (1.02-1.17)
No				1
Friends drunk in their presence (during the past 30 days)				
Yes				2.22 (1.93-2.54)**
No				1
Friends smoked in their presence (during the past 30 days)				
Yes				1.89 (1.69-2.10)**
No				1
Friends used drugs in their presence (during the past 30 days)				
Yes				3.94 (3.50-4.43)**
No				1

*PR_{aj} = adjusted Prevalence Ratio; **p-value<0.001.

Source: Authors.

Our findings show that prevalence of polysubstance use was higher in boys. A study in the United States also showed that boys were more likely to belong to all typologies of substance use than girls[1]. This was also observed among Malaysian[5] and European[18] adolescents. In contrast, a study in three cities in Brazil reported that girls were more likely to drink heavily and be poly users[7]. While gender differences may be influenced by cultural changes in the role women play in society[19], both boys and girls may use several different combinations of substances, meaning it is difficult to accurately capture these differences[20].

With regard to regions and polysubstance use, the strength of association was lowest in adolescents living in the Northeast and highest in the Midwest. In the latter region, prevalence of trying and recently using the substances investi-

gated by the study were high. The Federal District ranked first among the country's states for trying illicit drugs and second for trying water pipes and recent use of illicit drugs[11]. Other national studies[21,22] have showed that schoolchildren living in regions with higher gross domestic product, such as the Southeast, South and Midwest, showed higher prevalence of alcohol and illicit drug use.

The parental monitoring variables "skips school without parent permission" and "parents did not know what children were doing in their free time" remained associated with polysubstance use. National studies[23,24] have highlighted the importance of parental monitoring for preventing adolescent drug use, with children whose parents adopt a neglectful parenting style being more likely to be poly users. Paying attention, taking an interest in children's free time activities and friends[24], and open communication[25,26] are considered protective factors. In addition, it is important that school drug prevention programs include activities that target parents to reduce neglectful practices and raise parent awareness of their role[23,24].

Parent disapproval of drug use has also been highlighted as an important protective factor against polysubstance use, with adolescent drug use being lower in families who set rules restricting the use of substances[26]. In contrast, children of parents who use psychoactive substances themselves are more likely to be polysubstance users[27]. While our study data are cross-sectional, the significant association between having "parents/guardians who smoke" and polysubstance use may be explained by parental influence, as these types of parents reinforce behaviors that are conducive to drug use. It is also worth highlighting that studies[28,29] have demonstrated a possible genetic predisposition to substance use/dependency. However, several questions still need to be answered, especially in relation to the epigenetic approach to human development, which suggests that hereditary conditions associated with environmental factors throughout life have an impact on the manifestation of predisposition to chemical dependency.

Also in relation to family context, experiencing physical aggression from parents/guardians was associated with higher prevalence of polysubstance use. A study with adolescents in Spain showed that prevalence of all types of maltreatment was higher among polydrug users, suggesting that drugs may be a way of coping with *past* experiences of *suffering*[30]. Socially constructed beliefs that children should be educated using punishment and humiliation is a worrying risk factor as it normalizes this type of violence[31].

Although the variables related to sexual abuse did not remain associated with substance use in the final model, it is important to highlight that almost one-third of poly users in the present study reported suffering sexual harassment and around 17% were threatened, intimidated or forced to have sex or perform any other type of sexual act against their will. According to data from the national notifiable diseases information system for the period 2011- 2017, the most commonly reported types of sexual violence against adolescents were rape (70.4%) and sexual harassment (9.9%)[32]. A study with American adolescents showed that youth exposed to both physical and sexual assault were more likely to be polysubstance users[33]. One possible explanation for these findings is that experiencing this type of violence is extremely distressing for the adolescent and can have a negative effect on identity construction, increasing the risk of polysubstance use to cope with these traumatic experiences[30,34].

A little over half of the polysubstance users in our study reported feeling that life is not worth living. This finding is cause for concern, as according to the report The State of the World's Children 2021, 17.1% of Brazilian adolescents are living with a mental health condition[35]. Exposure to problems such as school, violence and mental-health difficulties, which are common in early adolescence, can increase substance use over time and predict subsequent polysubstance use[36]. Adolescents may use tabaco, alcohol or drugs to create moments of pleasure and well-being as a way of reducing symptoms of depression or stress[5]. The interrelations between polysubstance use and depressive symptoms during adolescence are complex, with symptoms of one disorder promoting symptoms of the other[37].

Another alarming finding is early drinking, with around half of the poly users reporting having tried drinking before the age of 13. This shows that, despite a ban on the sale of alcoholic beverages to teenagers, it is not hard for youth to get alcoholic drinks, which are easily available at parties or at their own or relatives' homes[38] and easy to purchase[39]. Besides being the most common used-alone drug, alcohol is present in most of the combinations of substances used by poly drug users and its *widespread availability* makes it the base substance of these combinations[40].

Around one-quarter of poly users reported having tried illicit drugs before the age of 13. Easy access to socially acceptable drugs (alcohol[39]

and cigarretes[41]) exposes adolescents to increased availability and social influence from other drug users, predisposing them to illicit drug use[42]. The earlier the access to these substances, the greater the likelihood of long-term drug use, which can have a permanent effect on the brain[43]. In addition, the effects of these drugs are associated with increased mortality and morbidity during adolescence[44]. Strategies to prevent drug use or delay the onset of first use should therefore include the effective restriction of access to alcohol and cigarrettes[45] and school-based interventions[7].

Polysubstance use during adolescence takes places mainly in groups, when use is not necessarily determined by the psychoactive effects of the substances as mentioned above, but rather the drug chosen by the group[40]. Adolescents who are more susceptible to peer pressure and whose friends value or use drugs are more likely to use drugs[46], although being part of a group that uses or abuses substances does not necessarily mean that individuals make personal use of drugs[47]. It is also important to highlight that parental supervision and support reduces substance use[48] and can diminish the negative influence of peers who use drugs[26].

This study has some limitations. First, the data are from a school-based sample and therefore do not show substance use among adolescents who are not at school. Second, while the study analyzed self-reported use during the past 30 days, the questionnaire does not make a distinction between whether the substances were used at the same time or at different points in time. This information would be useful to estimate the prevalence of concurrent and simultaneous polysubstance use among Brazilian adolescents. However, the data presented are relevant given the importance of understanding which groups of schoolchildren are most exposed to polysubstance use. Study strengths include the analysis of data from the 2019 PeNSE on concurrent alcohol, cigarette and illicit drug use, given that studies of this nature are scarce in Brazil as much research is limited to the separate analysis of drugs and other substances without considering the range of variables related to polysubstance use and the context in which adolescents live.

Conclusion

The findings of this study show that the prevalence of concurrent alcohol, cigarette and illicit drug use among Brazilian school-age youth was high and associated with sociodemographic, family and behavioral factors, and stressors. This study has important implications and it is suggested that prevention of illicit drug use and polysubstance use should focus on restricting access to alcohol and tobacco products, which serve as a gateway to other drugs, and actions to prevent concurrent substance use. This requires efforts from families, schools, civil society and the media directed at reinforcing educational actions and pressuring different spheres of government to impose effective restrictive measures.

Collaborations

MGM Sousa worked on the conception and design of the study, analysis and interpretation of data and writing of the manuscript. LC Castro worked on the data analysis and interpretation and writing of the manuscript. DC Malta carried out the critical review. AMS Gonçalves worked on writing the manuscript. FGV Silva Júnior worked on writing the manuscript. LHO Lima worked on the study design and contributed to the review of the manuscript. All authors approved the final version to be published.

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Article submitted 08/05/2023
Approved 26/09/2023
Final version submitted 28/09/2023

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva