

Sleep disturbances among children with autism spectrum disorders, attention deficit/hyperactivity disorders, and their gender, age group-matched siblings

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ABSTRACT


Background: Sleep disturbances are commonly associated with autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). The strength of this association with comparison to matched general population published in the previous studies was inconclusive. **Objectives:** The objectives of this study were to examine sleep disturbances among ASD and ADHD children in comparison to their matched control of typically developed siblings. **Materials and Methods:** Children, aged 3–17 years, attending Al-Wafa and Al-Rashad Centers, were recruited using convenience sampling. Each registered case with ASD diagnoses had a typically developed siblings matched for sex and age group of ± 5 years differences (75 cases and 75 siblings). ADHD group included children with similar age group, diagnosed as ADHD, who attended school health clinics (50 cases and 50 siblings); same inclusion criteria were applied to both ASD and ADHD cases. Sibling groups were brothers and sisters of ASD or ADHD cases matched for gender and age group of ± 5 years. The mothers were interviewed and completed a fact and data sheet prepared for the study. The data sheet included items from the sleep disorders scale for children sleep disorder scale for children. **Results:** There were no significant differences between children with ASD and their siblings. Children with ADHD had significant difference with siblings in sleep variables such as movement during sleep ($P = 0.04$), reading prior to sleep ($P = 0.002$), and the need to take medicine ($P = 0.01$). Children with ASD showed more disturbances in sleep variables compared to children with ADHD but did not reach significant level with the exception of suffocation during sleep which was more among children with ADHD. **Conclusion:** The differences between the groups were unremarkable. Parental attitude and sleep hygiene practice were the major determinants of sleep problems which need further elucidation.

KEY WORDS: Attention deficit hyperactivity disorder ; Autism Spectrum Disorder; Bahrain; Pervasive Developmental Disorders; Sleep

INTRODUCTION

Children and adolescent with autism spectrum disorders (ASD) suffer from higher rate of sleep disorders than

typically developing (TD) children, ranging from 40% to 80% compared with 25 to 40% in typically developed children.^[1-6] The types of sleep disorders encountered are mostly bedtime resistance, insomnia, parasomnia, and problem in waking up in the morning.^[7] Children with ASD and TP were reported to have longer sleep onset latency, increased wake-ups after sleep onset but no differences in sleep stages.^[8] In children with ASD, it was shown that sleep problems were correlated with increased challenging behavior, aggression, hyperactivity, and poor mental health status.^[9] Furthermore, insomnia and decreased willingness to fall sleep might lead

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to poor appetite and growth problem^[10] a study from China showed that preschool children with more screen time and short night time sleep duration were significantly more likely to have behavioral problems.^[11] A study from India investigated sleep dysfunction and behavioral daytime problems among ASD children and TD controls found that children with ASD were at a greater risk for sleep problems and daytime behavioral disturbances.^[12] Data reporting the prevalence of sleep disorders among ASD children in the Arab region are scarce. In Bahrain, a survey report of 80 participants revealed that 40% mothers of children with ASD ($n = 80$) and 9% with attention deficit hyperactivity disorder (ADHD) suffered sleep problems.^[6]

Sleep disorders are most common conditions associated with ADHD.^[13] The relationship between ADHD and sleep has been well documented in meta-analysis and systematic review.^[13] Children with ADHD showed high rates of sleep problems such as bedtime resistance, night waking, difficulties with morning awakening, and daytime sleepiness in comparison with non-ADHD controls.^[13,14] Rates of sleep problems have been cited as being as high as 70% of youth with ADHD, depending on demographic, and types of measurement.^[15] Sleep difficulties impact attention, self-regulations, and executive functions in children and greater impact on ADHD youth.^[16] Moreover, sleep disorder and ADHD might have a common causative factor specifically in disruption of melanogenic pathways. Melatonin has been shown to be effective in reducing sleep latency problems for children with ADHD.^[17] A review addressing relationship between sleep and alertness in children with ADHD concluded that children with ADHD had higher daytime sleepiness and more movements during sleep.^[14] Gruber *et al.* presented evidence that ADHD is associated with a delayed sleep phase as distinct circadian rhythm pattern.^[16]

We are not aware of reported data on the association of sleep and ADHD in Bahrain or in the Gulf Cooperation Council Countries. In the current study, we are reporting the rate of sleep disturbance types and characteristics of Bahraini sample of ASD, ADHD, and age- and sex-matched siblings. The study hypothesis is that sleep disorders are more common among children with ASD in comparison to children with ADHD and their control siblings.

MATERIALS AND METHODS

Design – Case-control study.

Study period between September 2017 and December 2017.

Sample

Mothers of children aged 3–17 years attending Al-Wafa and Al-Rashad Centers were recruited as a study sample for ASD.

The first group ($n = 75$) consisted of mothers of children of ASD according to the child medical history. The second group ($n = 75$) consisted of mothers of each case sibling, sex-matched without any neurodevelopment disorders comorbidity. All ASD cases were diagnosed according to Diagnostic and Statistical Manual (DSM) IV-TR criteria. Diagnosis of ASD was made using the diagnostic specifics of childhood Autism Rating Scale, modified checklist for Autism in Toddlers, Revised with Follow-Up, and Autism Diagnostic Observation Schedule.

Mothers of children aged 3-17 years that attended School Health and received a diagnosis of ADHD according to DSM-5 criteria were recruited as cases. The controls were brothers or sisters of ADHD cases who were typically developed matched for sex and age group of ± 5 years $n = 50$ cases, 50 control.

There were no exclusion criteria and none of the mothers refused to participate in the study. Cases and controls who met the inclusion criteria were recruited as convenient sample. Mothers signed a written informed consent before the interview. Participation in the study was voluntary and did not affect the services provided by the centers for both mother and child.

Setting

The study was conducted in conjunction with the Bahraini Association of Intellectual Disability and Autism. The association provides services through two main centers. Al-Wafa Center is targeting children with ASD aged 2–11 years and Al-Rashad Center for adolescent aged 12–18 years.

Statement of Ethics

Ethical statement

The Research Ethics Committee of the Secondary Healthcare Ministry of Health, Bahrain approved the research, and data collection was started following receiving the approval.

Informed consent

Electronic informed consent was sought and obtained from the participants. Participation was voluntary and the participant was permitted to withdraw at any time in the middle of the questionnaire if he/she desired.

Data collection procedures

Mothers were interviewed face-to-face by a trained research assistant using data collection sheet in Arabic language designed for the study [Appendix 1]. Data collection focused on seeking information on basic demography, mother education and employment, child sleep duration, sleep resistance, number of minute, needed for sleep induction, sleep continuity, number of sleep interruptions, daytime sleep, movements during sleep, getting enough sleep, sleep apnea,

snoring, teeth grinding, sleep routine, and mother perception of sleep quality. Sleep items were constructed based on items from Sleep Disturbance Scale for Children (SDSC).^[18]

The data sheet was pilot tested on ten mothers before their use for ensuring clarity. The interview took 10–15 min to be completed.

Data analysis

Data were entered into SPSS version 25. Descriptive Statistics were summarized for the demographic characteristics and outcome measures. The mean and standard deviation were reported for continuous variables, and count and percentages were reported for categorical variables. Pearson Chi-square or Fisher's exact test used to investigate the differences between groups.

RESULTS

Among 125 participants included in the study, 60% ($n = 75$) were diagnosed with ASD and 40% ($n = 50$) were diagnosed with ADHD. The ratio between males and females was 2:1; mean age for ASD was 8.5 ± 3.2 and 7.7 ± 3.5 for ADHD cases. Cases from both groups were from families of similar socio-economic background.

Table 1 shows ASD cases and siblings by sleep variables. More ASD cases woke up more than once, slept during the day, moved during sleep, ground teeth, and reported as bad sleeper by mother. None of these differences reached statistical significance. ASD cases and siblings were almost similar on sleep items such as suffocation during sleep and time sleep.

Table 2 shows the differences between cases of ADHD and their typically developed siblings by studied sleep variables. ADHD cases scored more on sleep variable: Tendency to sleep early, wake up more than once, daytime sleep, movement during sleep, suffocation during sleep, grinding of teeth (bruxism), reading before sleep, need to take medicine and were bad sleepers compared to their TD siblings.

Only variables for "movement during sleep" ($P = 0.04$), "reading before sleep" ($P = 0.002$), and "take medicine" ($P = 0.01$) reached significant levels.

Sleep variables for "sleep early" and "duration of sleep" were almost equal for both groups.

Table 3 shows cases of ASD, ADHD according to sleep variables. Cases with ASD reported more frequent "wake up more than once," "move during sleep," and "stay awake till 10 pm" compared to cases with ADHD. However, in cases with ADHD, mothers reported more frequent "suffocation during sleep" ($P = 0.0481$), "grinding teeth," "sleep early

Table 1: ASD cases and siblings by studied sleep variables

Item	Cases	Siblings	P value
	n (%)	n (%)	
Child sleep early*			
Yes	51 (68)	49 (65.3)	0.86
No	24 (32)	26 (34.7)	
Number of time child wake up			
Once	57 (76.0)	62 (82.7)	0.42
More than once	18 (24.0)	13 (17.3)	
Day time sleepiness			
Yes	30 (40.0)	19 (25.3)	0.08
No	45 (60.0)	56 (74.7)	
Movement during sleep			
Yes	23 (30.7)	17 (22.7)	0.36
No	52 (69.3)	58 (77.3)	
Child has suffocation signs			
Yes	5 (6.7)	5 (6.7)	1.0
No	70 (93.3)	70 (93.3)	
Grind teeth			
Yes	11 (14.7)	8 (10.7)	0.62
No	64 (85.3)	67 (89.3)	
Time child sleep			
Before 8 o'clock	6 (8.0)	6 (8.0)	0.86
Between 8 and 1 pm	43 (57.3)	46 (61.3)	
After 1 pm	26 (34.7)	23 (30.7)	
Sleep evaluation by mothers			
Good	73 (97.4)	74 (98.7)	0.49
Bad	2 (2.6)	1 (1.3)	
	75 (100)	75 (100)	

*Judged by mothers. ASD: Autism spectrum disorder

before 8 pm," "reading before sleep" ($P = 0.014$), and "take medicine" ($P = 0.01$) compared to children with ASD. Both groups scored similarly on variables "child sleep early" and "sleep quality reported by mother."

Few of cases with ASD use medication (16%) risperidone and up to one fourth (26%) of ADD cases with ADHD used medication (methylphenidate).

DISCUSSION

To the best of our knowledge, this is the only controlled study using gender-matched siblings addressing the problem of sleep disturbances among children with ASD and ADHD in the region. A number of findings emerged. First, cases ASD and ADHD and siblings shared the same frequency in items such as sleep latency and quality of sleep judged by mothers with their siblings. The reason in our opinion is dictated by practicing style of sleep preparations. Parents who have more than one child most likely are going to put their children to bed at the same time, the same room. The issue of parenting style and sleep problems among children with ADHD was discussed in a recent publication.^[19]Second, ASD and ADHD children

Table 2: Sleep variables for ADHD cases and typically developed

Siblings variable	Cases	Sibling	P value
	n %	n %	
Child sleeps early*			
Yes	34 (68.0)	37 (74.0)	0.66
No	16 (32.0)	13 (26.0)	
Number of time child wake up			
Once	26 (52.9)	34 (68.6)	0.48
More than once	24 (47.1)	16 (31.4)	
Day sleep			
Yes	16 (32.0)	12 (24.0)	0.50
No	34 (68.0)	38 (76.0)	
Movement during sleep (restless legs)			
Yes	11 (22.0)	3 (6.0)	0.04*
No	39 (78.0)	47 (94.0)	
Child suffers suffocation			
Yes	9 (18.0)	3 (6.0)	0.12
No	41 (82.0)	47 (94.0)	
Child grinds teeth			
Yes	10 (20.0)	5 (10.0)	0.26
No	40 (80.0)	45 (90.0)	
Time child sleeps			
Before 8 o'clock	8 (16.0)	9 (18.0)	
Between 8 and 10 pm o'clock	31 (64.0)	31 (62.0)	1.0
After 10 pm	10 (20.0)	10 (20.0)	
Child habits before sleep			
Reading	16 (36.0)	5 (10.0)	
Showering	10 (20.0)	12 (24.0)	0.002*
Others	22 (44.0)	33 (66.0)	
Child takes medicine			
Yes	13 (26.0)	3 (6.0)	0.01*
No	37 (74.0)	47 (94.0)	
Child sleep evaluation by mother			
Good and very good	48 (96.0)	50 (100.0)	0.71
Bad and very bad	2 (4.0)	00.0 (00.0)	

*Judged by mothers. ADHD: Attention deficit hyperkinetic disorder

scored the same on items such as sleep latency and sleep quality judged by mothers. This finding adds more support to the above explanations which emphasized the role of parenting style in sleep induction. Third, children with ASD differed significantly from children with ADHD on item of child suffocation during sleep and reading before sleep in favor of ADHD.

The association of breathing difficulties and ADHD was reported in several studies.^[4,20] Reading prior sleep is probably dependent on the presence of learning and cognitive difficulties which usually are more often encountered among cases of ASD in comparison to ADHD. In summary, the trend of sleep patterns suggests that children with

Table 3: Cases of ASD and ADHD by sleep variables

Sleep variable	ASD (75) n %	ADHD (50) n %	P value
Child sleep early **			
Yes	51 (68.0)	34 (68.0)	1.000
No	24 (32.0)	16 (32.0)	
Sleep without interruption			
Yes	55 (73.3)	40 (80.0)	0.522
No	20 (26.7)	10 (20.0)	
Number child wake up			
Once	57 (76.0)	9 (18.0)	0.075
More than once	18 (24.0)	8 (16.0)	
Day time sleep			
Yes	30 (40.0)	16 (32.0)	0.450
No	45 (60.0)	34 (68.0)	
Movement during sleep			
Yes	23 (30.7)	11 (22.0)	0.195
No	52 (69.3)	39 (78.0)	
Child suffocation			
Yes	5 (6.7)	9 (18.0)	0.048*
No	70 (93.3)	41 (82.0)	
Grin teeth			
Yes	11 (14.7)	10 (20.0)	0.471
No	64 (89.3)	40 (80.0)	
Time child sleep			
Before 8 pm	6 (8.0)	8 (16.0)	0.124
Between 8 and 10 pm	43 (57.3)	32 (64.0)	
After 10 pm	26 (34.7)	10 (20.0)	
Child habit before sleep			
Reading	11 (14.7)	18 (36.0)	0.014*
Showering	13 (17.3)	10 (20.0)	
Massage	5 (6.7)	5 (10.0)	
Others	46 (61.3)	17 (34.0)	
Child takes medicine			
Yes	12 (16.0)	13 (26.0)	0.180
No	63 (84.0)	37 (74.0)	
Child sleep quality			
Very good	57 (76.0)	37 (74.0)	0.979
Good	16 (21.3)	11 (22.0)	
Bad	1 (1.3)	1 (2.0)	
Very bad	1 (1.3)	1 (2.0)	

*Significant, **Judged by mothers. ASD: Autism spectrum disorder, ADHD: Attention deficit hyperkinetic disorder

ASD stayed late (beyond 10 pm) while more children with ADHD slept early (8 pm) though the differences were not significant. The pattern of sleep characteristics for children with ASD was staying later than 10 O'clock, moving during their sleep, wakeup more than once during the night and sleep during the day time in comparison to children with ADHD partially support our research hypotheses that sleep problem is more common among ASD children. Children with ADHD had more breathing difficulties during sleep, grin teeth, sleep earlier than 8 O'clock, read before sleep, and take medicine in comparison to cases of ASD. All these differences did not reach significant level with the exception of child suffocation which has reported in several previous studies.^[13]

Sleep pattern in children with ASD showed an increase in frequency of wakeup more than once, daytime sleepiness, moving during sleep, grin teeth, and bad sleeper evaluated by mother compared to their siblings. None of differences in these items reached significant level. This could be due to small sample size. Both ASD cases and siblings scored the same in breathing difficulties during sleep and sleeping early. This is again the results of sleep preparation routine by the same mothers among ASD children are probably worse and more pathological in comparison to siblings. Sleep pattern among children with ASD seem to be more disturbed and pathological in comparison to their TD siblings.

Children with ADHD in comparison to their TD siblings scored more frequently on items such as sleeping later than 10 O'clock, wakeup more than once, daytime sleepiness, feeling of suffocation, movement during sleep, grin teeth, scored bad sleeper by mother rating, read before sleep, and take medicine. The same findings were reported earlier by several studies.^[13] The two groups scored similarly regarding "times child goes to sleep," and mother's subjective opinion on "child gets enough sleep." These findings were not received with surprise as mother usually treat children the same at bed times and in the same room. Again the differences between ADHD cases and TD siblings on sleep variables did not reach statistical significance due to the sample size. The only exception was taking medication and reading before initiating sleep in favor of ADHD cases. Taking medications was expected to be more among children with ADHD in comparison to TD children. The use of medications (Stimulus) could affect sleep pattern. Subjective and objective studies investigating the effects of stimulus on sleep in ADHD produced mixed results.^[13] The study findings support the working hypothesis that sleep disturbances are more frequent among children with ADHD in comparison to TD Siblings. Reading as an activity before sleep among children with ADHD was more frequently encountered compared to TD siblings, this may be due to age difference between the two groups. The TD children, even if they were matched for age group they might be among the younger age strata. In spite of the fact that many children with ADHD have comorbidity with reading difficulties.^[21] It may be that the siblings were 2-3 years younger than children with ADHD, hence their reading skills and habit were different. The minority of cases with ASD used medication while up to fourth cases of ADHD used stimulant medication. The influence of this factor on the difference in sleep habits cannot be rolled out.

Notwithstanding several strengths of this study such as using matched siblings for gender and age group as a control, and addressing sleep disturbance among two prevalent neurodevelopmental disorders in an area that lacks clarity, there are some limitations. First, the recall bias due to relying on memory of mothers and subjectivity in evaluating some of the sleep variables, retrospective design has limitations. Second, siblings shared comparable genetic profile with

the cases, something to be considered when evaluating the causation of sleep disorders. Third, it would be more eliminating if the attitude of mother toward sleep hygiene such consistencies and warmth was part of the objectives of this study.

In this study of sleep disturbances among children aged 3–17 years with ASD, ADHD, and TD siblings, mothers reported similar pattern of sleep habit and poor sleep between ASD and siblings. Mothers of children with ADHD reported significantly more suffocation during sleep, reading before sleep and use of medicine in comparison to TD siblings. Children with ADHD frequently had movements during sleep, reading before sleep compared to children with ASD. Sleep variables such as sleep latency, sleep interruption, and teeth grinding were almost similar between ASD and ADHD groups.

CONCLUSION

Sleep disturbances were more encountered among children of ASD in comparison to children with ADHD and TD siblings in this order. Sleep hygiene and parents' attitude toward sleep induction were important factors that influence the sleep pattern of children. Any attempt to improve sleep among children with ASD and ADHD should take these factors into consideration when assessing the problems or managing it.

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APPENDIX 1

The following questions are focused on your child sleeping habits in the past month. Please answer all questions.

1. Child Age
2. Child Gender
3. Mother's Education
Read and Write Primary Secondary College Post graduate
- Mother's Employment
Employed Unemployed Retired Student Homemakers
4. How many hours your child sleep every night?
5. Does he sleep once he is in bed? Number of minutes between going to bed and actual sleep.
6. Does he sleep till morning – uninterrupted sleep?
Yes No
7. If the answer is No – How many time sleeps are interrupted?
8. Does your child sleep during the day?
Yes No
9. Does your child move his Ceqs. while a sleep?
Yes No
10. Does he sleep more hours compared to his siblings, for example?
11. In your opinion, does your child sleep enough hours?
12. Does your child has difficulty in breathing that causes sleep interruption while a sleep?
Yes No
13. Does your child grind his teeth during sleep?
14. Does your child snore while sleeping?
Yes No
15. What time your child go to bed?
Before 8 pm Between 8 and 10 pm After 10pm
16. Are there any ritual that you child perform before going to bed?
Reading Taking bath Massage body Others
17. Does your child take medication?
Yes No
If answer is yes – what is it ?
18. During the last month – you overall assessment of sleep quality in general way.
Very good Somewhat good Somewhat bad Bad