Original Article

DOI: 10.7860/JCDR/2023/60469.17647

Paediatrics Section

Sleep Disorders and Attention-Deficit/ Hyperactivity Disorder in Children: A Hospital-based Observational Study from a Regional Early Intervention Centre in Kerala, India

SHAFIQ AHAMED MOHAMED ISMAIL[1], FABINA ABDUL GAFOOR[2]

ABSTRACT

Introduction: Attention Deficit Hyperactivity Disorder (ADHD) is one of the most extensively studied neurobehavioural disorders of childhood. The association of sleep disorders with ADHD is multidimensional, and understanding them is important in effectively managing patients with ADHD.

Aim: To examine the presence of sleep disorders in children with ADHD, to correlate it with parameters of age and ADHD subtypes, and to find out the association between sleep disorders and other socio-demographic, and clinical factors.

Materials and Methods: The study sample of this hospital-based observational study consisted of 70 subjects who presented to the Regional Early Intervention Centre (REIC), Thrissur, diagnosed with ADHD based on Diagnostic and Stastistical Manual of Mental Disorders (DSM)-5 criteria and belonging to the age group 5-16 years. Subjects were interviewed using a structured questionnaire to assess socio-demographic and clinical details. The 'Sleep Disturbance Scale for Children' (SDS-C) was used to assess sleep disorders in children. The information thus obtained was analysed using SPSS software version 23.

Results: Out of the 70 subjects with ADHD, 49 (70%) had sleep disorders. The mean age of study population was 8.66±2.72 years, and the male:female ratio was 4:1. There was co-morbid behavioural disorder in 32 subjects (45.7%), and parental history of ADHD in 33 subjects (47.1%). There was a significant association between sleep disorders and behavioural disorders (p-value=0.003) and parental history of ADHD (p-value=0.042). There was a significant negative correlation between age and sleep disorder (p-value=0.033).

Conclusion: The prevalence of sleep disorders in ADHD is high in the study population. The relationship between sleep disorders and the presence of co-morbid behavioural disorders in ADHD suggests that recognition and management of sleep disorders may require more attention. The association between sleep disorder and parental history of ADHD may enhance the understanding of genomic variants associated with ADHD.

Keywords: Attention deficit hyperactivity, Behavioural disorders, Parental history, Sleep disturbances

INTRODUCTION

The ADHD is a childhood-onset neuro-behavioural disorder defined by the presence of developmentally inappropriate and impairing levels of inattention, impulsivity, and hyperactivity [1]. The aggregated prevalence of ADHD based on the study by Polanczyk G and Rohde LA was 5.29% [2]. ADHD exhibits marked diverseness at clinical, aetiological, and pathophysiological levels. The symptomatology level of impairment, and co-morbidities, and family and social factors vary among subjects diagnosed with ADHD [3].

Children with ADHD experience inferior quality of sleep in comparison to their counterparts without this disorder [4,5]. Mild to severe sleep problems are seen in 60% to 70% of children with ADHD [5,6]. The association of sleep with ADHD is understood to be multidimensional and intricate. The sleep disorders seen in ADHD cases may be an innate feature of the disease itself. On the other hand, sleep disturbances per se can cause symptoms similar to ADHD, which in turn may result in a wrong diagnosis [7,8].

The use of psychostimulant medications to treat ADHD may impair sleep in some patients [9], but paradoxically improve sleep in others via a calming effect [10]. Children with ADHD and sleep problems tend to have worser cognitive and behavioural outcomes than children with ADHD alone. Hence, sleep is an important parameter to be monitored in children with ADHD [11].

Subjects who suffer from sleep disorders have been reported to exhibit symptoms of ADHD [12]. On the other hand, subjects with ADHD exhibit symptoms of sleep disturbances like initiation of sleep, periodic limb movements in sleep, sleep-disordered breathing, insomnia, and altered sleep architecture [13].

Research looking at the association between core symptoms of ADHD, subtypes, and sleep disorders has shown inconsistent results. While most studies imply that sleep disorders exist in ADHD [14,15], few studies have shown otherwise. LeBourgeois MK et al., compared subjective measures of sleep among healthy paediatric controls and children of various ADHD subtypes, and found that children with ADHD were sleepier than children without ADHD, and that children of the inattentive subtype (ADHD-I) had a tendency to be sleepier than those with hyperactive-impulsive (ADHD-HI) and combined (ADHD-C) subtypes [16]. A study by Mayes SD et al., observed that children of the inattentive subtype experienced increased sleepiness, whereas those with ADHD-C suffered from disturbances in sleep [17].

The possible mechanisms that connect sleep to ADHD may exist points towards the complexity of the aetiology of ADHD [4]. Further studies are needed to establish that sleep disturbances are an intrinsic feature of ADHD.

The impact of co-morbidities in ADHD on sleep has to be taken into account. The presence of co-morbidity was found to be a key

mediating variable in a meta-analysis [4]. There is a link between co-morbid anxiety/depression and sleep disorders in ADHD [18]. A study by Mayes SD et al., observed that sleep disturbances were more in subjects with ADHD, when co-morbid with anxiety and depression [17]. In a study, ADHD co-morbid with Oppositional-Defiant Disorder (ODD) was shown to be associated with bedtime resistance and morning rise problems [13].

The role of family environment in influencing sleep has to be considered, which has been reported by various studies [19-23].

There are very few studies regarding sleep disorders in ADHD, in particular from India [22,23]. This study aimed to examine the proportion of sleep disorders in children with ADHD attending the REIC, and to determine factors associated with sleep disorder in children with ADHD.

MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted at the REIC attached to Department of Paediatrics, Government Medical College, Thrissur. The study was conducted in conformity with and after obtaining approval from the Institutional Ethics Committee of Government Medical College, Thrissur, Kerala, India (IEC approval number: IEC/GMCTSR/168/2021 dated 28/07/2021). The study was conducted for a period of one year from August 2021 to July 2022. Informed consent was obtained from the parents of subjects who participated in the study.

Inclusion criteria: Children aged 5 years to 16 years, with the diagnosis of ADHD based on Diagnostic and Statistical Manual 5 (DSM 5) [1], were selected for the study. These subjects were referred to the REIC from periphery hospitals, and from Paediatric Outpatient Department of this institute itself, with symptoms suggestive of ADHD for detailed evaluation.

Exclusion criteria: Children who did not give consent for the study, those with moderate to severe intellectual disability (as ascertained by history, academic records and clinical assessment), those diagnosed with primary sleep disorders, or other co-morbid illnesses that could influence sleep per se, and those already on any sedating drugs were excluded from the study.

Study Procedure

The selected children and parents/guardians were interviewed using specially designed socio-demographic and clinical proforma. The SDS-C was used to assess sleep disorders [24]. SDS-C is 26 item Likert-type rating scale which assesses sleep behaviour and disturbance during the previous six months. The SDS-C scale was used after performing a translation and linguistic validation to suit the study group. The SDS-C assesses disorders of initiating and maintaining sleep, sleep breathing disorders, disorders of arousal, excessive somnolence, sleep-wake transition disorders, and sleep hyperhidrosis. The subscales of this tool fit into the categories of Association of Sleep Disorders Centres (ASDC 1979) and the association for the psychophysiological study of sleep diagnostic classification of sleep and arousal disorder. The total score is the sum of the 26 items retained with a possible range from 26 to 130. The cut-off score taken is 39, which corresponds to a sensitivity of 89% and specificity of 74% [24].

In order to obtain parental history of ADHD, birth mothers were asked the following questions:

1. Did you often have trouble paying attention or concentrating in school in childhood?
2. Did you often face problems because you were overactive, fidgety or impulsive (that is doing things that might be dangerous or get you into trouble without thinking about them first)?

The next questions were about child's birth father's activity and attention:

3. As far as you know, did the child's father often have difficulty in paying attention or concentrating in school during his childhood?
4. As far as you know, did the child's father often have problems because he was overactive, fidgety or impulsive (that is doing things that might be dangerous or get him into trouble without thinking about them first) during his childhood?

If respondents answered 'yes' to any of these four questions, their child was considered to have a positive parental history of ADHD symptoms [25].

The subjects whose parents(s) were diagnosed with a psychiatric disease were considered to have a positive parental history of psychiatric disease. The socio-economic status of families was assessed by modified BG Prasad Socio-economic Classification, Update-2019 [26].

The subjects whose sibling(s) were diagnosed with a psychiatric disease were considered to have a positive sibling history of psychiatric disease.

The behavioural disorders namely conduct disorder and oppositional defiant disorder, were diagnosed using the DSM-5 criteria [1]. The language and learning disorders were diagnosed using DSM-5 criteria [1]. The psychomotor development of subjects was assessed using the Indian adaptation of Vineland Social Maturity Scale by Bharat Raj [27].

STATISTICAL ANALYSIS

The data collected were entered into an excel worksheet, after appropriate coding. The socio-demographic characteristics were summarised using descriptive statistics like frequency and percentages in case of discrete data, or mean and standard deviation (SD) in the case of continuous data. A descriptive analysis was done for demographic variables. The association between sleep disorders and other factors was analysed using Chi-square test/ Fischer's-exact test. The association between sleep disorders and age was analysed using Spearman rho correlation. The relation of sleep disturbances with presentation of ADHD was analysed using Kruskal-Wallis test. A p-value of less than 0.05 was considered to be statistically significant. Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 23.

RESULTS

The study sample consisted of 70 ADHD patients, 56 of whom were boys. The mean age of the study population was 8.66±2.72 years. Most of the subjects (64.3%) were of first birth order. Analysis showed that the majority of children in the study population (45.7%) were from lower primary schools. Based on the grades obtained in the last yearly examination, 49 subjects (70%) were found to be in the 'Needs improvement' category, indicating suboptimal scholastic performance [Table/Fig-1].

Variables	n (%)	Mean±SD
Age		
5-10 years	49 (70)	8.66±2.718
11-16 years	21 (30)	
Gender		
Female	14 (20)	
Male	56 (80)	
Birth order		
1	45 (64.3)	
2	19 (27.1)	
3	5 (7.1)	
4	1 (1.4)	
Percentage distribution of sample according to school grade^		
Pre primary	11 (15.7)	
Lower primary	32 (45.7)	
Upper primary	19 (27.1)	
Secondary	8 (11.4)	

School performance*		
Good	21 (30)	
Needs improvement	49 (70)	
Socio-economic status		
I (Upper class)	18 (25.7)	
II (Upper middle class)	15 (21.4)	
III (Middle class)	22 (31.4)	
IV (Lower middle class)	10 (14.3)	
V (Lower class)	5 (7.1)	
ADHD presentation		
Predominantly inattentive	17 (24.3)	
Predominantly hyperactive	7 (10)	
Combined	46 (65.7)	
History of ADHD in sibling		
No	43 (61.4)	
Not applicable	12 (17.1)	
Yes	15 (21.4)	
History of psychiatric disease in sibling		
No	56 (80)	
Not applicable	12 (17.1)	
Yes	2 (2.9)	
Primary caregiver		
Mother	68 (97.1)	
Father	1 (1.4)	
Guardian	1 (1.4)	
Occupational status of primary caregiver		
Employed full time	20 (28.6)	
Employed part-time	2 (2.9)	
Homemaker	47 (67.1)	
Retired/disabled	1 (1.4)	
Marital status of primary caregiver		
Married	65 (92.9)	
Divorced/separated	3 (4.3)	
Widowed	2 (2.9)	
Parental history of ADHD		
No	37 (52.9)	
Yes	33 (47.1)	
Parental history of psychiatric disease		
No	54 (77.1)	
Yes	16 (22.9)	
Presence of sleep disorder(s)		
Yes	49 (70)	
No	21 (30)	
Perinatal risk factors in ADHD		
LBW	16 (22.9)	
Separation of mother and infant for >1 day	22 (31.4)	
Substance abuse in pregnancy	0 (0)	
Psychiatric and medical co-morbidities in ADHD		
Delayed psychomotor development	30 (42.9)	
Behavioural disorders	32 (45.7)	
Learning disorder	57 (81.4)	
Language disorder	46 (65.7)	
Epilepsy	6 (8.6)	
Hypoxic ischemic encephalopathy	3 (4.3)	
Sleep disorders- subtypes in the study population		
		Mean±SD
Disorders of initiating and maintaining sleep		12.87±5.016
Sleep breathing disorders		3.74±1.481
Disorders of arousal		4.33±1.338
Sleep-wake transition disorders		10.71±3.887
Disorders of excessive somnolence		10.91±4.462
Sleep hyperhidrosis		2.59±1.814
Total score-Sleep disorders		**45.14±11.281**

[Table/Fig-1]: Sample characteristics of ADHD.
^Pre-primary (1-2 grades), Lower primary (3-4 grades), Upper Primary (5-7 grades), and Secondary (8-10 grades).

The majority (65.7%) of subjects had a combined presentation of ADHD, followed by predominantly inattentive presentation (24.3%); 21.4% of the subjects had sibling(s) with a history of ADHD, whereas only 2.9% had sibling(s) with history of psychiatric disease. Almost half of the subjects (47.1%) had parents with a history of ADHD, whereas only 22.9% had parents with a history of psychiatric disease. Out of the 70 subjects having ADHD, 49 subjects (70%) had sleep disorder.

Sleep disorders in ADHD [Table/Fig-2]

The association between sleep disorder in ADHD presentation is given in [Table/Fig-3].

Variables		Sleep disorder	
		Yes	p-value
Age	5-10 years (n=49)	37 (75.5%)	0.124†
	11-16 years (n=21)	12 (57.1%)	
Gender	Female (n=14)	11 (78.5%)	0.433*
	Male (n=56)	38 (67.8%)	
School grade^	Pre primary (n=11)	10 (90.9%)	0.125*
	Lower primary (n=32)	21 (65.6%)	
	Upper primary (n=19)	11 (57.8%)	
	Secondary (n=8)	7 (87.5%)	
Recent school marks#	Good (n=21)	14 (66.6%)	0.69†
	Needs improvement (n=49)	35 (71.4%)	
Socioeconomic status	I (Upper class) (n=18)	15 (83.3%)	0.203*
	II (Upper middle class) (n=15)	10 (66.6%)	
	III (Middle class) (n=22)	15 (68.1%)	
	IV (Lower middle class) (n=10)	4 (40%)	
	V (Lower class) (n=5)	4 (80%)	

[Table/Fig-2]: Association between sleep disorder in ADHD and socio-demographic factors.
*Fisher's-exact test; †Chi-square test
^School grades: Pre-primary (1-2 grades), Lower primary (3-4 grades), Upper primary (5-7 grades), and Secondary grade (8-10 grades)
#Based on the marks in previous year's yearly examination, those subjects with remarks 'excellent' and 'fair' were grouped into 'Good school performance' category. Those with remark 'poor', repeated a year in school or expelled from school were grouped into 'Needs improvement' category

ADHD presentation	Sleep disorder	
	Yes	p-value
Predominantly inattentive (n=17)	11	0.069*
Predominantly hyperactive-impulsive (n=7)	7	
Combined (n=46)	31	

[Table/Fig-3]: Association between sleep disorder in ADHD and ADHD presentation.
*Fisher's-exact test

The association between sleep disorder in ADHD and perinatal risk factors, medical and psychiatric co-morbities is given in [Table/Fig-4].

The relationship between subtypes of sleep disorder and ADHD presentations is given in [Table/Fig-5]. The association between sleep disorder and family factors is given in [Table/Fig-6]. The relation of sleep disorder categories with age is given in [Table/Fig-7].

The prevalence of sleep disorder(s) in this study was 70%. There was a statistically significant association between sleep disorder

Parameters	Sleep disorder	
	Yes	p-value
LBW (n=16)	12	0.615*
Separation of mother and baby >1 day (n=24)	19	0.227†
Delayed psychomotor development (n=30)	24	0.114†
Behavioural disorder (n=32)	28	0.003*
Learning disorder (n=57)	39	0.546*
Language disorder (n=46)	34	0.323†
Epilepsy (n=6)	5	0.456*
Hypoxic ischemic encephalopathy (n=3)	3	0.246*

[Table/Fig-4]: Association between sleep disorder in ADHD and perinatal risk factors, medical and psychiatric co-morbidities.

Parameters		Median	Maximum	p-value#
Disorders of initiating and maintaining sleep	Predominantly inattentive	11	26	0.813*
	Predominantly hyperactive/ impulsive	13	21	
	Combined	12	28	
Sleep breathing disorders	Predominantly inattentive	3	7	0.126*
	Predominantly hyperactive/ impulsive	4	7	
	Combined	4	8	
Disorders of arousal	Predominantly inattentive	4	8	0.117*
	Predominantly hyperactive/ impulsive	3	5	
	Combined	4	8	
Sleep-wake transition disorders	Predominantly inattentive	11	19	0.477*
	Predominantly hyperactive/ impulsive	10	11	
	Combined	10.5	24	
Disorders of excessive somnolence	Predominantly inattentive	11	17	0.82*
	Predominantly hyperactive/ impulsive	11	19	
	Combined	10.5	24	
Sleep hyperhidrosis	Predominantly inattentive	2	8	0.286*
	Predominantly hyperactive/ impulsive	2	2	
	Combined	2	10	
Total score-sleep disorder	Predominantly inattentive	44	77	0.886*
	Predominantly hyperactive/ impulsive	43	50	
	Combined	43.5	85	

#Kruskal-Wallis test

[Table/Fig-5]: Relation between sleep disorder-subtypes and ADHD presentations.

Parameters		Sleep disorder	
		Yes	p-value
Family	Nuclear (n=37)	25	0.638†
	Joint (n=33)	24	
Sibling with ADHD (n=15)		9	0.383†
Sibling with h/o psychiatric disease (n=7)		5	0.88*
Parental h/o ADHD (n=33)		27	0.042†
Parental h/o psychiatric disease (n=16)		13	0.263*

[Table/Fig-6]: Association between sleep disorder and family factors.
*Fisher's-exact test; †Chi-square test

Parameters	Correlation coefficient (r)	p-value
Disorders of initiating and maintaining sleep	-0.165	0.173
Sleep breathing disorders	0.02	0.871
Disorders of arousal	-0.186	0.123
Sleep-wake transition disorders	-0.139	0.252
Disorders of excessive somnolence	-0.128	0.29
Sleep hyperhidrosis	-0.045	0.71
Total score-sleep disorder	**-0.256**	**0.033**

[Table/Fig-7]: Relation of sleep disorder categories with age (Spearman rank correlation).

in ADHD and behavioural disorder (p-value=0.003). There was a statistically significant association between parental history of ADHD and sleep disorder (p-value=0.042).

The predominantly hyperactive-impulsive type had the highest prevalence of sleep disorder (100%), followed by combined (67.3%) and predominantly inattentive types (64.7%). However, there was no statistically significant difference among the groups. There was no significant association between sleep disorder in ADHD and the socio-demographic factors assessed in the study population.

DISCUSSION

The prevalence of sleep disorders in the study population was 70%. ADHD is widely recognised to be more frequent in boys than girls; the male to female ratio in the study sample was 4:1.

The majority of the children were in the age group of 5-10 years which constituted 70% of the study population. Hyperactivity and inattention are frequent in children who are biologically more immature [28]. There was a statistically significant reduction in sleep disorder (total score) with increasing age. This could be related to a change in behaviour of the child with maturity and also a reduction in symptoms of ADHD with increasing age. There is also the possibility of parents being less aware of the sleep disturbances in older children [29].

Family and ADHD: Various studies have estimated that the heritability of ADHD is around 80% [30,31]. In this study, 47.1% of the children had parent(s) with a history of ADHD, as ascertained by clinical history from parents regarding ADHD symptoms in their childhood [25]. Only 22.9% of the children had parent(s) with a history of psychiatric disease. There was statistically significant association between parental history of ADHD and sleep disorder in the present study.

For the majority of children, the primary caregiver was mother. In the majority of cases, the primary caregiver was a homemaker. The majority of primary caregivers were married. Studies have pointed out the association of family adversity to ADHD in children [32,33].

Perinatal risk factors and ADHD: In the current study, only 22.9% of the children were born Low Birth Weight (LBW), even though studies have shown that children born LBW have an increased risk of ADHD [34,35]. In this study, none of the mothers had a history of substance abuse during pregnancy, even though studies have pointed towards an association between the same and ADHD [36,37].

Psychiatric and medical co-morbidities in ADHD: A significant association was noted between behavioural disorder and sleep disorder. The most common psychiatric co-morbidity associated with ADHD was learning disorder, followed by language disorder and behavioural disorder. Based on a review of various literature, it is found that the rate of language impairment in children with ADHD often exceeds 50%, and as many as 90% of children with ADHD have co-existing language problems [38]. The scholastic performance of majority of students in the current study was found to be poor based on grade and school reports of the last term exams.

ADHD has lately been characterised as a dysfunction of the striatum. The watershed regions of the brain, including the striatum, are most vulnerable to fetal circulatory insufficiency with loss of autoregulation and systemic hypotension. In addition, the convergent glutaminergic afferent synaptic transmission from almost the entire cortex to the striatum contributes to its vulnerability to ischemia-induced liberation of the excitatory neurotransmitter glutamate, and consequent excitotoxicity [39]. In this study, only 7.14% of cases had a history

of Hypoxic-Ischemic Encephalopathy (HIE), and 8.6% of cases had a history of epilepsy.

ADHD subtypes: The majority (65.7%) of children in the study population had combined presentation of ADHD, followed by a predominantly inattentive presentation and predominantly hyperactive presentation, which is similar to a study published by Vaidyanathan S et al., [29]. The predominantly hyperactive/impulsive group had the highest prevalence of sleep disorder (total score), followed by combined and then predominantly inattentive presentation. This finding also is in concordance with the report by Vaidyanathan S et al., [29]. However, the difference in this study was not statistically significant.

In the present study, the majority of children were from lower primary schools. This could be because young-for-grade children are more likely to be diagnosed with ADHD. This is in line with various international and Indian studies. Schools play an important role in the diagnosis of ADHD, given that dysfunctional behaviour and poor scholastic performance are key factors in suspecting ADHD [40].

Limitation(s)

Since this is not a case control study, only observations could be made regarding the possible risk factors. It took around one hour each for obtaining history of a subject, which may not be practical in outpatient setting. An accurate history regarding past medications, perinatal risk factors and other medical illness were not obtained in some cases due to lack of documentation. A larger sample size would have added power to the study. The sleep questionnaire was parent rated only and subjective. Hence, there was chance for recall bias. The sleep disorders detected were not confirmed by objective measures of assessment. Co-morbidity of ODD with ADHD was analysed, which may independently cause sleep related issues.

CONCLUSION(S)

The current knowledge that ADHD and sleep disturbances are closely associated that the presence of one can exacerbate the symptoms of the other and the presence of overlap of symptomatology in both conditions point towards the possibility of common neural mechanisms. The interventions targeting sleep disturbances at the outset may alleviate the symptoms of ADHD, and thus improve the quality of life in these patients. A proper elucidation of the neurophysiological mechanisms that govern sleep and attention, and the impact of hereditary and environmental factors on them may aid in framing newer modalities of treatment for ADHD. The future challenge in studying sleep disturbances in ADHD is to eliminate methodological flaws by appropriately accounting for possible confounders like age, ADHD subtypes, and co-morbid illnesses. Many encouraging studies concerning the 'sleep phenotypes' of ADHD offer new hopes for identifying early markers of ADHD like chronic sleep deprivation, which could help in the early detection and intervention of this disorder.

REFERENCES

[1] American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 5th edition. Washington: American Psychiatric Association, 2013.
[2] Polanczyk G, Rohde LA. Epidemiology of attention-deficit/hyperactivity disorder across the lifespan. Curr Opin Psychiatry. 2007;20(4):386-92.
[3] Miller M, Hinshaw SP. Attention-deficit/hyperactivity disorder. Encycl Ment Heal Second Ed. 2015;387:116-23.
[4] Yoon SYR, Jain U, Shapiro C. Sleep in attention-deficit/hyperactivity disorder in children and adults: Past, present, and future. Sleep Med Rev. 2012;16(4):371-88.
[5] Sung V, Hiscock H, Sciberras E, Efron D. Sleep problems in children with attention-deficit/hyperactivity disorder: Prevalence and the effect on the child and family. Arch Pediatr Adolesc Med. 2008;162(4):336-42.
[6] Efron D, Lycett K, Sciberras E. Use of sleep medication in children with ADHD. Sleep Med. 2014;15(4):472-75.
[7] Cortese S, Konofal E, Yateman N, Mouren MC, Lecendreux M. Sleep and alertness in children with attention-deficit/hyperactivity disorder: A systematic review of the literature. Sleep. 2006;29(4):504-11.
[8] Owens JA. Sleep disorders and attention-deficit/hyperactivity disorder. Curr Psychiatry Rep. 2008;10(5):439-44.
[9] Spruyt K, Gozal D. Sleep disturbances in children with attention-deficit/hyperactivity disorder. Expert Rev Neurother. 2011;11(4):565-77.
[10] Jerome L, Segal A. Benefit of long-term stimulants on driving in adults with ADHD. The Journal of Nervous And Mental Disease. 2001;189(1):63-64.
[11] Bullock GL, Schall U. Dyssomnia in children diagnosed with attention deficit hyperactivity disorder: A critical review. Aust N Z J Psychiatry. 2005;39(5):373-77.
[12] Chervin RD, Archbold KH, Dillon JE, Panahi P, Pituch KJ, Dahl RE, et al. Inattention, hyperactivity, and symptoms of sleep-disordered breathing. Pediatrics. 2002;109(3):449-56.
[13] Corkum P, Moldofsky H, Hogg-Johnson S, Humphries T, Tannock R. Sleep problems in children with attention-deficit/hyperactivity disorder: Impact of subtype, comorbidity, and stimulant medication. J Am Acad Child Adolesc Psychiatry. 1999;38(10):1285-93.
[14] Schredl M, Alm B, Sobanski E. Sleep quality in adult patients with Attention Deficit Hyperactivity Disorder (ADHD). Eur Arch Psychiatry Clin Neurosci. 2007;257(3):164-68.
[15] Gau SSF, Kessler RC, Tseng WL, Wu YY, Chiu YN, Bin YC, et al. Association between sleep problems and symptoms of attention-deficit/hyperactivity disorder in young adults. Sleep. 2007;30(2):195-201.
[16] LeBourgeois MK, Avis K, Mixon M, Olmi J, Harsh J. Snoring, sleep quality, and sleepiness across attention-deficit/hyperactivity disorder subtypes. Sleep. 2004;27(3):520-25.
[17] Mayes SD, Calhoun SL, Bixler EO, Vgontzas AN, Mahr F, Hillwig-Garcia J, et al. ADHD subtypes and comorbid anxiety, depression, and oppositional-defiant disorder: Differences in sleep problems. J Pediatr Psychol. 2009;34(3):328-37.
[18] Ivanenko A, Crabtree VM, Obrien LM, Gozal D. Sleep complaints and psychiatric symptoms in children evaluated at a pediatric mental health clinic. J Clin Sleep Med. 2006;2(01):42-48.
[19] Becker SP, Langberg JM, Byars KC. Advancing a biopsychosocial and contextual model of sleep in adolescence: A review and introduction to the special issue. J Youth Adolesc. 2015;44(2):239-70.
[20] Tynjälä J, Kannas L, Levälahti E, Välimaa R. Perceived sleep quality and its precursors in adolescents. Health Promot Int. 1999;14(2):155-66.
[21] Meltzer LJ, Montgomery-Downs HE. Sleep in the family. Pediatr Clin North Am. 2011;58(3):765-74.
[22] Bhargava SC, Sethi S. Sleep disorders in children with attention-deficit hyperactivity disorder. Indian J Psychiatry. 2005;47(8):113-15.
[23] Joseph AA, Gupta A, Hazari N, Kalaivani M, Pandey RM, Sagar R, et al. A cross-sectional comparative study of sleep disturbances in children with ADHD and matched controls. Brain Sci. 2022;12(9):1158.
[24] Bruni O, Ottaviano S, Guidetti V, Romoli M, Innocenzi M, Cortesi F, et al. The Sleep Disturbance Scale for Children (SDSC) construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence. J Sleep Res. 1996;5(4):251-61.
[25] Rowland AS, Skipper BJ, Rabiner DL, Qeadan F, Campbell RA, Naftel AJ, et al. Attention-Deficit/Hyperactivity Disorder (ADHD): Interaction between socio-economic status and parental history of ADHD determines prevalence. J Child Psychol Psychiatry Allied Discip. 2018;59(3):213-22.
[26] Pandey VK, Aggarwal P, Kakkar R. Modified BG prasad socio-economic classification, update-2019. Indian J Community Heal. 2019;31(1):123-25.
[27] Swayamsidtha-Prakashana M, Raj B. Vineland Social maturity scale and manual, indian adaptation-enlarged version. Indian J Clin Psychol [Internet]. 2019;46(2):91-102. Available from: Raj B. Vineland Social Maturity Scale and Manual, Indian Adaptation-Enlarged Version.
[28] Zoëga H, Valdimarsdóttir UA, Hernández-Díaz S. Age, academic performance, and stimulant prescribing for ADHD: A nationwide cohort study. Pediatrics. 2012;130(6):1012-18.
[29] Vaidyanathan S, Shah H, Gayal T. Sleep disturbances in children with Attention-Deficit/Hyperactivity Disorder (ADHD): comparative study with healthy siblings. J Can Acad Child Adolesc Psychiatry. 2016;25(3):145-51.
[30] Sprich S, Biederman J, Crawford MH, Mundy E, Faraone SV. Adoptive and biological families of children and adolescents with ADHD. J Am Acad Child Adolesc Psychiatry [Internet]. 2000;39(11):1432-37.
[31] Krifcher B, Moore C, Sprich-buckminster S, Ugaglia K, Jellinek MS, Steingard R, et al. Further evidence for family-genetic risk factors in attention deficit hyperactivity disorder-Patterns of comorbidity in probands and relatives in psychiatrically and pediatrically referred samples. Arch Gen Psychiatry. 1992;49:728-38.
[32] Biederman J, Milberger S, Faraone SV, Kiely K, Guite J, Mick E, et al. Family-environment risk factors for attention-deficit hyperactivity disorder. A test of Rutter's indicators of adversity. Arch Gen Psychiatry. 1995;52:464-70.
[33] Johnston C, Mash EJ. Families of children with attention-deficit/hyperactivity disorder: Review and recommendations for future research. Clin Child Fam Psychol Rev. 2001;4(3):183-207.
[34] Linnet KM, Wisborg K, Agerbo E, Secher NJ, Thomsen PH, Henriksen TB. Gestational age, birth weight, and the risk of hyperkinetic disorder. Arch Dis Child. 2006;91(8):655-60.
[35] Taylor HG, Klein N, Minich NM, Hack M. Middle-school-age outcomes in children with very low birthweight. Child Dev. 2000;71(6):1495-511.
[36] Linnet KM, Dalsgaard S, Obel C, Wisborg K, Henriksen TB, Rodriguez A, et al. Reviews and overviews-maternal lifestyle factors in pregnancy risk of attention deficit hyperactivity disorder and associated behaviours: Review of the current evidence. Am J Psychiatry. 2003;160(6):1028-40.
[37] Eriksson P, Ankarberg E, Fredriksson A. Exposure to nicotine during a defined period in neonatal life induces permanent changes in brain nicotinic receptors and in behaviour of adult mice. Brain Res. 2000;853(1):41-48.

[38] Mueller KL, Tomblin JB. Examining the comorbidity of language impairment and attention-deficit/hyperactivity disorder. Top Lang Disord. 2012;32(3):228-46.
[39] Lou HC. Etiology and pathogenesis of Attention-deficit Hyperactivity Disorder (ADHD): Significance of prematurity and perinatal hypoxic-haemodynamic encephalopathy. Acta Paediatr Int J Paediatr. 1996;85(11):1266-71.
[40] Rivas-Juesas C, de Dios JG, Benac-Prefaci M, Colomer-Revuelta J. Analysis of the factors linked to a diagnosis of attention deficit hyperactivity disorder in children. Neurol Neurologia. 2017;32(7):431-39.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Paediatrics, Government Medical College, Thrissur, Kerala, India.
2. Psychiatrist, Department of Health Services, Government of Kerala, Thrissur, Kerala, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Shafiq Ahamed Mohamed Ismail,
Assistant Professor, Department of Paediatrics, Government Medical College, Thrissur, Kerala, India.
E-mail: drshafiqam@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 01, 2022
- Manual Googling: Nov 12, 2022
- iThenticate Software: Dec 20, 2022 (7%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Sep 27, 2022**
Date of Peer Review: **Nov 18, 2022**
Date of Acceptance: **Dec 23, 2022**
Date of Publishing: **Mar 01, 2023**