Research Article

Sleep Disturbance in ADHD Children: Prevalence, Clinical Profile and Influencing

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Background: Attention deficit-hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder that is frequently accompanied by several comorbidities, making it complicated and challenging to manage. Sleep disturbance is one of the ADHD comorbidities with complex, multi-directional, and multifactorial relationships.

Objective: To determine the prevalence and factors that influence sleep disturbance in ADHD children.

Methods: A cross-sectional study conducted at Soerojo Hospital, involving 60 children under aged 6-15 years who had been diagnosed with ADHD using DSM-5 criteria, at the child and adolescent mental health department, outpatient clinic of Soerojo Hospital, Central Java in May 2022 - October 2022. Data collected by purposive sampling technique, using validated and reliable Indonesian version of the Sleep Disturbance Scale for Children (SDSC) questionnaire. Logistic regression analysis was used to determine the factors that are influencing sleep disturbance.

Results: A total of 60 ADHD children in this study, sleep disturbance prevalence was 12 (20%). Sleep hyperhidrosis (13%) was the most common sleep disturbance type, followed by disorders of initiating and maintaining sleep (3%) and sleep breathing (3%) then disorders of excessive somnolence (1%). Based on bivariate analysis we found that the factors that influence sleep disturbance in ADHD children were Asthma (ϱ-=0.025) and epilepsy (ϱ-=0.037).

Conclusion: Prevalence of sleep disturbance in ADHD children is relatively high. Asthma and epilepsy were significant influences on increased sleep disturbance incidents in children with ADHD. Early screening for sleep disturbance in ADHD children and its influencing factors is necessary to provide effective prevention and treatment.

Keywords: Sleep disturbance, ADHD, SDSC, influencing factors.

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders that can develop in both children and adults, characterized by an inability to maintain attention according to the level of growth, restlessness, and/or hyperactive-impulsive psychomotor behavior[1]. Children with ADHD may have troubles paying attention, hyperactivity, and impulsivity and may adversely impact social, academic, or other activities [2]. ADHD, a perennial neurodevelopmental disorder that impacts 2.5% of adults and 5% of children and adolescents globally [3].

There is no clear data available on the prevalence of ADHD children in Indonesia but there are a number of studies that can describe the prevalence of ADHD. The previous survey discovered that a significant proportion of primary school students (26.2%) experience ADHD in the capital city of Indonesia[4] and the other research by Paramashanti *et al* (2018) in Bantul-DIY reported ADHD prevalence was 29.19% [5].

ADHD is typically accompanied by a number of comorbidities, making it challenging and complicated to manage[6]. Most children and adolescents with ADHD have comorbid conditions, often multiple comorbidities or at least one comorbid. The results of a study by Radmanovic (2020) reveal that sleep disturbance is one of the comorbid ADHD and other comorbidities such as learning difficulties, speech-language difficulties, mood disorders, and eating disorders[7]. Therefore, the association between sleep disorder and ADHD are complex, multi-directional, and multifactorial and are often associated with poorer daily functioning[8].

Compared to 7% of the general population, patients with ADHD reported sleep alteration 25-55% of the time[9]. Hodgkins *et al* (2013) provided data that as many as 25-55% of parents reported that their children with ADHD had sleep disorders[10]. Based on this description, this study was conducted with the aim of assessing sleep disturbance and their influencing factors in ADHD children, so that the results of this study can provide appropriate prevention and treatment.

METHOD

Study design and data collection

A cross-sectional design was carried out from May to October 2022 at Soerojo Hospital. Purposive sampling technique was used to select a total of 60 respondents. The inclusion criteria were ADHD pediatric patients aged 6-15 years accompanied by parents or caregivers willing to participate in the study, therefore informed consent was obtained from the child's parent or caregivers. Meanwhile, ADHD children with comorbidities such as schizophrenia/psychotic disorders and/or other mental disorders: anxiety disorders, mood disorders, dissociative disorders, personality disorders, substance intoxication or drug withdrawal, autism, and mental retardation were excluded. This study was approved by The Ethics Committee, Soerojo Hospital issued on 28 April 2022 (No: 22/KEH/IV/2022).

Data collection

Data collection begins with determining the sample based on inclusion and exclusion criteria. Respondents who agree to participate in the research will sign an informed consent and be recruited as a sample. Data obtained by distributing questionnaires to respondents. The questionnaire consists of questions related to sleep disturbances in children with ADHD. We also collected data about the demographic characteristics of respondents and the influencing factors of sleep disturbance that consist of: history of therapy, comorbidities, Low Birth Weight (LBW), malnutrition, screentime, and socio-economic conditions of parents.

Research instrument

We measured all subjects' weight and height and plotted it into CDC growth charts to measure malnutrition; other data were collected through interviews with their parents. The SDSC (Sleep Disturbance Scale for Children) questionnaire was distributed to get sleep disturbance data. SDSC is a sleep disturbance screening instrument for standardizing the assessment, identifying specific limits, and identifying sleep disturbance in children using a sleep scoring system (Herwanto et al., 2018). SDSC questionnaire contains 26 question items divided into 6 sleep disturbance type :1) SHY (Sleep Hyperhidrosis); 2) DIMS (Difficulty in Initiating and Maintaining Sleep); 3) SBD (Sleep Breathing Disorder); 4) DOES (Disorder Of Excessive Somnolence);5) DOA (Disorders Of Arousal);6) SWTD (Sleep–WakeTransition Disorder). The questions are scored on a Likert scale of 1 to 5 and the sum of the scores determines a total sleep score (Total SDSC). The validated and reliable Indonesian version of the Sleep Disturbance Scale for Children (SDSC) questionnaire was adopted in this study (Natalita et al., 2016).

Data analysis

The distribution and proportion of the demographic and clinical profile of children with ADHD, sleep disturbance, and influencing factors were analyzed using univariate analysis. Meanwhile, the chi-square test was used in bivariate analysis to determine the association between influencing factors and sleep disturbance. Two variables are statistically significant if the calculated ρ-value is less than 0.05. Data was analyzed using the SPSS software.

RESULT

The study was conducted at the child and adolescent mental health clinic at Soerojo Hospital for four months from May to August 2022. There were 60 respondents who met the inclusion and exclusion criteria in this study with the following basic characteristics.

Table 1. Basic Characteristics of Respondents

Characteristics	N= 60	
	n	%
Age (years)		
5-11	45	75%
≥ 12	15	25%
Gender		
Male	54	90%
Female	6	10%
LBW (Low Birth Weight)		
< 2500 gr	8	13%
2500 gr	3	5%
> 2500 gr	49	82%
Comorbid		
Asthma	2	3%
Epilepsy	7	12%

The proportion of ADHD children between the ages of 5 - 11 years is 3 times higher than that of children with ADHD aged > 12 years, which is 75% versus 25% (3:1). Meanwhile, based on gender data, it is known that the number of ADHD children is 54 (90%) boys and 6 (10%). Among all child respondents, 8 (13%) had a history of low birth weight, 2 (3%) had comorbid asthma and 7 (12%) had comorbid epilepsy.

Table 2. Distribution of Sleep Disturbance

SDSC Results	n	%	x ± SD
Non-Sleep Disturbance	48	80%	20 ± 0.403
Sleep Disturbance	12	20%	
Sleep Hyperhidrosis (SHY)	8	13%	
Difficulty in Initiating and Maintaining Sleep (DIMS)	2	3%	
Sleep Breathing Disorder (SBD)	2	3%	
Disorder Of Excessive Somnolence (DOES)	1	1%	
Disorders Of Arousal (DOA)	0	0%	
Sleep–Wake Transition Disorder (SWTD)	0	0%	

It is known that the prevalence of sleep disturbance in ADHD children is 12 or 20% of the total respondents with ADHD. The data was obtained based on a questionnaire answered by parents according to the sleep habits of children with ADHD. Hyperhidrosis disorder during sleep (13%) was the most common type of sleep disturbance found in this study. Followed by the type of disorder in initiating sleep and maintaining sleep (3%) and breathing disorders during sleep (3%) and excessive somnolence (1%). It was found that there was 1 child with ADHD who had 2 types of sleep disturbance at once, namely respiratory disorders and hyperhidrosis during sleep.

Table 3. Demographic and Clinical Profile of Respondents

No	Variable	Total (N=60)	Sleep Disturbance		Non-Sleep Disturbance	
			n	%	n	%
1	**Age (Children)**					
	5-11 years	45	8	18%	37	82%
	≥ 12 years	15	4	27%	11	73%
2	**Gender**					
	Male	54	10	19%	44	81%
	Female	6	2	33%	4	67%
3	**Pharmacotherapy**					
	Yes	35	7	20%	28	80%
	No	25	5	20%	20	80%
4	**Asthma**					
	Yes	2	2	100%	0	0%
	No	58	10	17%	48	83%
5	**Epilepsy**					
	Yes	7	4	57%	3	43%
	No	53	8	15%	45	85%
6	**LBW History**					
	Yes	8	1	12.5%	7	87.5%
	No	52	11	21%	41	79%
7	**Malnutrition**					
	Yes	31	6	19%	25	81%
	No	29	6	21%	23	79%
8	**Screentime**					
	Exceed recommendation	32	7	22%	25	78%
	Within recommendation	28	5	18%	23	82%
9	**Education (Mother)**					
	Low Education	32	7	22%	25	78%
	High Education	28	5	18%	23	82%
10	**Socio-economic Conditions**					
	Low Income	20	5	25%	15	75%
	High Income	40	7	17.5%	33	82.5%

Based on table 3, there are 8/45 children with ADHD aged 5-11 years having sleep disturbance. Among all ADHD children who have sleep disturbance, 10 of them are male. It is also known that 7 out of 35 ADHD children receiving pharmacological ADHD therapy have sleep disturbance. There are 2 of all respondents have asthma and both have sleep disturbance. In addition, there are 4 out of 7 ADHD children with epilepsy who have sleep disturbance.

Among ADHD children with sleep disturbance, one child had a history of low birth weight, 6 children had non-ideal nutritional status or malnutrition, and 7 children had screen time exceeding the recommendation. There are 7 ADHD children with sleep disturbance who have mothers with low levels of education (< high school) and 5 children with lower socioeconomic backgrounds.

Table 4. Factors Affecting Sleep Disturbance

No	Variable	Sleep Disturbance (n=12)	Non-Sleep Disturbance (n=48)	*p--value*	OR	95% CI
		n				
1	**Age (Children)**					
	5-11 years	8	37	0.472	1.682	0.425 – 6.659
	≥ 12 years	4	11			
2	**Gender**					
	Male	10	44	0.59	2.2	0.353 – 13.728
	Female	2	4			
3	**Pharmacotherapy**					
	Yes	7	28	1	1	0.277 – 3.608
	No	5	20			
4	**Asthma**					
	Yes	2	0	**0.037***	1.2	0.932 – 1.546
	No	10	48			
5	**Epilepsy**					
	Yes	4	3	**0.025***	7.5	1.404 – 40.050
	No	8	45			
6	**LBW History**					
	Yes	1	7	1	0.532	0.059 – 4.798
	No	11	41			
7	**Malnutrition**					
	Yes	6	25	1	0.92	0.260 – 3.261
	No	6	23			
8	**Screen time**					
	Exceed recommendation	7	25	0.756	1.288	0.358 – 4.631
	Within recommendation	5	23			
9	**Education (Mother)**					
	Low Education	7	25	0.756	1.288	0.358 – 4.631
	High Education	5	23			
10	**Socio-economic Conditions**					
	Low Income	5	15	0.511	1.571	0.428 – 5.765
	High Income	7	33			

The results of bivariate analysis of relationship between sleep disturbance and each factor are presented in table 6. Based on the chi-square test for bivariate analysis, it was found that comorbid asthma had a statistical relationship with sleep disturbance in ADHD children (ρ-value 0.037) and the OR value was 1.2, which means that ADHD children who have asthma are 1.2 times more likely to have sleep disturbance. In addition, epilepsy comorbidity also has a relationship with sleep disturbance in ADHD children (ρ-value 0.025) with an OR value of 7.5, which means that ADHD children who have epilepsy have a 7 times greater risk of having sleep disturbance.

DISCUSSION

ADHD is a chronic neurodevelopmental behavior disorder characterized by symptoms of inattention, impulsivity and hyperactive behavior[11]. The result of this study indicates that children with ADHD are found more in boys than girls and a higher proportion of ADHD in children aged 5 to 11 years than aged >12 years.

ADHD children are more susceptible to having sleep difficulties[12]. Sleep disorders have been identified as a comorbid condition in 25–50% of children and adolescents with ADHD[10]. ADHD is multidirectional and multifactorial along with other conditions, one of which is sleep disorder[13]. Sleep disorders affect the quantity, quality, and timing of sleep, causing daytime distress and functional impairment[14].

Types of sleep disturbances were measured using SDSC questionnaire and categorized into 6 types including DIMS (Difficulty in Initiating and Maintaining Sleep); SBD (Sleep Breathing Disorder); DOA (Disorders Of Arousal); SWTD (Sleep–Wake Transition Disorder); DOES (Disorder Of Excessive Somnolence); and SHY (Sleep Hyperhidrosis)[15,16]. Results of this study, 13% of ADHD respondents had sleep hyperhidrosis. According to Zeron et al. (2020), while ADHD combined-type patients experience more severe sleep breathing problems and sleep hyperhidrosis, ADHD inattentive patients have problems with substantial behavioral sleep, including problems falling asleep and staying asleep, sleep-wake transition abnormalities, and excessive daytime somnolence[17]. ADHD patients who scored high on the sleep hyperhidrosis subscale were more likely to have night sweats and had shorter sleep durations. According to the SDSC questionnaire, type of sleep hyperhidrosis consists of two points, including falling asleep sweating and night sweating [15,16].

In addition to sleep hyperhidrosis, disorder of initiating and maintaining sleep was identified in 3% of ADHD respondents. These results are consistent with previous research conducted at Child Development Polyclinic Dr. Sardjito Hospital, Yogyakarta knew that 64,8% of ADHD children experienced sleep disorders with the majority having disorders of initiating and maintaining sleep (48.1%), sleep-wake transition disorders (14,6%), and disorders of excessive somnolence (1,9%)[18]. Disorder of initiating and maintaining consists of several points including sleep duration, sleep latency, unwillingness to go to bed, difficulties falling asleep, anxiety before falling asleep, nighttime awakenings, and difficulty getting back to sleep after awakenings[15,16].

The results of this study also found that 3% of ADHD respondents experienced sleep breathing disorders. In a narrative review of sleep disorders in ADHD patients[19], thirteen research examined the sleep characteristics of individuals with sleep breathing disorders and ADHD. Sleep breathing disorders are characterized by irregular breathing and/or ventilation during sleep and research has shown that higher sleep breathing disorders symptoms are correlated to higher total ADHD symptoms. This correlation is stronger for hyperactivity, then impulsivity, and also poor social skills, and lower academic performance. The first line treatment for ADHD children with sleep breathing disorders is surgical removal of the tonsils or adenoids. Sleep breathing disorders consist of three points including breathing problems, sleep apnoea, and snoring[16]

In this study, disorders of excessive somnolence were found with the least number (1%). In a study conducted by Cohen and colleagues (2013) on 186 children aged from 2 to 18 years consisting of 109 boys and 77 girls. The SDSC questionnaire was

given to their parents to complete. The questionnaires were separated into three groups: ADHD (62 patients), epilepsy (58 patients), or other (66), according to their primary neurologic diagnosis. Total abnormal sleep scores for fifty children. Initiating and maintaining sleep (24.7%), arousal nightmares (23.1%), and excessive sleepiness (25.3%) were the three most prevalent sleep disorders[20]. Disorders of excessive somnolence consist of several points including distress and tiredness when waking up, daytime somnolence, sleep paralysis, and sleep attacks [16].

Furthermore, the results of the bivariate statistical analysis, it is known that epilepsy and asthma are comorbidities in ADHD children associated with sleep disorders. Clinical studies estimate a prevalence of 30-40% for ADHD in children with epilepsy, which is substantially higher than in the general pediatric population[21]. According to studies, ADHD is the most prevalent problem among preschoolers and school-aged children with epilepsy, affecting both males and girls equally. The presence of sleep disturbance in children with epilepsy is related to impaired GABA release. Decreased GABA or increased acetylcholine and norepinephrine are responsible for the pathophysiology of sleep disorders in children with epilepsy. The pathophysiology of epilepsy causes prolonged sleep onset, sleep phase disorder, prolongation of NREM 1 and 2 phases, decreased sleep spindle density, and decreased REM phase [22]. The results of these studies are consistent with the bivariate statistical analysis in this study, that there is an association between comorbid epilepsy and sleep disturbance in ADHD children (ρ-value 0.025).

Besides epilepsy, comorbid asthma is also one of the factors associated with sleep disturbance in ADHD children. The bivariate analysis results showed a significant association between comorbid asthma and sleep disturbance in ADHD children (ρ-value 0.037). These results are consistent with previous research by Furtado *et al*, which stated that asthma causes sleep disorders, based on clinical experience there is a significant interaction between respiratory function disorders and sleep quality. Uncontrolled history of comorbid asthma in children or adolescents could be functional condition and progression, impaired growth, as well as attention deficit disorders, excessive drowsiness, psychological issues, increased school absences, and inadequate academic performance that impact their QoL[23]. Hypoxia and breathing maintenance activities exacerbate attention problems that children with asthma may experience. Additionally, difficulty breathing at night might disrupt sleep, aggravating attention deficit hyperactivity disorder [24].

Based on the description, it is known that sleep disorders are one of the comorbidities highly prevalent in ADHD children. Therefore, proper assessment of sleep disorders is needed, especially for those who have sleep problems, so early treatment can be given, and should be noted that sleep disturbances and ADHD have a reciprocal relationship associated with poorer daily functioning. The results of the study are expected to be a scientific basis for identifying the risk of sleep disorders in ADHD children so appropriate prevention and management can be carried out.

The limitation of this study was the research sample consisted of ADHD children who were already undergoing therapy. The obtained pharmacological or non-pharmacological therapy has the potential to cause bias in the measurement of sleep disorders.

CONCLUSION

Based on the identification using the SDSC questionnaire, 20% of ADHD children have sleep disturbance. The types of sleep disturbance experienced by respondents in this study were sleep hyperhidrosis (SHY), a disorder of initiating and maintaining sleep (DIMS), sleep breathing disorders (SBD), and disorders of excessive somnolence (DOES). There is a research respondent who has more than one type of sleep disturbance.

In this study, ADHD children who had comorbid asthma and epilepsy were more likely to have sleep problems. Although the association between sleep disturbance and ADHD are complex (multi-directional and multifactorial). Based on the results of this study and supported by a number of previous studies, an initial screening of sleep disturbance in pediatric patients with ADHD is required in order to provide effective prevention and treatment.

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