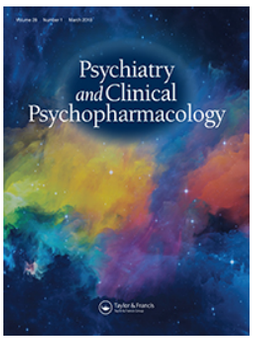

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Behavioural sleep problems in previously untreated children with attention deficit hyperactivity disorder

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ABSTRACT

OBJECTIVE: Although sleep symptoms are not included in the diagnostic criteria of attention deficit hyperactivity disorder (ADHD), these problems are common in children with ADHD. The presence of sleep problems was associated with impairment in functionality and increase in ADHD intensity. The aims of the study were to evaluate sleep problems of children with ADHD who had never received any psychiatric treatment and investigate the effects of these problems in functionality.

METHODS: The present study included 83 children who were diagnosed as having ADHD and had never received any psychiatric treatment. The control group consisted of 106 healthy children. Psychiatric diagnostic interview was applied to all children. The parents completed the Conner's Parent Questionnaire to evaluate the intensity of ADHD in the children, the Children's Sleep Habits Questionnaire (CSHQ) to evaluate sleep problems, and the Weiss Functional Impairment Rating Scale to evaluate the functionality of the children.

RESULTS: The total scores of subscale and scales of CSHQ were significantly higher in the study group. ADHD children slept 1 hour later and sleep quantity was 1.5 hours less than the control group. There was a significant correlation between sleep problems, ADHD severity, and functionality of these children.

CONCLUSIONS: The results demonstrated that children with ADHD experienced more sleep problems and slept less than the children in the healthy control group, and functional impairments increased due to these problems. Another important finding is that sleep problems are not related to drug use. Maintaining sleep hygiene or interventions against sleep problems may increase sleep quality and may improve self and family functionality. Therefore, the standardized sleep evaluation must be performed in cooperation with parents in all children with ADHD.

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Sleep disorders; sleep hygiene; management; attention deficit hyperactivity disorder; children

Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the most common childhood mental diseases and the worldwide prevalence is suggested as 5% in the school-age group [1]. The main characteristics are short attention span, difficulty in controlling behaviours, and hyperactivity symptoms. ADHD symptoms, which affect various areas of children's' lives, are persistent and resulting in inappropriate behaviours for their age. Children and adolescents with ADHD are at risk of academic failure, comorbidity, antisocial behaviours, low sense of self, and committing crimes [2].

Researchers have become interested in the association between sleep and ADHD in recent years, and investigated the association between ADHD and sleep disorders using subjective (scale based) and objective (neurophysiologic) measurements. Although sleep symptoms are not included in the diagnostic criteria of ADHD, they are frequently recognized in clinical practice. Children with ADHD have more sleep problems compared with their peers [3]. Their parents report sleep problems in 25–55% [4] and the prevalence of sleep problems, such as falling asleep and maintaining sleep, can vary between 55% and 74% [5–7]. The primary sleep disorder symptoms are resistance against sleep, an increase in the amount waking at night, and sleepiness during the day [8,9]. The most frequently reported symptoms of children and the parents are resistance against sleeping and sleep-onset insomnia [8]. The increase in sleep disorders in these children is associated with the increase in ADHD symptoms [10] and weakening in functionality of the child and the family [7]. However, sleep problems may develop without any biologic symptoms, the reason may be due to the high numbers of undiagnosed sleep problems in children with ADHD compared with healthy children [11].

Between 57% and 87% of children and adolescents with ADHD may have at least one comorbidity, and

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about 20% have three or more comorbid conditions, such as Tourette syndrome, bipolar disorder, posttraumatic stress disorder, and obsessive-compulsive disorder [12–14]. These comorbidities frequently accompany sleep problems [15]. Therefore, psychiatric comorbidities must be considered in the evaluation of sleep problems in these children. However, researchers presumed that sleep problems may be due to the use of drugs in ADHD treatment, the available evidence showed that drugs could only be a possible cause of sleep problems, and children with ADHD had more sleep problems compared with healthy controls independent of drug use [16].

Sleep has a significant role for the physical, mental, and social growth and development of children [17]. Irregular sleep is associated with a decrease in cognitive functions, inattention, problematic behaviours, psychopathologic progress, and weakness in emotional regulation [18]. Therefore, a proper evaluation of sleep problems and interventions against problems in children with ADHD may positively contribute to the life quality of the child and family, and may increase the functionality of children through a positive contribution to the management of ADHD symptoms.

The aim of the study was to evaluate parent-reported sleep problems of children with ADHD who had never received any psychiatric treatment and investigate the effects of these problems in functionality. We hypothesized that moderate/severe sleep problems would be associated with high ADHD symptoms and poor functionality.

Methods

Design, setting, and recruitment

Eighty-three children aged between 6 and 12 years who presented to Mardin Public Hospital Child and Adolescent Psychiatry outpatient clinic, and were diagnosed as having ADHD in accordance with the Fourth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) were included in the study. The inclusion criteria were determined as follows: (1) children diagnosed as having ADHD according to the DSM-IV criteria assessed via a semi-structured interview and had never been medicated before; (2) clinically, children must have normal intelligence quotient (IQ > 70); (3) aged between 6 and 12 years; and (4) willingness of children and parents to participate in the study. Children who had comorbid mental (e.g. depression, bipolar disorder, anxiety disorder, posttraumatic stress disorder, and obsessive-compulsive disorder) or chronic medical disease that may cause sleep problem were excluded.

The control group consisted of 106 children aged between 6 and 12 years who presented to Mardin Public Hospital Healthy Child Outpatient clinic. Paediatricians identified children aged 6–12 years and asked the family if they were interested with the study.. Families and children who agreed to participate to the study were sent to child and adolescent psychiatry unit. All children were evaluated for psychiatric diseases by a child and adolescent psychiatrist via a semi-structured interview and asked to parents for any physical diseases that can be related with sleep problems. Additionally, children who use medication with known possible effect on sleep, and have obstructive sleep apnoea or other sleep disorders were also excluded. After the psychiatric and physical assessment of all control, children with no history of chronic medical diseases were included in the study.

A total of 189 children were included in the study after considering the inclusion and exclusion criteria. Ethics approval was provided by Clinical Research Ethics Board of Diyarbakır Gazi Yaşargil Education and Training Hospital.

Procedures

A physician performed a structured interrogation schedule for affective disorders and schizophrenia for present and lifetime (K-SADS-PL) on children of school age for the exclusion of any psychiatric disorder in both the control and study groups and their parents. The physician was a child and adolescent psychiatrist and he is certified to apply K-SADS-PL. The parents of the study group completed the Conner's Parent Questionnaire to evaluate the intensity of ADHD in the children, the Children's Sleep Habits Questionnaire (CSHQ) to evaluate sleep problems, and the Weiss Functional Impairment Rating Scale (WFIRS) to evaluate the functionality of the children. The parents of the control group completed the CSHQ and WFIRS.

Measures

The schedule for affective disorders and schizophrenia for school-age children present and lifetime version (K-SADS-PL)

The K-SADS-PL is a semi-structured interview form designed for the identification of past or present psychopathologies of children and adolescents in accordance with the diagnostic scales of DSM-III-R and DSM-IV [19]. The form consists of three sections: sociodemographic data are questioned in the first section, psychiatric symptoms in the past and present are questioned in the second section, and the general functioning of children is evaluated in the third section. Affective disorders, psychotic disorders, anxiety disorders, elimination disorders, disruptive behaviour disorders, alcohol and drug abuse disorders, eating disorders, and tic disorders may be evaluated during the interview. The Turkish translation of K-SADS-PL

and validity and reliability were performed previously [20].

Conners' Parent Rating Scale (CPRS-48)

Conners' Parent Rating Scale (CPRS-48) was developed by Conners for children [21,22]. The scale has been used for the identification of behaviour disorders in children, and for monitoring treatment and evaluation as an additional scale [23]. Short and long versions of scale were developed recently [24,25]. The short version of CPRS involves additional items for psychosomatic disorders and anxiety in addition to the items of hyperactivity, learning, and behaviour problems. The Turkish validity and reliability study of the form was performed [26].

Children's sleep habits questionnaire

The questionnaire was developed by Owens et al. [27] and the Turkish validity and reliability was performed [28]. The short version of scale consists of 33 items. The scale is evaluated in eight different subscales as the resistance against sleep time, delay in falling asleep, sleep period, sleep anxiety, waking in the night, parasomnias, sleep breathing disorders, and daytime somnolence. The parents completed the form considering the sleep characteristics of the previous week.

Weiss Functional Impairment Scale Parent Form

The Weiss Functional Impairment Scale Parent Form (WFIRS-P) was developed for children and adolescents with ADHD, and for the evaluation of functional impairment. The parent form consists of 50 items. The scale is divided into seven subscales as family, school, behaviour, life skills, child's sense of self, social activities, and risky actions. The Turkish validity and reliability of the form has been performed [29].

Sociodemographic data form

This form was created by the authors to collect data on the demographic characteristics of children and adolescents based on the literature. The form questions the age, sex, socioeconomic level, education level, and the family.

Table 1. The subscale score comparison of CSHQ in the study and control groups.

CSHQ subscales	Study group ($n = 83$) Mean ± SD	Control group ($n = 106$) Mean ± SD	p*
Sleep time resistance	11.2 ± 3.4	8.1 ± 2	<001
Delay in falling asleep	1.9 ± 0.8	1.4 ± 0.8	<.001
Sleep period	5.2 ± 1.8	4 ± 1.4	<.001
Sleep anxiety	7.4 ± 2.3	5.7 ± 1.9	<.001
Waking in the night	4.8 ± 1.6	3.8 ± 1	<.001
Parasomnias	10.1 ± 2.3	8.1 ± 1.7	<.001
Sleep breathing disorders	4.5 ± 1.6	3.3 ± 0.7	<.001
Daytime somnolence	15 ± 5.6	11.3 ± 2.9	<.001
Total score	56.3 ± 10.2	42.9 ± 6.1	<.001

*Mann–Whitney U test; CSHQ, Children's Sleep Habits Questionnaire.

Statistical analyses

The data were evaluated using IBM SPSS statistics software version 22. The measured variables were expressed as median ± standard deviation, and the categorical variables were defined as percentage and number. The distribution of numeric variables was evaluated using the Kolmogorov–Smirnov test and by evaluating histograms. The comparison of normal distribution of numeric variables was evaluated using the Student's t test, and non-normally distributed numeric variables were evaluated using the Mann–Whitney U test. The categorical variables were evaluated using the Pearson's Chi-square test and the Fisher's exact test. The Pearson's test was used to identify the direction and level of the association in numeric variables, and the Spearmen's correlation test was used for non-normally distributed numeric variables. The value of statistical significance was determined as $p < .05$.

Results

The mean age was 8.8 ± 1.4 years in the study group and 8.6 ± 0.8 years in the control group. The study group consisted of 22.9% girls ($n = 19$) and 77.1% boys ($n = 64$); the control group comprised 55.7% girls ($n = 59$) and 44.3% boys ($n = 47$). As expected, the number of boys was greater in the study group compared with the control group. There was a significant difference between the distribution of sexes in the two groups ($\chi^2 = 20.6$, df = 1, $p < .001$). The school success of children with ADHD was significantly lower compared with the control group ($\chi^2 = 74.9$, df = 4, $p < .001$). No significant difference was detected between the groups considering the age, number of siblings, parents' unity, parents age, and family incomes ($p > .05$).

In the study group, 77.1% of children ($n = 64$) were diagnosed as having combined type, 13.3% had inattentive type, and 9.6% had hyperactive-impulsive type ADHD. The total score of CPRS was detected as 51 ± 13 in the study group.

The total scores of subscale and scales of CSHQ in the study and control group were compared using the Mann–Whitney U test because there was no normal distribution. The total scores of subscale and scales in the study group were significantly higher compared with the control group (Table 1). An increase in scale scores signifies a functional problem in that area. The total scores of the CSHQ were compared using the Kruskal–Wallis test considering the subtypes of ADHD and a significant difference was found between the three different groups ($p = .036$). The CSHQ scores of the paired comparison of combined and hyperactivity dominant type were significantly higher compared with the inattentive type ($p < .05$). No significant

difference was found between the combined type and hyperactivity-dominant ADHD patients with regard to sleep problems ($p > .05$).

A significant difference was detected in the study group considering the sleeping time at night, amount of sleep, and waking time in the morning (Table 2).

The subscale scores in WFIRS-P (family, school, behaviour, life skills, sense of self of the child, social activities, risky activities) and total scores were found significantly higher in the study group compared with the control group ($p < .05$). Increases in WFIRS-P scale scores were considered to indicate problem in the functioning of that area.

Correlations

The correlations between the total scores of CSHQ, WFIRS, CPRS score, and attack/hyperactivity subscale scores were examined to investigate the possible effects of sleep problems on the intensity of ADHD symptoms and functionality. A significant correlation was detected between the CSHQ scores and WFIRS-P (r: 0.707, $p < .001$) and CPRS scores (r: 0.302, $p = .012$). In addition, there was a significant correlation between the CSHQ and Conner's Parent Rating attack/hyperactivity subscale scores (Spearmen's rho = 0.398, $p < .001$).

Discussion

Sleep habits and sleep problems, and their effects on the functionality of children with ADHD who were not initiated treatment were evaluated in the present study. The results demonstrated that children with ADHD experienced more sleep problems and slept less than the children in the healthy control group, and functional impairments increased due to these problems. Although sleep problems are not included in the diagnostic criteria of ADHD, and psychiatric comorbid diseases that might cause sleep problems were excluded in the study, the outcomes revealed that it is important to evaluate sleep habits in children and initiate intervention programmes against the symptoms.

The outcomes of the scale completed by the parents regarding the previous 7 days' routine revealed that sleep problems such as resistance against sleep, delay in falling asleep, sleep period, waking in the night, and parasomnias were significantly higher in the study group compared with the control group. This finding is compatible with the studies of Cortese et al. and Yook, Jain, and Shapiroin which the researchers indicated that resistance against sleep, delay in falling asleep, decrease in the quantity of sleep, increase in the amount waking at night, and daytime somnolence increased in children with ADHD [8,9]. These children slept 1 hour later and sleep quantity was 1.5 hours less than the control group. Daytime somnolence would be expected due to less sleep and sleeping at later hours. Accordingly, the parents of children with ADHD reported that their children experienced more somnolence [5]. We also found more somnolence among children in our study. In addition, researchers reported that short-period sleep was associated with externalizing problems [30]. In light of the findings, it could be suggested that the children had difficulty in starting and maintaining sleeping. The subjective [6,31–33] and objective methods [34,35] demonstrated that these children experienced discomfort during sleep and had higher activity levels. They might have difficulty in waking refreshed in the morning and getting up and starting the day due to weakness in the organization of sleep routine, discomfort during sleep, and frequent waking; therefore, they might feel daytime somnolence and may experience an increase in the intensity of current ADHD symptoms.

Resistance against sleep might be due to difficulty in sleep regulation. However, all possible disorders associated with sleep were excluded, but oppositional defiant disorder (ODD) was not excluded. It may be suggested that children with comorbid ODD may have more resistance against sleeping time.

In addition, the incidence of breathing disorder during sleep was found higher in these children. However, the association between ADHD and sleep-disordered breathing (SDB) is controversial [36]. Chervin et al. reported that the incidence of snoring and SDB was higher in children with ADHD [37]. The authors reported that the relative hypercapnia, hypoxia and free radicals, inflammatory cytokines, and increase in oxidative stress might cause inattention, hyperactivity, or impulsive symptoms resulting in neurologic dysfunction [38]. It may be suggested that the presence of SDB might be a factor affecting the intensity of disease. Although the clinical history cannot exactly clarify the conditions such as obstructive sleep apnoea and primary snoring, upper respiratory tract examination and questioning SDB-related symptoms from the parents may be beneficial in the event that the gold standard polisomnography [39] cannot be performed. Therefore, a careful investigation of SDB-related symptoms has great importance in these children. The American Academy of Pediatrics recommends

Table 2. The comparison of sleeping time at night, amount of sleep, and waking time in the morning between the groups.

	Study group ($n = 83$)	Control group ($n = 106$)	
	Mean ± SD	Mean ± SD	p*
Sleeping time at night (time)	11:00 pm ± 1.4	10:10 PM ± 1	<.001
Amount of sleep (hours)	8.5 ± 1	10.3 ± 1.2	<.001
Waking time in the morning (time)	7.30 am ± 1.2	8.30 AM ± 1	<.001

*Mann–Whitney U test.

screening for SDB-related symptoms in children with ADHD [40].

Researchers reported that untreated persistent sleep disorders in children with ADHD caused an increase in behavioural symptoms, decrease in daily functionality, and a decrease in life quality of children and their families [7]. The correlation between CPRS and the WFIRS-P form in our study supports this finding. In addition, using the outcomes of WFIRS, we identified that the family functionality of children was worse. Severe sleep problems might cause psychosocial difficulties, and may even affect family functionality at the same time. The outcomes of WFIRS revealed that school, life skills, and child's sense of self were poorer compared with the control group. However, the impairment in functionality of the children might be due to ADHD symptoms; the correlation of this impairment with sleep symptoms indicates that sleep problems affected most parts of the lives of the children.

The prevalence of sleep problems was reported to vary between the subtypes of ADHD; however, the prevalence was higher in the combined type [41]. Similarly, in our study 77.1% ($n = 64$) of children were diagnosed as having combined type ADHD and sleep problems were more frequent in combined-type and hyperactivity-type ADHD compared with inattentive type.

The limitations of the study must be considered during the evaluation of our findings. Although sleep-associated comorbid conditions were excluded from the study, ODD was not excluded. Children with ODD may react with problematic behaviours, particularly early in the morning and before sleep at night. Secondly, we did not evaluate restless leg syndrome and periodic leg movement disorder in our study. Thirdly, all scales were completed by parents; thus, findings may reflect a common effect of parental perception on measures. Fourthly, even though there is no mental and physical conditions, children may show sleep problems by several other causes, such as family sleeping attitudes, daily physical activity, and use of electronics before bedtime. In the current study, we did not examine other causes that may affect the sleep pattern in children with ADHD and controls.

In addition, the problematic interaction between parents and child might have affected the results of our study because children were not initiated into any treatment. Researchers demonstrated that most families had improper sleep habits, which may contribute to the problems in falling sleep, maintaining sleep, and difficulty in waking for children with ADHD [42]. We may suggest, considering the exclusion criteria of the study, that drug use and comorbid psychiatric problems other than ODD do not cause sleep-related problems in children.

In conclusion, the findings of the study revealed that ADHD caused an impairment not only at night, but appear in the morning and daytime. According to the inclusion and exclusion criteria, in present study, we can exclude the possible effect of medications and comorbid mood and anxiety disorders on sleep difficulties. Therefore, we conclude that sleep problems in children with ADHD cannot be explained by the use of medication and non-ODD psychiatric comorbidity. The increase in sleep problems is associated with impairment in functionality and increase in ADHD intensity, similarly maintaining sleep hygiene or interventions against sleep problems may increase sleep quality in children with ADHD, and may improve self and family functionality. Therefore, the standardized sleep evaluation must be performed in cooperation with parents in children with ADHD and patient-specific maintenance of sleep hygiene must be included in the treatment protocol of all children diagnosed with ADHD. In addition, SDB-related symptoms must be attentively evaluated, and advanced evaluations must be performed when required. Furthermore, pharmacologic methods may be beneficial for the resolution of sleep problems in addition to behavioural interventions. Advanced studies are needed for the evaluation of the effects of comorbid sleep problems on treatment and prognosis.

Disclosure statement

No potential conflict of interest was reported by the authors.

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