Research Square

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Sleep Problems in Chinese Children with ADHD Symptoms: Associations with Emotional and Behavioral Difficulties

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Abstract

Background

Children with attention-deficit/hyperactivity disorder (ADHD) symptoms are frequently reported to experience more sleep problems than their peers without ADHD symptoms; however, this association has not been well examined in children in China. Moreover, it remains unclear whether the coexistence of ADHD symptoms and sleep problems is associated with greater emotional and behavioral difficulties.

Methods

Participants were drawn from a large cross-sectional study of 12,343 students from 14 primary schools in Shenzhen, China. ADHD symptoms and emotional and behavioral problems were assessed using the Conners' Parent Rating Scale. Parents also completed questionnaires assessing their children's sleep duration and sleep problems. A total of 330 children with ADHD symptoms and 10,273 control children were identified and included in the analyses.

Results

Compared with controls, students with ADHD symptoms had shorter sleep duration and more sleep problems, particularly among female students, those aged 10–15 years, those reporting average or poor family relationships, and those with average or poor interpersonal satisfaction. Among students with ADHD symptoms, those who also had sleep problems showed significantly higher levels of psychosomatic symptoms, anxiety symptoms, and learning problems than those with ADHD symptoms alone ($p < 0.05$).

Conclusions

Chinese students with ADHD symptoms experience substantial sleep problems, which are associated with greater emotional and behavioral difficulties. These findings highlight the importance of identifying and addressing sleep problems as part of interventions for children with ADHD symptoms.

1. Background

Attention deficit/hyperactivity disorder (ADHD) is a common and chronic neurodevelopmental disorder characterized by difficulty concentrating, a short attention span, hyperactivity, impulsiveness, and learning difficulties compared with children of the same age (Association, 2013). Recent meta-analysis showed that the global prevalence of ADHD was 7.6% in children (Salari et al., 2023) and 6.67% in adults (Song et al., 2021). Notably, the incidence of ADHD among children and adolescents in China has increased in recent years, reaching 6.26% (Wang et al., 2017). Thus, ADHD has became a significant

public health concern. Beyond its core symptoms, ADHD is frequently accompanied by comorbid behavioral and psychological disorders, including disruptive behavior disorder, depressive disorder, obsessive-compulsive disorder, anxiety disorder, and etc. (İpÇİ et al., 2020), increasing the difficulty of identifying and treating ADHD. Among these, sleep problems are particularly common and have attracted increasing research attention in recent years.

Sleep is essential for children, and problems such as difficulty falling asleep, pre-sleep anxiety, insomnia, frequent awakenings, unrefreshing sleep, bedtime resistance, and restless or insufficient sleep can negatively impact neurocognitive and social development (Baddam et al., 2018). Neurologically, insufficient sleep deficits impair brain modulation and synaptic development (Lokhandwala & Spencer, 2022). Cognitively, disturbed sleep is associated with poorer cognitive performance, such as attention, memory, and processing speed (Rey et al., 2025). Socially, insufficient sleep was found associated with poor self-reported health, poor academic performance, and and social functioning, including increased peer repulsion and loneliness as well as lower friendship satisfaction and self-worth (Becker, 2014; Hedin et al., 2020).

Despite the importance of sleep for child development, children with neurodevelopmental disorders are more likely to experience significant sleep problems. In the context of ADHD, sleeping problems effects more children with ADHD than healthy peers and these issues are particularly acute. Estimates suggest that sleeping problems affect 21.3% to 70.0% of children with ADHD (Cortese et al., 2013; Lycett et al., 2014; Weiss & Salpekar, 2010), which is approximately two to three time higher than other healthy peers (Hansen et al., 2011). Moreover, sleep disturbances in ADHD children are often more severe. For instance, even after controlling for puberty, medication, and comorbidities, ADHD remains independently associated with shorter sleep duration and greater sleep disturbance (Becker et al., 2019).

As awareness of the comorbidity between ADHD and sleep problems has increased, a growing body of research has documented their associations with emotional and behavioral difficulties. For instance, For example, previous studies have suggested that sleep problems are closely related to children's emotional and behavioral functioning (Gregory & Sadeh, 2012). Evidence indicates that children with ADHD and comorbid sleep problems experience poorer physical health, mental health, and overall quality of life compared with their peers, and that appropriate identification and treatment of sleep problems may improve quality of life for both children and their families, as well as reduce the severity of ADHD symptoms (Yürümez & Kılıç, 2016). Longitudinal research further suggests that, among adolescents with ADHD, sleep problems predict increased depressive symptoms and oppositional behaviors over time (Becker et al., 2015).

However, despite growing international evidence, research examining the relationships among ADHD symptoms, sleep problems, and emotional and behavioral outcomes in China remains limited and contextually restricted. Existing Chinese studies have primarily focused on preschool-aged children (Wang et al., 2020) or on primary school children with clinically diagnosed ADHD (Dong et al., 2024), leaving a gap in understanding among school-aged children and adolescents identified based on ADHD

symptoms in community or school-based settings. This distinction is important, as symptom-based assessments are widely used for early screening and public health surveillance and capture a broader population that may experience significant functional impairment without meeting diagnostic criteria. Therefore, the present cross-sectional study aimed to investigate the prevalence of sleep problems among children and adolescents with ADHD symptoms in Shenzhen, China, and to further examine the associations between sleep problems and emotional and behavioral difficulties in this population. We hypothesized that: (i) children and adolescents with ADHD symptoms would exhibit more sleep problems than those without ADHD symptoms; and (ii) children and adolescents with ADHD symptoms and comorbid sleep problems would demonstrate greater emotional and behavioral difficulties than those with ADHD symptoms alone.

2. Methods

2.1 Participants

Participants were drawn from a larger cross-sectional study conducted in 14 primary schools in Shenzhen, China. These schools were selected using a cluster sampling method. From September to December 2019, questionnaires were distributed to students' parents or guardians with the assistance of schoolteachers. Teachers with a background in school psychology explained the purpose of the study and provided standardized instructions for questionnaire completion.

A total of 17,400 questionnaires were distributed to parents or guardians. Informed consent was obtained from all parents or guardians, as well as from the children, prior to participation. To protect participant privacy, personally identifiable information, such as names, was not collected.

The questionnaires included the Conners' Parent Rating Scale and items assessing children's sleep duration and sleep problems. Students with ADHD symptoms were identified based on a hyperactivity index score greater than 1.5 on the Parent Symptoms Questionnaire. Based on this criterion, participants were categorized into an ADHD symptoms group and a normal control group.

2.2 Ethics declaration

This study was conducted in accordance with the Declaration of Helsinki and relevant international and national ethical guidelines, including the CIOMS International Ethical Guidelines for Health-related Research Involving Humans and applicable Chinese regulations. Ethical approval was obtained from the Ethics Committee of Shenzhen Kangning Hospital (approval number: 2019-K009-01-1). The committee operates in compliance with ICH-GCP and relevant Chinese laws and regulations.

2.3 Measures

Demographics

The demographics questionnaire included items related to general demographic information such as gender (male/female), age, whether the student was an only child (yes/no), and whether the student was born in Shenzhen (yes/no). For analytical purposes, several demographic and psychosocial variables were dichotomized based on response distributions.

1. **Academic performance**: "How would you rate your child's academic performance?" (excellent/good/average/pass/fail). For analysis, the responses were dichotomized as follows: For analysis, the responses were dichotomized as follows: "excellent" and "good" were categorized as "good academic performance," while "average," "pass," and "fail" were categorized as "average or poor academic performance."
2. **Learning pressure**: "How much pressure do you feel regarding your child's learning?" (none/low/average/large/very large). For analysis, this was dichotomized into "average or below average learning pressure" (none/low/average) and "large learning pressure" (large/very large).
3. **Relationship with others**: Three questions assessed children's social relationships:

- Relationship with classmates: "How is your child's relationship with their classmates?"
- Relationship with teachers: "How is your child's relationship with their teachers?"
- Relationship with family: "How is your child's relationship with their family?"

Responses for all three items were rated on a 5-point scale (very bad/bad/average/good/very good) and dichotomized into "good" (good/very good) and "average or poor" (very bad/bad/average) for analysis.

4. **Satisfaction with interpersonal relationships**: "Is your child satisfied with their interpersonal relationships?" (very dissatisfied/relatively dissatisfied/average/relatively satisfied/very satisfied). Responses were dichotomized into "good" (relatively satisfied/very satisfied) and "average or poor" (very dissatisfied/relatively dissatisfied/average).
5. **Family financial situation**: "What is the financial situation of your family?" (very poor/relatively poor/average/relatively rich/very rich). For analysis, this was dichotomized into "average and wealthy" (average/relatively rich/very rich) and "below average" (very poor/relatively poor).

Parent Symptoms Questionnaire (PSQ): The PSQ, originally developed in 1970 with 93 items, was revised in 1978 to include 48 items scored on a 4-point scale (0, 1, 2, 3). These 48 items are grouped into six factors that address common behavioral problems: conduct problems, learning problems, psychosomatic symptoms, hyperactivity/impulsivity, anxiety, and a hyperactivity index. The reliability and validity of these factors have been well-established (Fan et al., 2005; Su et al., 2001). In this study, (i) children with a hyperactivity index greater than 1.5 were classified as exhibiting ADHD symptoms, and (ii) scores greater than 2 standard deviations above the mean for the other five factors were considered indicative of behavioral problems (Fan et al., 2005; Su et al., 2001).

Sleep Time and Sleep Problems Questionnaires (STSPQ)

The STSPQ (Owens & Dalzell, 2005) was adapted from the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). It includes the following items

1. **Average sleep duration**: "On average, how long does your child sleep each night?" (less than 5 hours; 5–6 hours; 6–7 hours; 7–8 hours; more than 8 hours).
2. **Difficulty falling asleep**: "Does your child have difficulty falling asleep?" (no/sometimes/often/always). For analysis, the responses were dichotomized into: "no" and "yes" (grouping "sometimes," "often," and "always").
3. **Frequent waking during sleep**: "Does your child frequently wake up during the night?" (no/sometimes/often/always). The responses were dichotomized into: "no" and "yes" (grouping "sometimes," "often," and "always").
4. **Early waking**: "Does your child wake up early?" (no/sometimes/often/always). Again, the responses were dichotomized into: "no" and "yes" (grouping "sometimes," "often," and "always").

The internal consistency of the sleep problem items in this study was satisfactory (Cronbach's alpha = 0.649).

2.4 Statistical analysis

Statistical analysis was conducted using SPSS version 19.0 (IBM, USA). Frequencies are reported as sample incidences along with 95% confidence intervals (CIs), calculated using standard methods. Chi-square tests were used to compare categorical variables (e.g., to assess differences in sleep problems across demographic groups). Independent t-tests were applied to compare continuous variables (e.g., to evaluate differences in emotional and behavioral problems between children with ADHD symptoms who had sleep problems versus those without). Statistical significance was set at $p < 0.05$.

3. Results

3.1 Sample characteristics

A total of 14,723 questionnaires were returned, yielding a response rate of 84.61%. After excluding incomplete questionnaires, 12,343 valid responses were included in the final analysis (Fig. 1). Based on the hyperactivity index criterion, 330 students were classified into the ADHD symptoms group and 10,273 students were classified into the normal control group. The demographic characteristics of participants in both groups, including sex, age, and place of birth, are summarized in Table 1.

In the ADHD symptoms group, there were 224 males (67.88%) and 106 females (32.12%), with a mean age of 8.88 ± 1.79 years. In the control group, 5,575 participants (54.20%) were male and 4,698 (45.80%) were female, with a mean age of 8.79 ± 1.88 years.

3.2 Demographic characteristics of students with ADHD symptoms and sleep problems

Associations between demographic characteristics and sleep problems among students with ADHD symptoms are presented in Table 1. Female students with ADHD symptoms had a significantly higher rate of early awakening than male students (31.13% vs. 20.09%; $\chi^2 = 4.861$, $p = 0.027$).

Age was also significantly associated with sleep problems. Students aged 10–15 years showed higher rates of difficulty falling asleep (56.30%), waking up during sleep (48.70%), and early awakening (36.97%) compared with students aged 6–9 years (41.36%, 34.55%, and 15.71%, respectively), with all differences reaching statistical significance ($p < 0.05$).

Family and interpersonal factors were further associated with sleep problems. Students reporting good relationships with family members had a lower rate of early awakening than those reporting average or poor relationships (20.82% vs. 32.14%; $\chi^2 = 4.437$, $p = 0.035$). In addition, students with good interpersonal satisfaction had lower rates of waking up during sleep (32.69% vs. 46.24%; $\chi^2 = 6.285$, $p = 0.012$) and early awakening (18.59% vs. 27.75%; $\chi^2 = 3.836$, $p = 0.049$).

3.3 Sleep duration and sleep problems among students with ADHD symptoms and normal controls

As shown in Fig. 2.1, students with ADHD symptoms generally had shorter sleep duration compared with students in the normal control group. The most frequently reported sleep duration among students with ADHD symptoms was 7–8 hours (boys: 50.45%; girls: 47.17%), whereas the most common sleep duration in the control group was 8 hours or longer (boys: 47.98%; girls: 44.08%).

As illustrated in Fig. 2.2, students with ADHD symptoms also exhibited a higher prevalence of sleep problems, including difficulty falling asleep, waking up during sleep, and early awakening, compared with the normal control group. Within the ADHD symptoms group, girls reported a higher prevalence of persistent sleep problems than boys. Specifically, 10.38% of girls and 5.80% of boys reported always having difficulty falling asleep. Persistent waking during sleep was reported by 3.77% of girls and 2.23% of boys, while early awakening was reported by 0.94% of girls and 0.89% of boys.

3.4 Emotional and behavioral problems in students with ADHD symptoms with and without sleep problems

Comparisons of emotional and behavioral problems between students with ADHD symptoms with and without sleep problems are presented in Table 2. Students with ADHD symptoms who experienced difficulty falling asleep or early awakening had significantly higher psychosomatic symptoms and anxiety scores compared with those without these sleep problems ($p < 0.001$). In addition, students with ADHD symptoms who reported waking up during sleep had higher levels of learning problems, psychosomatic symptoms, and anxiety than those who did not report waking during sleep ($p < 0.05$).

4. Discussion

4.1. Comparison of sleep duration and sleep problems between ADHD symptoms group and control group

Consistent with the aims of this study, our findings demonstrate that children and adolescents with ADHD symptoms exhibit markedly poorer sleep profiles than their peers without ADHD symptoms in a Chinese school-based population. These results align with the growing view that ADHD can be conceptualized as a "24-hour disorder," in which nighttime sleep disturbances, such as reduced sleep duration, contribute to daytime impairments including excessive sleepiness and functional difficulties (Becker, 2020). In the present study, the most commonly reported sleep duration among children with ADHD symptoms was 7–8 hours, which was shorter than that reported by children without ADHD symptoms (≥ 8 hours). This finding is consistent with previous research linking ADHD symptoms to shorter sleep duration (Hysing et al., 2016; Upasana et al., 2022), although some studies have suggested a more complex, non-linear association whereby both short (< 6 hours) and long (> 9 hours) sleep duration are associated with increased ADHD risk (Bogdan & Reeves, 2018).

Beyond sleep duration, children with ADHD symptoms in our study reported higher frequencies of difficulty falling asleep, nighttime awakenings, and early morning awakening across all response levels (sometimes, often, and always) compared with controls. These findings are consistent with a substantial body of literature documenting poorer subjective sleep quality in individuals with ADHD comparing with their typically developing peers (Çelikkol Sadiç et al., 2024; Hong et al., 2020; Korman et al., 2020; Thoma et al., 2020). For example, a meta-analysis reported that individuals with ADHD experienced more frequent nighttime awakenings and poorer self-reported sleep quality than controls (Lugo et al., 2020), and higher scores on the Children's Sleep Habits Questionnaire (CSHQ) have been consistently observed in children with ADHD (Joseph et al., 2022). Importantly, evidence from objective sleep assessments, including actigraphy and polysomnography, further supports these subjective findings, demonstrating longer sleep onset latency and lower sleep efficiency in children with ADHD compared with controls (Chin et al., 2018; Cortese et al., 2009; Ziegler et al., 2021).

Despite consistent evidence that children with ADHD experience poorer sleep than their peers, the mechanisms underlying this association remain unclear. Research suggests a bidirectional relationship between sleep problems and ADHD symptoms. Experimental studies have shown that sleep restriction can impair cognitive performance on tasks related to ADHD, including attention and inhibitory control (Becker, 2020). At the neurophysiological level, sleep deprivation disrupts synaptic plasticity and alters event-related potentials, which in turn may contribute to poorer neurocognitive functioning (Um et al., 2017). Supporting this, Knight and Dimitriou (2019) found that higher scores on the CSHQ predicted ADHD traits even among typically developing children (Knight & Dimitriou, 2019). A broader review also indicated that various sleep disorders may induce ADHD-like symptoms (Um et al., 2017). Longitudinal evidence further suggests that sleep problems in early childhood can predict the development of ADHD traits during adolescence (Carpena et al., 2020). Together, these findings underscore the possibility that sleep disturbances and ADHD symptoms may mutually influence each other across development.

4.2. Relationships between demographic characteristics and sleep problems in children with ADHD symptoms

We further explored demographic and psychosocial factors associated with increased sleep problems among children with ADHD symptoms. Girls with ADHD symptoms showed a trend toward a higher prevalence of all three types of sleep problems, with early morning awakening reaching statistical significance. This gender difference is consistent with findings from a longitudinal cohort study by Hvolby et al. (2020) (Hvolby et al., 2020), which reported a higher proportion of sleep problems in girls several years after an ADHD diagnosis, suggesting that sleep difficulties may become more pronounced or more readily reported in females over time.

Age-related differences were also observed, with older children and adolescents (10–15 years) exhibiting significantly higher rates of all three sleep problems compared with younger children (6–9 years). This pattern aligns with previous research indicating that sleep disturbances, particularly nighttime awakenings, increase with age in children with ADHD (Ruiz-Herrera et al., 2020). This age effect may be better explained by developmental changes in sleep regulation, increased academic and social demands, and pubertal-related biological shifts that place older children at greater risk for sleep disruption.

In addition to demographic factors, psychosocial context appeared to play an important role. Children with ADHD symptoms who reported poorer family relationships and average or poor interpersonal satisfaction were more likely to experience sleep problems. This makes sense, as poor family relationships and low interpersonal satisfaction can harm psychological health and limit the support available when help is needed, ultimately contributing to sleep problems. Conversely, positive family functioning and satisfying interpersonal relationships may serve as protective factors by promoting emotional regulation and stress buffering. It is also possible that this association is bidirectional, whereby poor sleep exacerbates emotional dysregulation and fatigue, thereby impairing interpersonal functioning. In contrast to these psychosocial factors, family income was not significantly associated with sleep problems in the present study. This finding differs from previous research reporting a positive association between family income and sleep problems in children with ADHD (Hvolby et al., 2020), suggesting that socioeconomic influences on sleep may vary across cultural or contextual settings.

4.3. Emotional and behavioral problems in students with ADHD symptoms and sleep problems

In the present study, children with ADHD symptoms who reported any of the three types of sleep problems exhibited higher levels of psychosomatic complaints and anxiety symptoms than those with ADHD symptoms alone. This finding is consistent with evidence that ADHD is associated with a range of somatic health conditions, including asthma, obesity, migraine, gastrointestinal symptoms, and sleep-related breathing disturbances that may compromise oxygen supply to the brain (Chin et al., 2018; French et al., 2024). Sleep problems that disrupt sleep duration or quality are known to impair emotional

regulation and functional performance, thereby increasing vulnerability to psychosomatic symptoms and emotional distress (Barrera-Valencia et al., 2025; Cooper et al., 2023; Wang et al., 2024). Accordingly, the co-occurrence of ADHD symptoms and sleep problems may exacerbate physical and emotional complaints and further reduce quality of life, as both conditions independently and jointly contribute to poorer well-being (Craig et al., 2020).

In addition, children with ADHD symptoms and sleep problems were more likely to experience anxiety than those without sleep problems. Anxiety disorders are known to impair cognitive functioning, including working memory, and to further disrupt sleep quality, potentially creating a reinforcing cycle of sleep disturbance and emotional dysregulation (D'Agati et al., 2019). Consistent with our findings, Bériault et a (2018) reported significantly higher CSHQ scores in children with comorbid ADHD and anxiety compared with those with ADHD alone (Bériault et al., 2018), suggesting that anxiety may intensify sleep-related difficulties in this population.

Notably, ADHD symptoms combined with nighttime awakenings were specifically associated with increased learning problems in the present study. This finding aligns with prior research indicating that daytime sleepiness is associated with greater ADHD severity and poorer academic performance (Instanes et al., 2018). Experimental evidence further demonstrates that sleep deprivation reduces task performance in both ADHD and typically developing children, with a more pronounced effect observed in those with ADHD (Dan et al., 2020). Together, these findings suggest that the co-occurrence of sleep problems and ADHD symptoms may place children at a higher risk for academic difficulties by further impairing attention, alertness, and learning capacity (Waldon et al., 2018).

In contrast, no significant differences were observed in conduct problems or hyperactivity/impulsivity between children with ADHD symptoms with and without sleep problems. This null finding may be partly attributable to the relatively small proportion of participants presenting with these behavioral difficulties in the current sample. Nevertheless, previous research has demonstrated that sleep problems are associated with an increased risk of behavioral difficulties, including gambling behaviors, Internet addiction, major disciplinary problems, and substance use, particularly among individuals with ADHD symptoms (Çelikkol Sadiç et al., 2024; Lucas et al., 2019; Stevens et al., 2021). Supporting this broader literature, studies have shown that shorter sleep duration in children with ADHD is associated with higher impulsivity scores (San Mauro Martin et al., 2019), and poorer sleep quality is linked to greater hyperactive–impulsive symptoms in adults with ADHD (Mahajan et al., 2010). These findings suggest that behavioral consequences of sleep problems may emerge more clearly across development or under specific contextual conditions.

4.4. Limitations

Several limitations of the present study should be acknowledged. First, due to the cross-sectional design, causal relationships between sleep problems and ADHD symptoms cannot be established. Longitudinal studies are needed to clarify the directionality and developmental pathways linking sleep disturbances and ADHD-related outcomes.

Second, sleep problems were assessed using a limited number of items, which may not fully capture the complexity of sleep behaviors in children and adolescents. Future research would benefit from the use of validated and comprehensive instruments, such as the CSHQ, to improve measurement precision (Papadopoulos et al., 2019).

Third, sleep assessment relied exclusively on subjective reports. Although subjective measures provide valuable information regarding perceived sleep difficulties, the inclusion of objective methods, such as actigraphy or polysomnography, would allow for a more detailed characterization of sleep patterns and a better understanding of the underlying mechanisms of sleep disturbances in children with ADHD symptoms.

Fourth, ADHD subtypes were not differentiated in the present study. Previous research suggests that sleep profiles may vary across ADHD presentations; for example, impaired sleep continuity assessed by polysomnography has been reported primarily in individuals with the hyperactive/impulsive subtype, but not in other ADHD subtypes (Becker, 2020; Ruiz-Herrera et al., 2020). Therefore, future studies could focus on sleep patterns in different subtypes.

Finally, the sample was drawn from Shenzhen, a relatively economically developed urban area in China, and the number of participants with ADHD symptoms was modest. These factors may limit the generalizability of the findings to other regions or populations with different socioeconomic backgrounds.

5. Conclusions

The findings of this study highlight the clinical importance of recognizing and addressing sleep problems in children and adolescents with ADHD symptoms. In particular, girls and older children with ADHD symptoms appear to be at a higher risk for sleep disturbances, suggesting the need for targeted screening in these subgroups. The protective role of positive family functioning and interpersonal satisfaction further indicates that psychosocial context should be considered when developing individualized intervention strategies. Importantly, children with ADHD symptoms who also experience sleep problems are more likely to present with psychosomatic complaints, anxiety, and learning difficulties, underscoring the potential benefits of early identification and management of sleep disturbances. Integrating sleep assessment and intervention into routine ADHD-related care may therefore contribute to improved emotional, behavioral, and functional outcomes in this population.

Declarations

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Consent statement

All participants were provided informed consent during the study accordance with the Helsinki guidelines.

Authors' information

Not applicable.

Consent for publication

Not applicable.

Disclosure statement

The authors report there are no competing interests to declare.

Author contributions

All authors of the manuscript participated in the realization and preparation of the study. YE, JB, JRM, and ES designed the study; acquired, analyzed, and interpreted the data; and drafted and revised the manuscript. AN performed statistical analysis and interpreted the data. BM performed the echocardiograms. DL performed renal ultrasounds. YN, MFM, BM, VM, FK, EK, BN, JM, AN and ES revised the manuscript. All authors (s) read and approved the final manuscript.

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Data availability statement

The data can be made available via email to anyone who wishes to contact Yannick Engole at the following address: yannickengole@yahoo.fr

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Tables

Tables 1 to 2 are available in the Supplementary Files section.

Figures

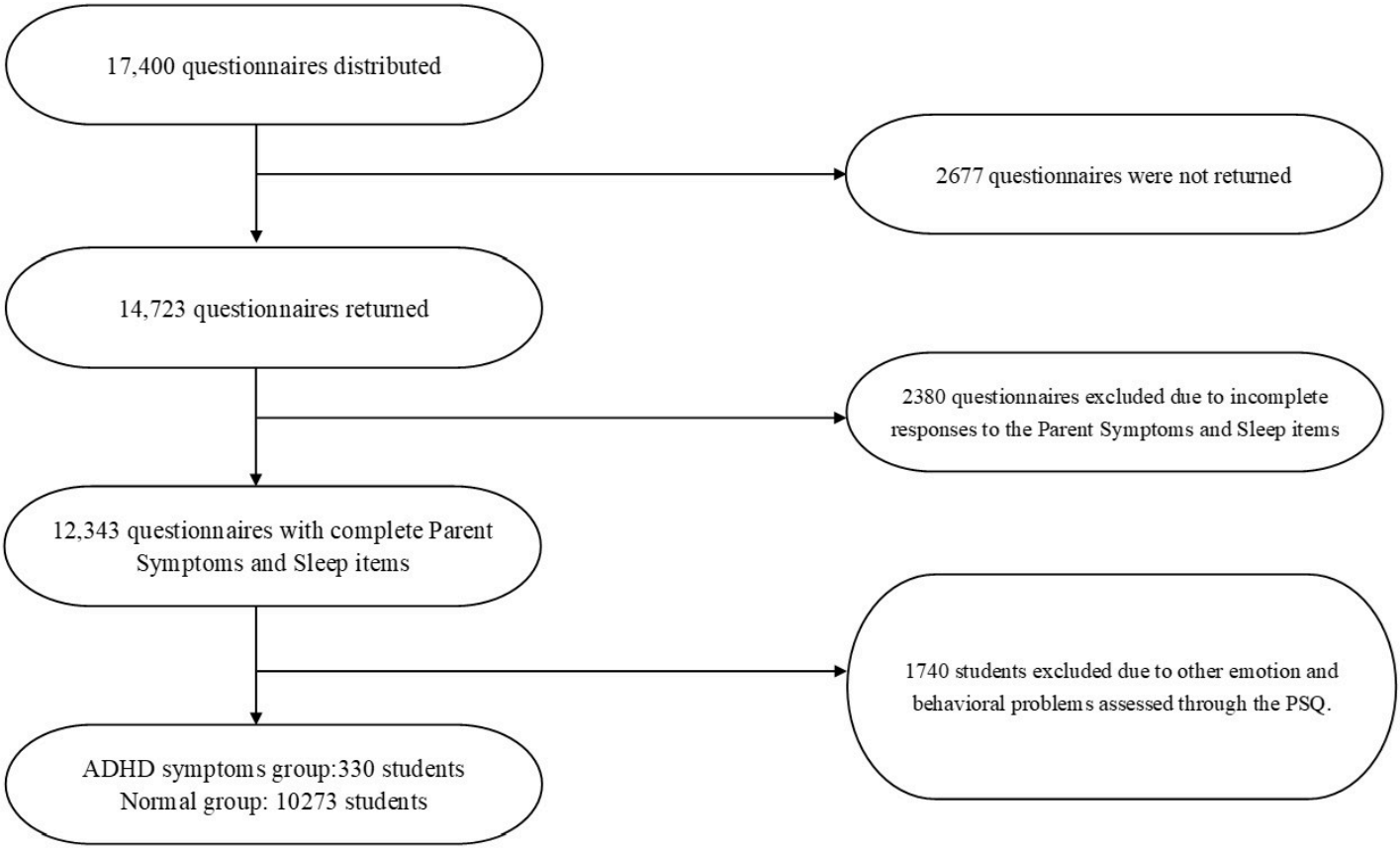


Figure 1

Flow chart of participants included in the analysis.

SLEEP_time		sample	N	Prevalence (95CI%)
< 5hours	ADHD symptoms_male	1	224	0.45 (0.08-2.48)
	ADHD symptoms_female	2	106	1.89 (0.52-6.62)
	Normal group_male	50	5575	0.9 (0.68-1.18)
	Normal group_female	44	4698	0.94 (0.7-1.25)
5-6hours	ADHD symptoms_male	3	224	1.34 (0.46-3.86)
	ADHD symptoms_female	7	106	6.6 (3.24-13.01)
	Normal group_male	88	5575	1.58 (1.28-1.94)
	Normal group_female	65	4698	1.38 (1.09-1.76)
6-7hours	ADHD symptoms_male	38	224	16.96 (12.62-22.43)
	ADHD symptoms_female	26	106	24.53 (17.32-33.51)
	Normal group_male	469	5575	8.41 (7.71-9.17)
	Normal group_female	440	4698	9.37 (8.57-10.23)
7-8hours	ADHD symptoms_male	113	224	50.45 (43.95-56.93)
	ADHD symptoms_female	50	106	47.17 (37.93-56.6)
	Normal group_male	2293	5575	41.13 (39.84-42.43)
	Normal group_female	2078	4698	44.23 (42.82-45.66)
> 8hours	ADHD symptoms_male	69	224	30.8 (25.12-37.13)
	ADHD symptoms_female	21	106	19.81 (13.34-28.4)
	Normal group_male	2675	5575	47.98 (46.67-49.29)
	Normal group_female	2071	4698	44.08 (42.67-45.51)

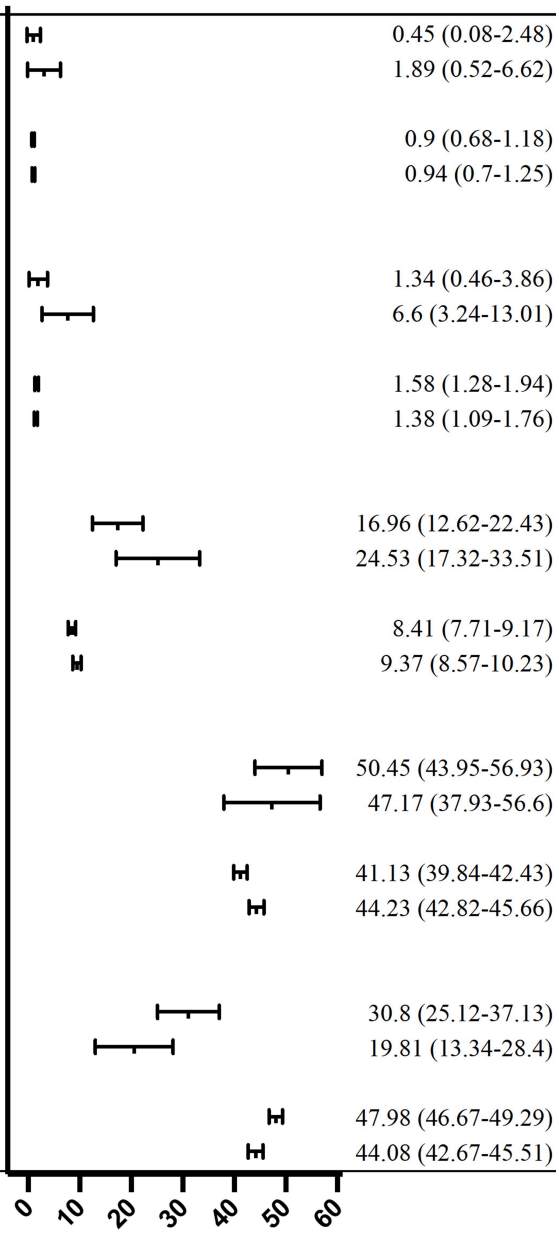
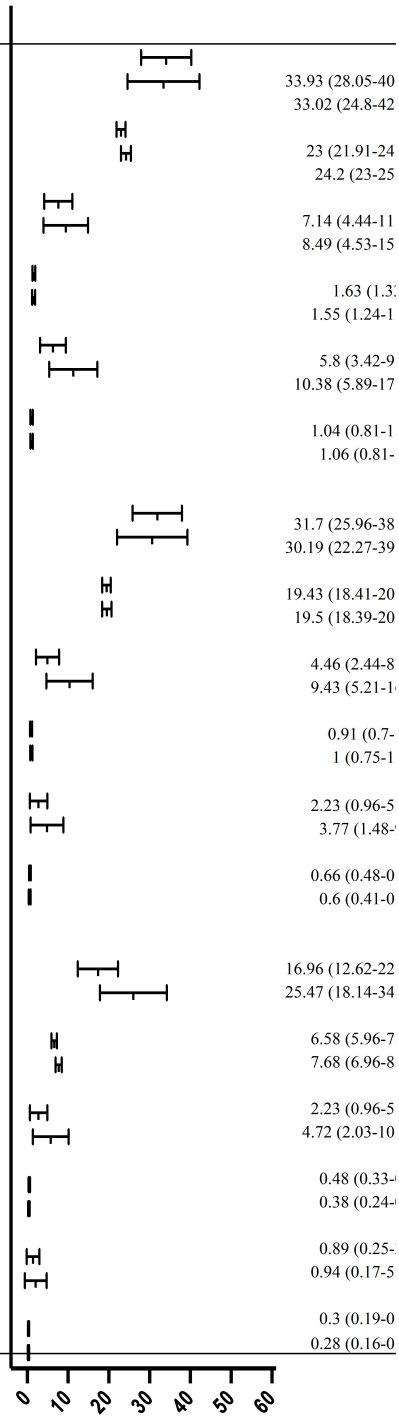


Figure 2

Figure 2.1 Comparison of sleep duration between students with ADHD symptoms and normal groups.

Sleep problems		sample	N	Prevalence (95C
Difficulty falling asleep				
sometimes	ADHD symptoms_male	76	224	33.93 (28.05-40
	ADHD symptoms_female	35	106	33.02 (24.8-42
	Normal group_male	1282	5575	23 (21.91-24
	Normal group_female	1137	4698	24.2 (23-25
often	ADHD symptoms_male	16	224	7.14 (4.44-11
	ADHD symptoms_female	9	106	8.49 (4.53-15
	Normal group_male	91	5575	1.63 (1.3
	Normal group_female	73	4698	1.55 (1.24-1
always	ADHD symptoms_male	13	224	5.8 (3.42-9
	ADHD symptoms_female	11	106	10.38 (5.89-17
	Normal group_male	58	5575	1.04 (0.81-1
	Normal group_female	50	4698	1.06 (0.81-
Waking up during sleep				
sometimes	ADHD symptoms_male	71	224	31.7 (25.96-38
	ADHD symptoms_female	32	106	30.19 (22.27-39
	Normal group_male	1083	5575	19.43 (18.41-20
	Normal group_female	916	4698	19.5 (18.39-20
often	ADHD symptoms_male	10	224	4.46 (2.44-8
	ADHD symptoms_female	10	106	9.43 (5.21-1
	Normal group_male	51	5575	0.91 (0.7-
	Normal group_female	47	4698	1 (0.75-1
always	ADHD symptoms_male	5	224	2.23 (0.96-5
	ADHD symptoms_female	4	106	3.77 (1.48-
	Normal group_male	37	5575	0.66 (0.48-0
	Normal group_female	28	4698	0.6 (0.41-0
Wake up early				
sometimes	ADHD symptoms_male	38	224	16.96 (12.62-22
	ADHD symptoms_female	27	106	25.47 (18.14-34
	Normal group_male	367	5575	6.58 (5.96-7
	Normal group_female	361	4698	7.68 (6.96-8
often	ADHD symptoms_male	5	224	2.23 (0.96-5
	ADHD symptoms_female	5	106	4.72 (2.03-10
	Normal group_male	27	5575	0.48 (0.33-
	Normal group_female	18	4698	0.38 (0.24-
always	ADHD symptoms_male	2	224	0.89 (0.25-
	ADHD symptoms_female	1	106	0.94 (0.17-5
	Normal group_male	17	5575	0.3 (0.19-0
	Normal group_female	13	4698	0.28 (0.16-0



Note: Three levels: sometimes; often; always, the severity of sleep-related problems increases in order.

Figure 3

Figure 2.2 The distribution of sleep problems among ADHD symptoms group and normal groups

Supplementary Files

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- Tables.docx