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Pediatric Neurology

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Research Paper

Associated Factors of Attention-Deficit/Hyperactivity Disorder Diagnosis and Psychostimulant Use: A Nationwide Representative Study



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ARTICLE INFO

Article history:

Received 21 August 2021

Accepted 21 November 2021

Available online 15 December 2021

Keywords:

ADHD
 Psychostimulant
 Community prevalence
 Epidemiology
 Diagnosis

ABSTRACT

Background: Connections between epidemiological findings and children's and adolescents' mental health policies have not been properly made in Brazil, and such nationwide studies are scarce. This epidemiological study (1) estimated the prevalence and predictors of parent-reported attention-deficit/hyperactivity disorder (ADHD) (ADHD-report), (2) estimated the probable diagnosis and risk of ADHD based on *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition, criteria (ADHD-probable), and (3) estimated current psychostimulant use (ADHD-pst) in a representative nationwide sample of Brazilian school-aged children and adolescents.

Methods: Data were obtained from 7114 school-aged children (49.9% boys) from 87 cities in 18 Brazilian states. Parents and teachers were interviewed using psychometrically sound questionnaires. Data and codes are available.

Results: The prevalence of ADHD-report, ADHD-probable, and ADHD-pst were 7.1%, 3.9%, and 1.9%, respectively. The agreement was low between ADHD-probable and ADHD-report (22.6%) and between ADHD-report and ADHD-pst (15.6%). Logistic regression revealed that predictors of all three categories were male gender (odds ratio [OR] = 1.71, 2.32, and 1.96, respectively), divorced parents (OR = 1.47, 1.65, and 1.68, respectively), and below-expectation school performance (OR = 3.1, 13.74, and 3.95, respectively). Socioeconomic status was a significant predictor of ADHD-report, and participants from lower classes were less frequently diagnosed with ADHD than their peers from upper classes (OR = 0.57, 95% confidence interval = 0.37–0.88, $P = 0.012$).

Conclusions: The present findings provide an accurate description of ADHD in Brazil. We suggest disparities in agreement between report, risk, and psychostimulant use among children and adolescents and discrepancies between socioeconomic classes concerning the prevalence of an ADHD diagnosis.

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Conflict of interest: The authors declare no conflict of interest.

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<https://doi.org/10.1016/j.pediatrneurol.2021.11.008>
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Introduction

Attention-deficit/hyperactivity disorder (ADHD) is the most prevalent neurodevelopmental disorder, affecting approximately 5% of children and adolescents worldwide.¹ Its symptoms can impair a child's development in virtually all domains of life, including pervasive and persistent age-inappropriate levels of

inattention, hyperactivity, impulsivity, and executive dysfunction.^{2,3} ADHD also increases the risk of defiant, disruptive, and antisocial behaviors, emotional problems, self-harm, substance use disorders, and deficits in communication, learning, and motor skills.⁴ Previous findings suggest that the burden of ADHD extends to the family at large⁵ and is maintained through adulthood.⁶

Psychostimulants are part of ADHD treatment and considered the first-line pharmacological treatment for all ages according to commonly used clinical practice guidelines.^{7,8} Previous findings suggest that proper treatment improves school performance and classroom behavior⁹ and reduces the risk of substance use/abuse,¹⁰ car accidents,¹¹ unintentional injuries, emergency department visits,¹² depression, and suicide.⁸

The proper diagnosis of ADHD is the first step toward appropriate treatment because it provides a means of improving a child's life. However, diagnosing ADHD can be challenging.¹³ Factors that are associated with misdiagnosis include ethnicity or race,¹⁴ gender,¹⁵ immigration status,⁶ and socioeconomic status.¹⁶ Clinical factors are also associated with misdiagnosis and inappropriate treatment, such as a lack of agreement about symptoms that are reported by parents and teachers,¹³ limited consultation time with physicians, and a lack of familiarity and discomfort with diagnostic and prescription guidelines.¹⁷

The present study analyzed a nationwide and representative sample of Brazilian school-aged children and adolescents. Parents and teachers were directly interviewed using standardized questionnaires. The present study (1) estimated the prevalence of parent-reported ADHD diagnosis, (2) estimated current psychostimulant use, (3) estimated the prevalence of children with probable ADHD according to Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5),² criteria, and (4) identified potential predictors of these outcomes.

Methods

Overview

The present study and surveys received approval from the Human Research Committee, São José do Rio Preto School of Medicine (São Paulo, Brazil). From a larger project, 198 teachers of Brazilian elementary schools participated in data collection. Each teacher was individually trained to gain the adequate skills to apply the questionnaires to their students. Parents were also trained by the first author to correctly apply these tools.

Participants

The sample consisted of all 5- to 18-year-old students who were educated by the 198 teachers. This strategy allowed us to sample children from all income levels and both urban and rural areas. Parents were invited to attend a school meeting where the study was explained in detail. Parents who agreed to participate completed the questionnaires, the administration of which was supervised by previously trained teachers. Teachers were also asked to complete validated questionnaires about their students (Table 1).

Information obtained from teachers

Teachers completed the Brazilian version of the Multimodality Treatment Study, Swanson, Nolan, and Pelham IV (MTA-SNAP-IV) scale.¹⁸ This tool is used to identify ADHD symptoms as required by the DSM-5. They were also asked to provide information about the students' school performance using measurements of overall achievement for the school year, derived from competencies in language, mathematics, science, and social studies. The children

TABLE 1
Target Sample and Consented and Analyzed Sample According to Demographic Characteristics.

Variables	Target Sample		Consented		Final Sample		Response Rate (%)	
	n		n	%	n	%	Relative to Target Sample	Relative to Consented
Age group (years)								
5-9	6949		4946	71.2	4239	59.6	61.0	85.7
10-13	3284		2734	83.2	2299	32.3	70.0	84.1
14-18	800		639	79.8	576	8.1	72.0	90.2
Gender								
Female	5238		3945	75.3	3562	50.1	68.0	90.3
Male	5465		4046	74.0	3552	49.9	65.0	87.8
Race								
White	6622		5110	77.2	4609	64.8	69.6	90.2
Non-white	4056		2551	62.9	2227	31.3	54.9	87.3
Nonrespondents			—	—	278	3.9	—	—
Income class ^a								
A, B	3615		2951	81.6	2635	37.0	72.9	89.3
C	5363		3988	74.3	3513	49.4	65.5	88.1
D, E	1816		1016	55.9	966	13.6	53.2	95.1
School								
Public	8549		6873	80.4	5993	84.2	70.1	87.2
Private	1463		1216	83.1	1121	15.8	76.6	92.2
Region								
North	610		419	68.8	250	3.5	41.0	59.6
Northeast	1538		1027	66.8	872	12.3	56.7	84.9
Midwest	963		735	76.3	628	8.8	65.2	85.5
South	3783		3232	85.4	3019	42.4	79.8	93.4
Southeast	3340		2455	73.5	2345	33.0	70.2	95.5
Population density								
<100,000	3601		2814	78.1	2600	36.5	72.2	92.4
100,000-500,000	4472		3456	77.3	3242	45.6	72.5	93.8
>500,000	2058		1546	75.1	1272	17.9	61.8	82.3
Total	10,105		7658	75.8	7114	100.0	70.4	92.9

^a Income classes defined according to Brazilian Economic Classification Criteria. Economic classes A and B represent upper economic classes. Economic classes D and E represent different levels of poverty. Economic class C is the middle class.

were ranked as below expectations, match expectations, or above expectations for their grade.

Information obtained from parents

Parents completed a standardized questionnaire with 102 questions that assessed sociodemographic characteristics, developmental milestones, and past medical history. To estimate the prevalence of parent-reported ADHD diagnosis (ADHD-report), the parents were asked, “Has a medical doctor ever told you that your child has attention-deficit disorder or attention-deficit/hyperactivity disorder, called ADD or ADHD?” A subsequent question asked, “Is your child currently taking any daily (continuous) medication?” and then, “Is your child currently taking any of the following medications?” A list of psychostimulants that were available at the time for the treatment of ADHD was presented. Students who currently used one of these psychostimulants were included in the ADHD-pst group.

Parents also completed the MTA-SNAP-IV scale and Brazilian version of the Strengths and Difficulties Questionnaire and impact supplement.¹⁹ The Cronbach's alpha and Gutmann's lambda were computed to check the reliability of these tools, with results equal to 0.92 and 0.93, respectively. These results were similar to previous cross-country findings, such as the United States²⁰ and China.²¹ The MTA-SNAP-IV assesses the presence of all 18 symptoms of ADHD according to DSM-5 criteria. The first nine symptoms reflect inattention, and the remaining nine reflect hyperactivity/impulsivity. A symptom is considered positive if it is rated “quite a bit” or “very much.” ADHD symptoms are considered present if six or more symptoms of inattention are reported by the caregiver for children up to age 16 years or if five or more symptoms of inattention are reported for adolescents at age 17 years and older. This same rule is applied for hyperactive/impulsivity. The parents were asked to complete the MTA-SNAP-IV scale and Strengths and Difficulties Questionnaire based on the children's behavior without the effect of ADHD medications to avoid information bias. The reliability of the data was checked via Cronbach's alpha and Guttman's lambda, with adequate results ($\alpha = 0.96$, $\lambda = 0.97$). Current symptoms were assessed if the children were not using ADHD medications. In children who used ADHD medications, symptoms before using medication were assessed.

Probable ADHD diagnosis (ADHD-probable)

According to DSM-5 criteria,² the diagnosis of ADHD depends on (A) six or more symptoms of inattention and/or hyperactivity/impulsivity for children up to age 16 years or five or more symptoms of inattention and/or hyperactivity/impulsivity for adolescents age 17+ years, (B) present before the age 12 years and persisting for at least 6 months, being inappropriate for developmental level, (C) several symptoms are present in two or more settings, (D) clear evidence that the symptoms interfere with or reduce the quality of social, school, or work functioning, and (E) symptoms are not better explained by another disorder. Results of this variable might be seen as a proxy for risk of having ADHD.

Statistical analyses

The data are summarized as descriptive statistics. The demographic characteristics of the participants are described as a function of ADHD-report, ADHD-probable, and ADHD-pst. The five income classes were defined according to Brazilian Economic Classification Criteria. The ADHD-report, ADHD-probable, and ADHD-pst groups were classified as binary groups (present or absent). Logistic regressions were performed to check the effect of

demographics (i.e., age, gender, race, income class, educational status of the head of household, parents' marital status, public or private school, city density, and national region where the child lives), prenatal exposure to tobacco and alcohol, school performance, and having a positive MTA-SNAP-IV score according to the parents and/or teachers on the proposed outcomes. The variance inflation factor was checked before interpreting the results. A cutoff of 3 was defined as the threshold for detecting multicollinearity.

The likelihood ratio (LR) test and Wald test were performed to check the level of significance of the model and its predictors. The LR test is an omnibus test that addresses the significance of the variable while ignoring the reference level. The Wald test tests the hypothesis that each coefficient is zero. We strongly recommended interpreting the results based on the LR instead of interpreting the results from univariate models.

The significance level was 5%. All analyses were performed using R, version 4.0, software.²² Data and codes are freely available in an open science repository (<https://osf.io/ubpve/>).

Results

Demographic information

Of the target sample of 10,105 children who were being educated by the 198 participating teachers (average of 51 students/teacher), parental consent was obtained for 7658 children, and analyzable/complete data were obtained from 7114 children. The sample was evenly distributed by gender and enrolled from 87 cities in 18 Brazilian states in five national regions (Table 1).

Prevalence of ADHD-report, ADHD-probable, and ADHD-pst

The preliminary analyses that contrasted the prevalence of the ADHD-report, ADHD-probable, and ADHD-pst groups as a function of demographic features are presented in Table 2. The prevalence of ADHD-report was 7.1%. The prevalence was higher in boys than in girls (relative risk [RR] = 1.76, 95% confidence interval [CI] = 1.48–2.10) and higher in children from upper-income classes A and B than in children from lower-income classes D and E (RR = 1.40, 95% CI = 1.05–1.88). The prevalence was higher in children who lived in the southern region of the country than in children who lived in the northeast region (RR = 1.59, 95% CI = 1.16–2.17).

The prevalence of ADHD-probable was 3.9%, which was higher in younger children and boys (RR = 2.97, 95% CI = 2.27–3.87). Children in the ADHD-probable group predominantly came from lower- (6.4%) and middle- (4.2%) income classes than from upper-income classes (2.6%) and came from public schools (4.2%) than from private schools (2.1%). The prevalence was also higher in children who lived in the southeast region (RR = 4.37, 95% CI = 1.40–13.64) and the south region (RR = 3.22, 95% CI = 1.03–10.08) than in children who lived in the north region and cities with a lower population density than a higher population density (RR = 1.43, 95% CI = 1.02–2.0).

The prevalence of ADHD-pst was 1.9%, which was higher in boys (RR = 2.30, 95% CI = 1.60–3.31) and in children who came from upper-income classes than in children from lower-income classes (RR = 1.97, 95% CI = 1.03–3.73) and moderately populated cities than from highly populated cities (RR = 1.96, 95% CI = 1.13–3.40). We advise these are simple bivariate analyses and should be interpreted with caution.

ADHD-report, ADHD-probable, and ADHD-pst agreement

A total of 114 (22.6%) of the 505 children in the ADHD-report group were also classified in the ADHD-probable group

TABLE 2
Prevalence and Relative Risk of Parent-Reported ADHD, Probable ADHD, and Current Use of Psychostimulants According to Demographic Characteristics.

Variables	ADHD-report				ADHD-probable				ADHD-pst			
	n	%	RR (95% CI)	P	n	%	RR (95% CI)	P	n	%	RR (95% CI)	P
Age group (years)												
5-9	297	7	1.3 (0.9-1.8)	0.192	176	4.2	2.0 (1.1-3.6)	0.011	74	1.7	1.1 (0.6-2.2)	0.783
10-13	176	7.7	1.4 (1.0-2.0)	0.077	89	3.9	1.9 (1.02-3.4)	0.031	52	2.3	1.4 (0.7-2.9)	0.299
14-18	32	5.6	Reference		12	2.1	Reference		9	1.6	Reference	
Gender												
Female	183	5.1	Reference		70	2	Reference		41	1.2	Reference	
Male	322	9.1	1.8 (1.5-2.1)	<0.001	207	5.8	3.0 (2.3-3.9)	<0.0001	94	2.6	2.3 (1.6-3.3)	<0.0001
Ethnicity												
White	322	7	Reference		163	3.5	Reference		94	2	Reference	
Non-white	167	7.5	1.1 (0.9-1.3)	0.452	104	4.7	1.3 (1.04-1.7)	0.025	36	1.6	0.8 (0.5-1.2)	0.225
Nonrespondents	16	5.8	0.8 (0.5-1.3)	0.541	10	3.6	1.0 (0.5-1.9)	0.923	5	1.8	0.9 (0.4-2.1)	0.889
Income class*												
A, B	203	7.7	1.4 (1.05-1.9)	0.019	68	2.6	Reference		59	2.2	2.0 (1.04-3.7)	0.028
C	249	7.1	1.3 (1.0-1.7)	0.074	147	4.2	1.6 (1.2-2.2)	<0.001	65	1.9	1.6 (0.9-3.1)	0.121
D, E	53	5.5	Reference		62	6.4	2.5 (1.8-3.5)	<0.0001	11	1.1	Reference	
School												
Public	417	7	Reference		254	4.2	2.1 (1.4-3.2)	<0.0001	114	1.9	Reference	
Private	88	7.9	1.1 (0.9-1.4)	0.287	23	2.1	Reference		21	1.9	1.0 (0.6-1.6)	0.959
National region												
North	16	6.4	1.2 (0.7-2.2)	0.446	3	1.2	Reference		2	0.8	2.3 (0.4-13.8)	0.386
Northeast	45	5.2	Reference		25	2.9	2.4 (0.7-7.8)	0.141	3	0.3	Reference	
Midwest	35	5.6	1.1 (0.7-1.7)	0.723	9	1.4	1.2 (0.3-4.4)	0.829	9	1.4	4.2 (1.1-15.3)	0.025
Southeast	192	8.2	1.6 (1.2-2.2)	0.003	123	5.2	4.4 (1.4-13.6)	0.001	45	1.9	5.6 (1.7-18)	<0.001
South	217	7.2	1.4 (1.0-1.9)	0.03	117	3.9	3.2 (1.0-10.1)	0.018	76	2.5	7.3 (2.3-23.2)	<0.001
Population density												
<100,000	183	7	1.1 (0.9-1.5)	0.337	129	5	1.4 (1.02-2.0)	0.031	45	1.7	1.5 (0.8-2.6)	0.184
100,000-500,000	243	7.5	1.2 (0.9-1.5)	0.129	104	3.2	0.9 (0.7-1.3)	0.664	75	2.3	2.0 (1.1-3.4)	0.011
>500,000	79	6.2	Reference		44	3.5	Reference		15	1.2	Reference	
Total	505	7.1			277	3.9			135	1.9		

Abbreviations:

ADHD = Attention-deficit/hyperactivity disorder
 ADHD-probable = Children with probable ADHD according to the DSM-5
 ADHD-pst = Children currently using psychostimulants
 ADHD-report = Parent-reported ADHD diagnosis
 CI = Confidence interval
 DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, 5th edition
 RR = Relative risk or Risk ratio

* Income classes defined according to Brazilian Economic Classification Criteria. Economic classes A and B represent upper economic classes. Economic classes D and E represent different levels of poverty. Economic class C is the middle class.

(McNemar $\chi^2_1 = 93.84, P < 0.001$). Additionally, 79 of the 505 children (15.6%) were classified in the ADHD-pst group. Conversely, 114 (41.2%) of the 277 children in the ADHD-probable group were classified in the ADHD-report group, and 36 (13%) were classified in the ADHD-pst group, as shown in Table 3.

Logistic regression

The following variables were associated with the ADHD-report group: male gender (vs. female, $P < 0.001$), divorced parents (vs.

TABLE 3
Prevalence of Parent-Reported ADHD, Probable ADHD, and Current Use of Psychostimulants.

Variables	Total		ADHD-report		ADHD-probable		ADHD-pst	
	n	%	n	%	n	%	n	%
ADHD-report	505	7.1	—		114	22.6	79	15.6
ADHD-probable	277	3.9	114	41.2	—		36	13.0
ADHD-pst	135	1.9	79	58.5	36	26.7	—	

Abbreviations:

ADHD = Attention-deficit/hyperactivity disorder
 ADHD-probable = Children with probable ADHD according to the DSM-5
 ADHD-pst = Children currently using psychostimulants
 ADHD-report = Parent-reported ADHD diagnosis
 DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, 5th edition

married, $P < 0.001$), upper-income classes A or B (vs. D or E, $P < 0.05$), studying in a private school (vs. public school, $P < 0.001$), below-expectation school performance (vs. match-expectation or above-expectation school performance, $P < 0.001$), and having ADHD symptoms reported by parents but not by teachers ($P < 0.001$).

The following variables were significantly associated with the ADHD-pst group: male gender (vs. female, $P < 0.001$), divorced parents (vs. married, $P < 0.05$), coming from middle-income class C (vs. A or B, $P < 0.05$), studying in a private school (vs. public school, $P < 0.05$), below-expectation school performance (vs. match-expectation school performance, $P < 0.001$), and having ADHD symptoms that were reported by parents but not by teachers ($P < 0.05$; Table 4).

The following variables were associated with the ADHD-probable group: male gender (vs. female, $P < 0.001$), divorced parents (vs. married, $P < 0.001$), and below-expectation school performance (vs. match-expectation school performance, $P < 0.001$).

Discussion

To our knowledge, this is the first study that relied on a representative and nationwide Brazilian sample of school-aged children and validated and standardized psychometric questionnaires that were completed by parents and teachers. Our results provide a

TABLE 4
Logistic Regression Analyses of Determinants of Parent-Reported ADHD, Probable ADHD, and Current Use of Psychostimulants.

Variables	ADHD-report				ADHD-probable				ADHD-pst			
	Crude OR (95% CI)	Adjusted OR (95% CI)	P Wald's Test	P LR-Test	Crude OR (95% CI)	Adjusted OR (95% CI)	P Wald's Test	P LR-Test	Crude OR (95% CI)	Adjusted OR (95% CI)	P Wald's Test	P LR-Test
School: private vs. public*	1.14 (0.88, 1.47)	1.73 (1.24, 2.39)	0.001	0.001	0.51 (0.32, 0.8)	1.05 (0.62, 1.78)	0.861	0.862	1.02 (0.62, 1.67)	1.97 (1.05, 3.68)	0.034	0.04
Population density: <100,000*				0.059				0.168				0.07
100,000-500,000	1.04 (0.84, 1.29)	1.16 (0.9, 1.49)	0.258		0.64 (0.48, 0.86)	0.75 (0.53, 1.05)	0.095		1.48 (0.98, 2.23)	1.63 (1.02, 2.6)	0.041	
>500,000	0.83 (0.61, 1.12)	0.78 (0.56, 1.08)	0.138		0.75 (0.51, 1.09)	0.74 (0.49, 1.13)	0.163		0.81 (0.44, 1.51)	0.93 (0.48, 1.79)	0.825	
National region:				0.041				0.099				<0.001
Midwest*												
Northeast	0.85 (0.52, 1.39)	0.94 (0.55, 1.62)	0.821		2.05 (0.91, 4.65)	1.41 (0.59, 3.41)	0.44		0.27 (0.07, 1.03)	0.38 (0.1, 1.52)	0.173	
North	1.08 (0.55, 2.1)	0.83 (0.41, 1.68)	0.611		0.96 (0.25, 3.64)	0.76 (0.19, 3.02)	0.701		0.63 (0.13, 3.01)	0.53 (0.11, 2.57)	0.43	
Southeast	1.36 (0.92, 2.03)	1.54 (0.96, 2.47)	0.072		3.39 (1.64, 7.01)	2.02 (0.9, 4.55)	0.088		1.18 (0.54, 2.55)	1.72 (0.7, 4.21)	0.234	
South	1.32 (0.89, 1.95)	1.53 (0.97, 2.43)	0.069		2.66 (1.29, 5.5)	2.18 (0.98, 4.85)	0.057		1.8 (0.86, 3.77)	2.57 (1.1, 6.02)	0.029	
Age†	0.99 (0.95, 1.03)	0.99 (0.95, 1.03)	0.812	0.811	0.96 (0.91, 1.01)	0.94 (0.89, 1)	0.046	0.043	1 (0.94, 1.08)	1.03 (0.95, 1.11)	0.455	0.458
Male vs. female*	1.9 (1.54, 2.33)	1.71 (1.38, 2.11)	<0.001	<0.001	2.84 (2.11, 3.82)	2.32 (1.7, 3.17)	<0.001	<0.001	2.21 (1.49, 3.3)	1.96 (1.31, 2.94)	0.001	<0.001
White vs. non-white*	0.9 (0.73, 1.11)	0.88 (0.7, 1.11)	0.275	0.277	0.75 (0.57, 0.98)	0.89 (0.66, 1.21)	0.467	0.468	1.35 (0.89, 2.05)	1.18 (0.75, 1.85)	0.471	0.467
Divorced vs. married*	1.6 (1.3, 1.97)	1.47 (1.18, 1.84)	<0.001	<0.001	2.07 (1.58, 2.7)	1.65 (1.23, 2.21)	<0.001	0.001	1.5 (1.02, 2.2)	1.68 (1.12, 2.53)	0.013	0.015
Education status of head of household: illiterate*				0.389				0.339				0.578
Completed elementary school	1.18 (0.65, 2.14)	1.43 (0.76, 2.68)	0.27		0.5 (0.29, 0.86)	0.83 (0.46, 1.49)	0.531		0.99 (0.36, 2.75)	0.93 (0.32, 2.67)	0.888	
Completed high school or more	1.2 (0.66, 2.19)	1.55 (0.8, 3)	0.192		0.36 (0.2, 0.62)	1.06 (0.56, 2.03)	0.854		0.89 (0.32, 2.5)	0.73 (0.24, 2.24)	0.583	
Income class:				0.034				0.183				0.068
A/B*												
C	1.02 (0.82, 1.25)	0.88 (0.69, 1.13)	0.326		1.83 (1.34, 2.52)	1.38 (0.95, 2)	0.091		0.76 (0.52, 1.12)	0.62 (0.4, 0.98)	0.04	
D/E	0.75 (0.53, 1.08)	0.57 (0.37, 0.88)	0.012		2.6 (1.74, 3.91)	1.53 (0.91, 2.59)	0.109		0.55 (0.27, 1.11)	0.46 (0.2, 1.05)	0.064	
Prenatal exposure to tobacco: yes vs. no*	1.66 (1.28, 2.16)	1.29 (0.95, 1.74)	0.103	0.108	1.98 (1.42, 2.75)	1.1 (0.75, 1.63)	0.62	0.622	1.03 (0.59, 1.81)	0.99 (0.54, 1.81)	0.97	0.97
Prenatal exposure to alcohol: yes vs. no*	1.64 (1.17, 2.29)	1.24 (0.85, 1.82)	0.267	0.274	2.25 (1.51, 3.35)	1.62 (1.01, 2.58)	0.045	0.052	0.51 (0.19, 1.4)	0.43 (0.15, 1.22)	0.112	0.076
School performance: Match expectations*				<0.001				<0.001				<0.001
Above expectations	0.51 (0.37, 0.7)	0.55 (0.4, 0.77)	<0.001		0.85 (0.43, 1.67)	0.88 (0.45, 1.75)	0.722		0.63 (0.34, 1.18)	0.62 (0.33, 1.17)	0.142	
Below expectations	2.76 (2.21, 3.44)	3.1 (2.44, 3.94)	<0.001		15.28 (9.69, 24.08)	13.74 (8.67, 21.78)	<0.001		3.56 (2.31, 5.48)	3.95 (2.5, 6.24)	<0.001	
SNAP-IV: parents positive vs. teacher negative*	3.61 (2.84, 4.6)	3.45 (2.65, 4.48)	<0.001	<0.001	—	—	—	—	2.1 (1.29, 3.43)	1.85 (1.1, 3.1)	0.02	0.027
SNAP-IV: teacher positive vs. parents negative*	1.29 (0.97, 1.71)	0.77 (0.56, 1.05)	0.104	0.098	—	—	—	—	1.34 (0.79, 2.25)	0.66 (0.38, 1.16)	0.152	0.139
Log-likelihood = -1361.0522					Log-likelihood = -637.6711				Log-likelihood = -503.7951			
AIC value = 2766.1044					AIC value = 1319.3421				AIC value = 1051.5903			

Abbreviations:

ADHD = Attention-deficit/hyperactivity disorder

ADHD-probable = Children with probable ADHD according to the DSM-5

ADHD-pst = Children currently using psychostimulants

ADHD-report = Parent-reported ADHD diagnosis

AIC = Akaike information criterion

CI = Confidence interval

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, 5th edition

OR = Odds ratio

The comparison group is displayed before the vs.

* Reference variable.

† Continuous variable.

better understanding of community prevalence (i.e., children identified in a representative population sample) and administrative prevalence (i.e., people receiving a clinical diagnosis in the population).

The number of parents who reported a diagnosis of ADHD, the use of psychostimulants, and a probable ADHD diagnosis (i.e., a surrogate for a certain diagnosis) was discrepant. Reciprocal agreement between the three groups was low. Despite preliminary analyses that showed that ADHD was related to children from middle- and lower-income classes, when sociodemographic variables were controlled, common predictors of all groups were male gender, divorced parents, and below-expectation school performance.

The literature suggests that community surveys that are based on standardized diagnostic criteria and structured interviews with parents and teachers provide reliable prevalence estimates of mental disorders, including ADHD.^{23,24} Systematic reviews and meta-regression analyses of community prevalence studies have estimated that the worldwide prevalence of ADHD in children and adolescents ranges from 2.2% to 7.1%.²⁵ We found a 3.9% prevalence of probable ADHD.

Administrative prevalence (i.e., the proportion of individuals of the sample with a parent-reported diagnosis of ADHD or the proportion based on health care databases and prescription data) is also useful. Evidence suggests that gender, age, ethnicity, socioeconomic status, psychiatric comorbidities, and health care systems can bias administrative prevalence, thereby acting as mediators of access to a diagnosis of ADHD and prescriptions and medications for ADHD.²⁶ Consequently, the administrative prevalence of ADHD provides broad estimates, from as little as 0.93% to as high as 11%,²³ which is consistent with our finding of 7.1% in the ADHD-report group.

The regression analysis showed similarities and differences among groups. Common predictors in the three groups were male gender, divorced parents, and below-expectation school performance. ADHD is more commonly diagnosed in males, with a gender ratio of 2:1 to 10:1, which is consistently higher in administrative prevalence studies than in community prevalence studies.^{14,23,27} Evidence suggests that girls with ADHD are less likely to be diagnosed and treated unless they have prominent hyperactivity/impulsivity symptoms, conduct problems, or poor school performance. The higher prevalence of parental divorce among the three groups of children is also reported in the literature. Longitudinal studies have reported a converging evidence that offspring ADHD increases parent's risk of marital problems (separation/divorce), accounting for possible genetic and environmental confounders.²⁸

The discrepancies among groups suggest that ADHD is perhaps being misdiagnosed and inappropriately treated in the present sample, regardless of income. Systematic reviews have shown that children from lower-income classes have a higher risk of ADHD than children from higher-income classes.²⁹ Although preliminary analyses showed that probable ADHD was more prevalent in lower-income classes, the logistic regression did not confirm this finding. However, parent-reported ADHD and the use of psychostimulants had a higher prevalence in the upper-income classes according to both analyses. Individuals in higher-income classes and who have easier access to health care and disease awareness programs face fewer barriers to diagnosis and treatment. Excessive disease awareness, however, can also inflate diagnosis and treatment in higher-income classes. This context favors an increase in false-positive cases in the wealthiest classes and favors false-negative cases in the poorest classes.³⁰ One explanation for the difference between our results and previous findings may be that we relied on a representative sample and adjusted estimates according to demographic and contextual variables.¹⁷

One of the strongest predictors of parent-reported ADHD and current use of psychostimulants was having ADHD symptoms that were reported by parents but not by teachers, which disagreed with the pervasiveness of symptoms, a compulsory criterion for the diagnosis of ADHD according to the DSM-5. It is important to notice that if the parents do not see symptoms of ADHD, they will have limited reason to start their child on medication. One longitudinal study in the United Kingdom showed that the severity of teacher-rated ADHD symptoms in children in early school years was a predictor of subsequent specialist health services.³¹ Other evidence has shown that teachers are better equipped than parents to discriminate developmentally appropriate executive functions.³ We suggest that the impact of a higher demand for attention in a more structured classroom setting than that of the home environment enhances the ability of teachers to identify disruptive behavior vs. merely agitation.

The low agreement among the ADHD-probable, ADHD-report, and ADHD-pst groups also suggests the possibility of misdiagnosis and inappropriate treatment. This outcome suggests overdiagnosis and overtreatment and a predominance of a heuristic diagnosis instead of the adoption of well-established diagnostic criteria.¹⁵ The proportion of cases in the ADHD-probable group with parent-reported diagnosed ADHD did not reach half, possibly because of an ADHD underdiagnosis.

Less than 15% of the children in the ADHD-report and ADHD-probable groups were using psychostimulants, which probably suggests undertreatment. A recent national survey in the United States reported that 62% of children with a parent report of current ADHD were taking medication.³² Lower rates were reported in the United Kingdom, France, and Germany, but data from lower- and middle-income countries are lacking. Notably, among children in the ADHD-pst group, one-third did not have parent-reported ADHD and could not endorse the criteria for probable ADHD, which supported the potential misuse of psychostimulants.³³

Strengths and limitations of our study deserve comment. Among the strengths are the nationally representative sample of children and adolescents, the use of internationally validated questionnaires that were completed by parents and teachers, and regression models that provided adjusted estimates. Among the limitations, although the teachers were trained to administer the questionnaires to the parents, we did not evaluate their accuracy relative to health professionals. This is not concerning, however, because the applied questionnaires are validated for self-administration.³⁴ We also highlight that recall bias frequently acts in surveys that are used to assess medical information. We lack information about the veracity of any prior medical ADHD diagnosis that was reported by the parents, when it was performed, and whether it was conducted by a pediatrician, family physician, child neurologist, or psychiatrist.

Conclusions

ADHD is one of the most common neurobehavioral disorders among children. Although ADHD is usually first diagnosed in childhood, its symptoms persist into adulthood in up to two-thirds of patients. A proper diagnosis is required for proper treatment. Therefore, an initial step for the proper management of ADHD is to investigate reasons for disparities among ADHD diagnoses. The present study conducted population-based research to estimate the prevalence of parent-reported ADHD diagnosis, current psychostimulant use in Brazilian school-aged children and adolescents, and the prevalence of children with probable ADHD according to the DSM-5.

In summary, ADHD appears to be misdiagnosed in this representative sample of Brazilian children and adolescents. It might also

be overdiagnosed and overtreated in some children and adolescents (e.g., those in higher-income families) and underdiagnosed in others (e.g., those in lower-income families and girls). Both of these situations are undesirable. Overdiagnosis may lead to stigmatization and overtreatment, but underdiagnosis and consequent undertreatment may also have deleterious short- and long-term consequences for children, their families, and society. Further studies should be conducted to confirm these findings and identify efficient interventions that can facilitate access to proper ADHD diagnosis and treatment in Brazil, in conjunction with continuing medical education programs that are based on well-established practice guidelines.

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