Brazilian Journal of Psychiatry
bjp
Revista Brasileira de Psiquiatria

Braz J Psychiatry. 2026;48:e20254592
doi:10.47626/1516-4446-2025-4592
Brazilian Psychiatric Association

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ORIGINAL ARTICLE

Alcohol consumption among adolescents with and without attention-deficit/hyperactivity disorder and its interaction with socio-emotional competences at age 18: data from the 2004 Pelotas Birth Cohort

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Objective: Alcohol consumption is becoming increasingly early and frequent among adolescents, and some psychiatric conditions are associated with alcohol-related problems and alcohol use disorder. This study described alcohol consumption frequencies and alcohol use disorder among Brazilian adolescents and investigated the moderating role of socio-emotional competences in the association between alcohol use and attention-deficit/hyperactivity disorder (ADHD).
Methods: This cross-sectional study included 3,093 18-year-old participants of the 2004 Pelotas Birth Cohort (Brazil). We used logistic regression models to evaluate the association between ADHD and alcohol consumption. Moderation analyses were conducted to determine whether socio-emotional variables modified the association between ADHD and alcohol consumption outcomes.
Results: ADHD had no significant effects on any alcohol consumption outcome. Adolescents with ADHD had significantly lower levels of self-control, self-esteem, and emotional control. Unexpectedly, higher emotional control may have been associated with an increased likelihood of alcohol use disorder. No significant interaction effects were found between self-control, self-esteem, and the association between ADHD and regular/excessive alcohol use or alcohol use disorder in the adjusted analysis.
Conclusions: Further research is needed to elucidate the inconsistencies observed in the literature regarding the associations between ADHD and alcohol use, as well as its interaction with socio-emotional factors during adolescence.

Keywords: Adolescents; alcohol abuse; alcohol use disorder, attention deficit disorder with hyperactivity

Introduction

Alcohol is the most commonly consumed psychoactive substance among adolescents in a number of countries.[1] In the United States, two-thirds of school-age students report having used alcohol, and approximately 20% of young people have reported binge drinking in the past 2 weeks.[1] Although data from some European countries show a decline in adolescent alcohol consumption (particularly among boys), a high prevalence of use persists in this age group. For example, a cross-sectional study in Greece involving 1,185 school-aged adolescents reported that 56.6% of boys and 48.4% of girls consumed alcohol at least once in the month prior to the survey, with a mean age of initiation at 13.2 years.[2] According to data from the 2019 Brazilian National School Health Survey (Pesquisa Nacional de Saúde do Escolar), the prevalence of alcohol experimentation was 63.3% among students aged 13 to 17 years, ranging from 55.9% among those aged 13 to 15 years to 76.8% among those aged 16 and 17 years.[3]

The persistently high prevalence of alcohol consumption and the early age of initiation underscore the need for greater attention and a more in-depth discussion of the factors associated with adolescent substance use, as well as the need for enhanced prevention strategies in schools and universities. It is well established that certain psychiatric conditions are associated with alcohol use,

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Submitted Sep 22 2025, accepted Mar 01 2026.

How to cite this article: Bozzini AB, Maruyama JM, Tovo-Rodrigues L, Santos IS, Barros AJD, Matijasevich A. Alcohol consumption among adolescents with and without attention-deficit/hyperactivity disorder and its interaction with socio-emotional competences at age 18: data from the 2004 Pelotas Birth Cohort. Braz J Psychiatry. 2026;48:e20254592. Epub 2026 Mar 30. http://doi.org/10.47626/1516-4446-2025-4592

and longitudinal studies have demonstrated an association between attention-deficit/hyperactivity disorder (ADHD) in childhood or adolescence and alcohol use during adolescence and adulthood.[4]

ADHD is a neurodevelopmental disorder characterized by a persistent pattern of inattention, hyperactivity, and impulsivity that is pervasive across multiple settings and leads to various degrees of functional impairment.[5] It is known that some socio-emotional competencies are jeopardized in individuals with ADHD.[6,7] However, the literature is scarce regarding how socio-emotional characteristics such as self-esteem, emotional control, and self-control may moderate the association between ADHD and alcohol use in adolescents.

This study's hypothesis was that low levels of self-esteem, self-control, and emotional control contribute to the association between ADHD, regular and excessive alcohol consumption, and alcohol use disorder (AUD). We believe that these socio-emotional characteristics do not influence alcohol experimentation, as such behavior constitutes an experience inherent to adolescence. To date, no population-based epidemiological studies have assessed the interaction between socio-emotional characteristics (self-esteem, self-control, and emotional control) and ADHD in relation to alcohol use. Moreover, few Brazilian studies have described patterns of alcohol consumption and AUD in this age group. The aim of this study was to describe the prevalence of alcohol consumption frequencies and AUD among Brazilian adolescents and examine the moderating role of socio-emotional factors in the association between alcohol use and ADHD.

Methods

Participants

The 2004 Pelotas Birth Cohort is a population-based longitudinal study conducted in Pelotas, a city in southern Brazil. All hospital births occurring between January 1 and December 31, 2004, were identified through daily visits to the city's five maternity hospitals, and subsequent follow-up assessments were conducted. A total of 4,231 live births from mothers residing in metropolitan Pelotas were recruited, with a non-response rate of $< 1\%$ at baseline. Trained interviewers administered structured questionnaires to collect information on demographic, socioeconomic, biological, and behavioral characteristics. For the present study, we used data from the perinatal assessment and the 18-year follow-up. The follow-up rate at 18 years was 85%, and 3,093 participants were included. The methodology has been described in detail elsewhere.[8-10]

Alcohol consumption and alcohol use disorder outcomes

The following alcohol consumption outcomes were identified: i) alcohol experimentation; ii) frequency of alcohol consumption, categorized as rarely or never/regular consumption/regular drinking; and iii) AUD. Alcohol consumption was assessed at age 18 using a confidential self-administered questionnaire that included the following questions: "Have you ever tried any alcoholic beverage?" and "How often do you consume alcoholic beverages?" Alcohol experimentation was reported as a dichotomous variable (yes/no), and the frequency of alcohol consumption was categorized as follows: rarely or never (drinks alcohol $<$ twice a month or never); regular drinking (drinks alcohol between twice a month and $<$ three times a week); and excessive drinking (drinks alcohol $\geqslant$ four times a week). AUD was assessed at age 18 through the Mini-International Neuropsychiatric Interview[11] with a specific section consisting of 20 items. The responses pattern to these questions was used to define the presence of AUD.

Attention-deficit/hyperactivity disorder

ADHD symptoms were assessed broadly using two reports: the Adult ADHD Self-Report Scale and mothers'/caregivers' reports on the Strengths and Difficulties Questionnaire at the 18-year follow-up. The Adult ADHD Self-Report Scale is a brief screening instrument to identify current ADHD symptoms.[12] The scale investigates 18 symptoms of inattention, hyperactivity, and impulsivity, defining ADHD according to the DSM-5.[13] Symptom severity is reported on a 5-point Likert-type scale (never, rarely, sometimes, often, and very often), with scores ranging from 0 to 72. The Adult ADHD Self-Report Scale interview was administered by trained psychologists according to standardized procedures in the research clinic at the Universidade Federal de Pelotas. The Adult ADHD Self-Report Scale has been validated for use in Brazil.[14] The Strengths and Difficulties Questionnaire consists of five subscales with five items each, including conduct problems, emotional problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Items are scored on a 3-point Likert-type scale (not true, somewhat true, and certainly true).[15] For the current study, we used the hyperactivity/inattention subscale, in which scores range from 0-10. The mothers or guardians answered the Strengths and Difficulties Questionnaire questions in a scheduled home interview. The Strengths and Difficulties Questionnaire has been validated for use in Brazil.[16] The final variable, determining the presence or absence of ADHD, was constructed based on the aforementioned scales and comprised 25 items covering the following domains: inattention (requiring at least five positive symptoms) and/or hyperactivity (also requiring at least five positive symptoms), pervasiveness (symptoms occurring in more than one setting), age of onset, and functional impairment in social, academic, occupational, or family contexts. For children and adolescents, an ADHD diagnosis requires six or more positive symptoms.

Socio-emotional competences

The present study examined three distinct socio-emotional competencies in adolescents at age 18: self-esteem, emotional regulation, and self-control. Self-esteem at age 18 was evaluated using the Portuguese version of the Rosenberg Self-Esteem Scale.[17,18] This

self-report instrument consists of 10 statements rated on a 4-point Likert scale ranging from 1 (totally disagree) to 4 (totally agree). The scale assesses overall perception of self-worth, comprising six items reflecting positive self-perception and four items indicating negative self-perception. The negatively worded items were reverse-coded, and the total score (ranging from 10 to 40) was determined by summing all responses, with higher values denoting greater self-esteem.

Emotion regulation was measured using the Portuguese version of the Emotional Regulation Index for Children and Adolescents (ERICA).[19,20] This 16-item self-report tool uses a 5-point Likert response format from 1 (totally disagree) to 5 totally agree), producing scores from 16 to 80. Ten items are reverse-scored so that higher totals indicate more effective emotion regulation.[21] The ERICA includes three subscales: i) Emotional control (seven items), which assesses tendencies toward socially inappropriate emotional reactions; ii) Emotional self-awareness (five items), which is related to recognizing one's own emotions and coping with negative feelings; and iii) Situational responsiveness (four items), which assesses empathy and sensitivity to others' emotions.

Self-control at age 18 was evaluated using the Portuguese version of the Brief Self-Control Scale – Revised, a refined and shortened version of the original scale.[22-24] This self-report instrument consists of four statements designed to assess trait self-control (inhibition domain), which were rated on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). The total score (ranging from 4 to 20) was determined by summing all responses, with higher values denoting greater self-control. The scale has shown satisfactory internal consistency and construct validity, providing a brief yet reliable measure suitable for use in research involving adolescents and adults.

Potential confounding factors

Maternal education (complete years of formal education), self-reported maternal race (White, Black, or Other – including mixed race, Asian, or Indigenous), the adolescent's sex, and monthly family income in the month prior to delivery (as quintiles) were used as covariates for adjustment. All of these variables were collected at the cohort baseline interview.

Data analysis

In our cross-sectional analysis, descriptive statistics were presented as means (SD) for continuous variables and as absolute and relative frequencies for categorical variables. Differences between groups were examined with one-way analyses of variance for continuous variables or χ^2 tests for categorical variables. For each alcohol-related outcome (regular/excessive drinking and AUD), we fitted separate multivariable logistic regression models in which ADHD (0 = no, 1 = yes) was the exposure. Effect modification for each socio-emotional competence was assessed on the multiplicative scale by adding a product (interaction) term between ADHD and the continuous moderator. We tested the assumption of linearity in the logit for each socio-emotional competence moderator using likelihood ratio tests comparing linear vs. quadratic models, Wald tests for the quadratic terms, and Wald and likelihood ratio tests for restricted cubic splines with four knots (percentiles 5, 35, 65, and 95). For most moderator-outcome combinations, no evidence of departure from linearity was found (all $p > 0.05$). The only exception was the association between ADHD and AUD as moderated by emotional regulation (ERICA score), for which the likelihood ratio test comparing the linear and quadratic models was statistically significant ($\chi^2_{[2]} = 6.63$, $p = 0.036$), indicating that a quadratic term improved model fit. Although the Wald test for the quadratic terms was not significant ($p = 0.116$), visual inspection of adjusted marginal predictions suggested a non-linear relationship, with distinct patterns between participants with and without ADHD. This moderator-outcome combination was thus modeled using a quadratic specification in the main analyses and presented at the 25th, 50th, and 75th percentiles of emotion regulation. For all other moderator-outcome combinations (self-esteem, self-control, and emotional control in models of regular/excessive alcohol use frequency), the linear specification was retained, and odds ratios for the interaction terms are reported. Separate moderation models were run for each of the three socio-emotional competences. All models were adjusted for potential confounders (sex, maternal race, maternal education, and family income). Odds ratios with 95%CIs were reported for the main effects and the interaction term. To facilitate interpretation of significant and borderline interaction effects, we used Stata's margins command to compute adjusted predicted probabilities and average marginal effects of ADHD across the observed range of each moderator. Graphics of these conditional marginal effects were generated using marginsplot. A two-sided $\alpha = 0.05$ was adopted for statistical significance. All analyses were conducted in Stata/SE 14.2 (StataCorp, College Station, TX, USA).

Ethics statement

The study protocol and all follow-ups of the 2004 Pelotas Birth Cohort study were approved by the Universidade Federal de Pelotas Medical School research ethics committee (35/10,889.753/CAAE: 38013414.9.0000.5317 and 3.554.667/CAAE: 20183419.1.0000.5317). This study was also approved by the Ethics Committee for Analysis of Research Projects (CAPPesq; Research protocol 4.951.457) of the Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo. All main caregivers and adolescents signed an informed consent form before data collection. At the 18-year follow-up, the adolescents also signed an informed assent form.

Results

Table 1 describes the study sample's characteristics, comparing participants included in the present study (n=3,093) with the original cohort (n=4,231). The available data on outcomes and main exposure for 3,093

Table 1 Description of the sample according to perinatal, adolescent, and maternal variables and comparison between the included participants and the original cohort, 2004 Pelotas Birth Cohort (Brazil)

Variable	Included (n=3,093)	Total cohort (n=4,231)	p-value[†]
Biological sex			
Male	1,550 (50.1)	2,195 (51.9)	< **0.001**
Female	1,543 (49.9)	2,036 (48.1)	
Maternal race			
White	2,273 (73.5)	3,088 (73.0)	0.346
Black	614 (19.8)	846 (20.0)	
Other	206 (6.7)	295 (7.0)	
Perinatal family income (quintiles)			
1	579 (18.7)	871 (20.6)	< **0.001**
2	615 (19.9)	854 (20.2)	
3	612 (19.8)	816 (19.3)	
4	675 (22.0)	858 (20.3)	
5	612 (19.6)	830 (19.6)	
Maternal education, years			
0	18 (0.6)	43 (1.0)	< **0.001**
1-4	399 (13.0)	611 (14.6)	
5-8	1,248 (40.9)	1,731 (41.3)	
⩾ 9	1,396 (45.5)	1,801 (43.1)	

Data presented as n (%).
Bold type denotes statistical significance.
[†] χ^2 test.

individuals at age 18 represent 73.1% of the original cohort. The included sample was 50.1% male. Most mothers self-identified as White (73.5% in the included sample vs. 73.0% in the total cohort), and the proportions of Black and other racial categories were also similar across both groups. The included sample was significantly more socioeconomically advantaged: 18.7% of participants in the included sample were in the lowest income quintile, compared to 20.6% in the total cohort. A significant difference was also observed in maternal education level, with a lower proportion of mothers with no formal education in the included sample. Overall, the included sample had a slightly higher percentage of males, higher maternal education levels, and came from more economically privileged backgrounds compared to the full cohort.

Sociodemographic characteristics, alcohol use, and socio-emotional competencies in the total sample and adolescents with and without attention-deficit/ hyperactivity disorder

Table 2 presents a description of sociodemographic characteristics, alcohol use, and socio-emotional competencies in the total sample (n=3,093) and in adolescents diagnosed with ADHD (n=254). We found an ADHD prevalence of 8.2% (3.3% boys and 4.9% girls). No differences were observed in terms of maternal race, family income, or maternal education level between those diagnosed with ADHD and the total sample. Similarly, the frequencies of alcohol experimentation, of alcohol consumption frequency, and AUD did not differ between the ADHD group and the full participant sample. Adolescents with ADHD scored significantly lower on self-control, self-esteem, and emotional regulation than the total sample.

Moderating effect of socio-emotional factors on alcohol use patterns among participants with attention-deficit/ hyperactivity disorder

Emotional control tended to moderate the association between ADHD and AUD. In the fully adjusted model, the ADHD × emotional-control interaction term yielded p = 0.05, OR = 3.53, and 95%CI 0.99-12.61 (Table 3). Although this result suggests a possible association, the confidence interval includes the null value; hence the possibility of no effect cannot be excluded. Therefore, this finding should be interpreted as suggestive rather than conclusive. Further analyses are needed to confirm this association.

Alcohol use stratified by sex

Supplementary Table S1 demonstrated that alcohol experimentation was slightly more common among female adolescents (51.0%) compared to male ones (49.0%) (p = 0.004). However, no sex differences were observed in the frequency of alcohol consumption (p = 0.539). Notably, the frequency of alcohol use disorder was more frequent among male adolescents (57.9%) than females (42.1%) (p < 0.001).

Alcohol use and ADHD

ADHD was not significantly associated with higher prevalence of alcohol consumption or AUD at age 18, as demonstrated in Supplementary Table S2.

Each one-point increase in the emotional-control score amplified the odds of AUD associated with ADHD by roughly 15%. Post-estimation marginal analyses illustrated this pattern (Figure 1): when emotional-control scores were low (< 35), the adjusted probability of AUD

Table 2 Sociodemographic description, alcohol use, and socio-emotional competences in all participants and those with ADHD at age 18, 2004 Pelotas Birth Cohort, Brazil

	Total sample (n=3,093)	ADHD diagnosis (n=254)	p-value
Adolescent sex			
Male	1,550 (49.9)	102 (3.3)	**0.001**
Female	1,543 (50.1)	152 (4.9)	
Maternal race			
White	2,273 (73.5)	197 (6.4)	0.172
Black	614 (19.8)	39 (1.3)	
Other	206 (6.7)	18 (0.6)	
Family income (quintiles)			
1 (poorest)	579 (18.7)	45 (1.5)	0.781
2	615 (19.9)	47 (1.5)	
3	612 (19.8)	50 (1.6)	
4	675 (22.0)	54 (1.7)	
5 (wealthiest)	612 (19.6)	58 (1.9)	
Maternal education, years			
0	18 (0.6)	1 (0.03)	0.675
1-4	399 (13.0)	31 (1.0)	
5-8	1,248 (40.9)	95 (3.1)	
9+	1,396 (45.5)	123 (3.9)	
Alcohol experimentation			
Yes	2,676 (86.5)	219 (7.0)	0.885
No	417 (13.5)	35 (1.2)	
Frequency			
Never/rarely	1907 (61.6)	156 (5.0)	
Regular	1085 (35.1)	87 (2.8)	0.601
Excessive	101 (3.3)	11 (0.4)	
AUD			
Yes	454 (14.6)	45 (1.5)	0.153
No	2,639 (85.4)	209 (6.7)	
Self-control (range: 4-20), mean (SD)	11.88 (2.5)	10.92 (2.5)	< **0.001**
Self-esteem (range: 12-40), mean (SD)	29.19 (4.7)	26.35 (4.9)	< **0.001**
Emotional control (range: 20-80), mean (SD)	57.02 (7.2)	52.69 (7.2)	< **0.001**

Data presented as n (%), unless otherwise specified.
Bold type denotes statistical significance.
ADHD = attention-deficit/hyperactivity disorder; AUD = alcohol use disorder.

Table 3 Moderation effect of emotional control, self-esteem, and self-control in alcohol use patterns among adolescents with attention deficit hyperactivity disorder at age 18, adjusted for covariates,† 2004 Pelotas Birth Cohort (Brazil)

	Regular/excessive alcohol use frequency OR (95%CI)	p-value	AUD OR (95%CI)	p-value
ADHD*Emotional control	1.06 (0.96-1.18)	0.218		
ADHD*Emotional Control (P25)	-	-	0.83 (0.21-3.36)	0.799
ADHD*Emotional Control (P50)	-	-	1.39 (0.39-4.96)	0.608
ADHD*Emotional Control (P75)	-	-	3.53 (0.99-12.61)	**0.050**
ADHD*Self-Esteem	1.01 (0.87-1.17)	0.860	0.93 (0.75-1.15)	0.551
ADHD*Self-Control	1.01 (0.75-1.36)	0.912	1.06 (0.71-1.58)	0.745

ADHD = attention-deficit/hyperactivity disorder; AUD = alcohol use disorder; OR = odds ratio; P25 = 25th percentile; P50 = 50th percentile; P75 = 75th percentile.
Non-linearity for emotion regulation in the AUD model supported by the likelihood-ratio test ($\chi^2_{[2]} = 6.63$, p = 0.036). All other moderator-outcome combinations retained linear specification.
† All models were adjusted for adolescent sex, maternal race, maternal education, and family income.
Bold type denotes statistical significance.

was similar for adolescents with and without ADHD; from ~ 55 points onward, the effect of ADHD increased steadily, more than doubling the probability of AUD at the highest levels of emotional control (global test of the interaction in marginal effects: p = 0.05). By contrast, emotional control did not moderate the association between ADHD and regular/excessive drinking. The interaction term was null (OR = 1.06; 95%CI 0.96-1.18; p = 0.218).

Neither self-esteem nor self-control moderate the association between ADHD and the examined alcohol outcomes. In fully adjusted models, the ADHD × self-

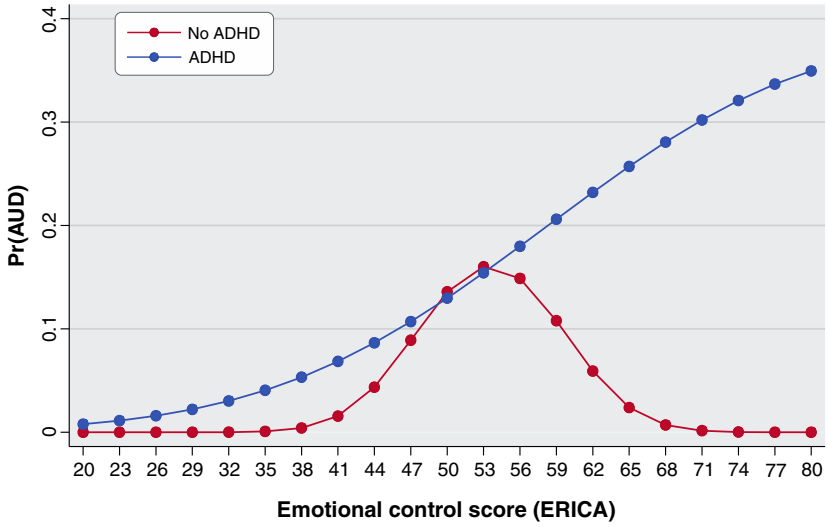


Figure 1 Predicted probability of AUD across emotional control scores in participants with and without ADHD, adjusted analysis (confidence interval bars were omitted to enhance the visual clarity of the figure) (p = 0.050). ADHD = attention-deficit/hyperactivity disorder; AUD = alcohol use disorder; ERICA = Emotional Regulation Index for Children and Adolescents.

esteem interaction was non-significant for AUD (interaction OR = 0.93, 95%CI 0.75-1.15, p = 0.551) and for regular/excessive drinking (interaction OR = 1.01, 95%CI 0.87-1.17, p = 0.860) (Table 3). Likewise, the ADHD × self-control term showed no evidence of moderation for AUD (interaction OR = 1.06, 95%CI 0.71-1.58, p = 0.745) or for regular/excessive drinking (interaction OR = 1.01, 95%CI 0.75-1.36, p = 0.912) (Table 3). Thus, in contrast to emotional control, self-esteem, and self-control do not appear to have mitigated or amplified the relationship between ADHD and adolescent alcohol involvement in this cohort.

Discussion

The present study explored alcohol consumption frequency and AUD in adolescents at age 18, the relationship between ADHD and alcohol use, and its interaction with socio-emotional competencies as potential moderator factors. We found an ADHD prevalence of approximately 8% (male and female) in the total sample. Previous studies have reported an ADHD prevalence of around 5.6%,[25] while more recent research has shown a steadily increasing prevalence trend in the general population, reaching 10%.[26] The findings from our cohort suggest that ADHD is more prevalent in women. Although ADHD was once thought of as a predominantly male disorder (at least in childhood), current research suggests that the number of women with ADHD may be nearly equal to that of men.[27,28]

We found an alcohol experimentation rate of 86.5%, which is roughly similar to the rate reported in the ERICA study, in which 67% of Brazilian adolescents aged 12 to 17 years reported having experimented alcohol. Regarding recent alcohol use, national data indicate a prevalence of 21% (ERICA)[29] and 27.3% (PENSE 2009).[30] Although we did not assess this specific measure, the prevalence of regular use (from twice a month to three times a week) found in our study was 35.1%. These data reveal that alcohol experimentation among Brazilian adolescents has not decreased over the past decade. Consistent with previous findings, we also observed a higher prevalence of alcohol experimentation among female adolescents and a significantly higher frequency of AUD among male adolescents.[31] This phenomenon may be due to sociocultural factors and changes in the dynamics of postmodern society.

In our sample, no significant differences were identified between individuals with and without ADHD in terms of family income, maternal educational attainment, frequency of alcohol consumption, alcohol experimentation, or the presence of AUD. The literature reveals that ADHD disproportionately affects socioeconomically disadvantaged children, but for unclear reasons.[32] Multiple adverse social determinants of health, including low income, low parental education level, short housing tenure, food insecurity, single parenthood, prenatal smoking, and family mental illness, are associated with ADHD diagnosis, symptom severity, and poor treatment response.[32-35] This finding may be partially explained by the fact that the individuals included in our study came from more economically advantaged backgrounds and had mothers with higher educational attainment.

Several clinical studies have demonstrated lower levels of self-esteem in individuals with ADHD than those without the disorder.[36,37] In accordance with the literature, we found significantly lower levels of self-esteem, self-control, and emotional regulation in individuals diagnosed with ADHD. Self-esteem is a complex construct that has been described in a variety of ways. Generally, it can be defined as one's cognitive and emotional concept of about oneself, and there is a growing consensus that self-esteem is a multidimensional construct involving different areas such as competence, achievement, and a judgment

of self-worth.[38] The association between ADHD and low self-esteem has been demonstrated by cross-sectional studies,[36,39] and recent findings from longitudinal studies also have shown that children diagnosed with ADHD report lower self-esteem in adolescence than controls.[39] This association could be attributed to the multiple failures that these patients experience in different social contexts (e.g., school, family, etc.), which lead to a lower perception of competency than their peers.

Self-control can be understood from multiple perspectives. For example, it has been described as a "satisfaction effect," and functionally, as the length of time an individual is willing to wait in order to obtain a more valuable but more delayed outcome.[40] People use self-control when they have decided to achieve a long-term goal. For such an achievement, a person may dismiss the pleasure of eating, drinking alcohol, gambling, spending money, staying awake, and/or sleeping. In many difficult and conflicting situations where making a choice is required, self-control is recommended.[40] Indeed, children with ADHD have demonstrated poorer social self-control than children without ADHD,[29,30] and our finding is in line with the existing literature.

Emotion regulation is commonly defined as the set of processes through which individuals influence the emotions they experience, when they experience them, and how they experience and express these emotions.[41] Including high affect lability and emotional reactivity, as well as reduced affect control, the concept of emotion regulation difficulties is a component of the Wender Utah criteria of adult ADHD.[42] Elevated emotion regulation difficulties are a relatively consistent observation in ADHD across the life span. A recent meta-analysis reported that ADHD is strongly associated with both emotion reactivity and emotion regulation difficulties.[43] Emotion regulation difficulties in ADHD are often hypothesized to result from individual or overlapping neurocognitive deficits in inhibition, working memory, and executive functions.[44]

The emotional competencies outlined above have been identified in the literature as potential risk factors for excessive alcohol use and AUD. In a German study, individuals with alcohol dependence had significantly greater difficulties in emotion regulation than controls.[45] Additionally, a cross-sectional study using secondary data from the National Longitudinal Study of Adolescent to Adult Health in the United States found that adolescents with low self-esteem, regardless of gender, had a higher likelihood of having consumed alcohol in the past 30 days and of engaging in binge drinking episodes.[6]

Notably, we found no evidence that better socio-emotional competencies mitigated the strength of the association between alcohol consumption frequency or AUD and ADHD. Contrary to our initial hypothesis, higher levels of emotional control may have been associated with an increased likelihood of developing AUD. This finding allows only a post hoc, exploratory interpretation and should be viewed as hypothesis-generating rather than confirmatory. Further analyses and independent studies are needed to clarify this association. Self-esteem was the only competence that appeared to mitigate the association between ADHD and AUD or regular/excessive alcohol consumption, demonstrating a trend towards a protective effect, although this association did not reach statistical significance.

These interactions have been poorly explored in the literature, and one study has found that high levels of emotional regulation were associated with an increased risk of AUD.[46] This unexpected hypothesis can be partially explained by the fact that adolescents with higher levels of emotional regulation possess greater social skills, which leads them to greater peer interactions and, consequently, higher exposure to social events and contact with alcoholic beverages.[46] Other studies have corroborated this finding. A recent randomized controlled trial based on the developmental biopsychosocial model, in which emotion dysregulation serves as a catalyst in the progression from ADHD to substance use problems in emerging adulthood, performed interventions aimed at minimizing emotion dysregulation in order to evaluate their effect on the trajectory of problematic alcohol use over 4 to 7 years. The results indicated that, contrary to expectations, treatment was associated with worse alcohol use problems among those who drank alcohol, beyond the effects of baseline alcohol use, age, gender, or oppositional defiant disorder diagnosis.[47] It is important to note that the cross-sectional nature of this study precludes causal inference and allows only the identification of associations. Consequently, these findings do not permit conclusions regarding causality or reverse causality, and should be interpreted solely as potential relationships that warrant further investigation.

Another interesting finding is that we observed no significant associations between alcohol consumption frequency and ADHD in this sample (Supplementary Table S2). Although ADHD has been widely associated with substance use in the literature, the nature of this association is not fully understood. A study using Mendelian randomization found no evidence that ADHD had a causal effect on liability to alcohol use.[45] They found evidence that liability to ADHD increases the likelihood of smoking initiation and heaviness of smoking, decreases the likelihood of smoking cessation, and increases the likelihood of cannabis initiation. There was weak evidence that liability to ADHD increases the risk of alcohol dependence. Although the study was based on large and powerful genetic datasets, there was no evidence of an association between alcohol consumption and ADHD. One possible explanation is that ADHD may only affect more severe manifestations of alcohol abuse that have been clinically diagnosed, rather than self-reported alcohol consumption.[45] The assessed socio-emotional characteristics appear to exert a stronger moderating effect on the association between ADHD and AUD than on the association between ADHD and frequency of alcohol consumption. More recently, several studies have explored socio-emotional deficits in several AUD, documenting massive impairments and suggesting that they could have a key role in the emergence and persistence of AUD. Accordingly, our study also highlights the need to further explore socio-emotional aspects, rather than predominantly cognitive factors, in populations with AUDs.

In conclusion, adolescent alcohol consumption continues to represent a major public health issue. Further investigations are needed to clarify the inconsistencies observed in the literature regarding the associations between ADHD, alcohol use, and socio-emotional competencies during adolescence.

While our study provides valuable insight into the role of socio-emotional competencies in alcohol use among adolescents with ADHD, it also involves several limitations. First, the cross-sectional nature of the data precludes causal inferences, and longitudinal studies are needed to assess the temporal dynamics of ADHD, emotional regulation, and alcohol use. Second, although we adjusted for covariates, there may be other unmeasured factors (e.g., peer influence, genetic predisposition, or other substance use) that contribute to alcohol use behaviors in this population and could be unmeasured confounders. Third, potential selection bias and limited generalizability should be considered, as ADHD was assessed using questionnaires without clinical confirmation, and no treatment information was available.

Future research should explore these additional influences to provide a more comprehensive understanding of the relationship between ADHD and alcohol use. However, This study also has strengths. It is a population-based study representative of adolescents at age 18 in an upper-middle income country. Furthermore, it is the first Brazilian population-based study to investigate the moderating role of certain socio-emotional variables in the association between ADHD and alcohol use among adolescents.

Acknowledgements

This study used data from the 2004 Pelotas Birth Cohort Study, which was conducted by the Universidade Federal de Pelotas Graduate Epidemiology Program, with the collaboration of the Brazilian Public Health Association. The World Health Organization, National Support Program for Centers of Excellence (PRONEX), the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), the Brazilian Ministry of Health, and Children's Pastorate supported previous phases of the study. The 18-year follow-up was supported by the Departamento de Ciência e Tecnologia do Ministério da Saúde (DECIT), CNPq (grant 409224/2021-9), the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; grant 2023/12905-0), the Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul (FAPERGS), the L'Oréal-Unesco-ABC Program for Women in Science in Brazil-2020, and the All for Health Institute. The present analyses were financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior-Brasil (CAPES) – Finance Code 001.

ABB is supported by a CNPq Postdoctoral Junior Fellowship (process 173631/2023-1). LTR, ISS, AJDB, and AM (grant 312746/2021-0) are supported by CNPq Research Scholarships. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Disclosure

The authors report no conflicts of interest.

Data availability statement

The data that support this study are not publicly available.

Author contributions

ABB: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.
JMM: Formal analysis, Methodology, Writing – original draft, Writing – review & editing.
LTR: Writing – original draft, Writing – review & editing.
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Handling Editor: João Castaldelli-Maia

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