Pattern of sleep disorders among children with autism spectrum disorder

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Abstract

Background Sleep disorders (SDs) are among many co-morbid medical conditions that affect children with autism spectrum disorder (ASD). Raising awareness and improving the standard of care for children diagnosed with ASD may result from identifying SDs among them. This study aims to evaluate patterns of SDs among Sudanese children diagnosed with ASD.

Method Using the Childhood Sleep Habit Questionnaire (CSHQ) to gather data on sleep disorders and SPSS version 26.0 for data analysis, a descriptive cross-sectional study was carried out in the five main autistic centres in Khartoum state covering all registered patients with ASD between April and June 2022. Ninety-two children diagnosed with ASD were enrolled in this study after the purpose of the research was explained and consent was obtained from their guardians. A p-value < 0.05 was considered to indicate statistical significance.

Results The mean age was 6.90 (± 2.6) years with a boys-to-girls ratio of 2.17:1. The prevalence of SDs (at least one sleep condition almost daily) was 95.65%. Sleep onset 71 (77.2%), limit setting 32 (32.6%), resistant onset to sleep 48 (52.2%), and combined 52 (56.5%) insomnia affected the majority of children. Additionally, there were significant associations between sex and Limit-setting insomnia, advanced sleep phase disorder, and narcolepsy type 2 (P values = 0.033, 0.009, and 0.037, respectively). Additionally, there was a significant association between age and sleep-related breathing disorders-snoring (p value = 0.031).

Conclusion The frequency of SDs is significant among children diagnosed with ASD from Sudan, and certain SDs are associated with age and sex. Subsequent studies are required to develop national guidelines for the prevalence, presentation, screening, and treatment of SDs in children diagnosed with ASD.

Keywords Autism spectrum disorder, ASD, Sleep disorders, CSHQ, Insomnia, Parasomnia, Children

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Introduction

Neurodevelopment disorders (NDDs) affect more than 2% of people worldwide [1]. Autism spectrum disorder is a developmental disorder that impacts behavior and communication [2]. It has been demonstrated to impact all demographic groups, irrespective of race, ethnicity, financial situation, or country of birth [3]. Although ASD can manifest in the first year of life, it can take till the child turns three years old to receive the diagnosis [4]. Children and adolescents with ASD often have a prevalence of sleep disturbance between 60% and 86%, which is two to three times higher than that of typically developing children [5, 6].

Children's cognitive development and daily functioning, including attention, learning, memory, mood management, and behavior, can be negatively impacted by SDs [7, 8]. These domains are also affected by ASD, indicating that SDs may further obstruct learning and everyday functioning in children with ASD. It has also been demonstrated that parents' sleep patterns and psychological well-being are significantly affected when their children with ASD have poor sleep [8–10].

Professional physicians use structured techniques such as the social responsiveness scale (SRS), Autism Diagnostic Observation Schedule Second Edition (ADOS-2), and Childhood Autism Rating Scale Second Edition (CARS-2) to observe the characteristics of ASD. The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) will be used to make a formal diagnosis after a multidisciplinary team evaluates cognitive function, thinking skills, language abilities, age-appropriate skills required to carry out daily tasks (such as eating, dressing, and using the restroom independently), genetic, metabolic, hearing, vision, and blood tests [3, 11–13]. Sleep problems can be assessed using both subjective (including sleep diaries and parental questionnaires) and objective techniques (including actigraphy, videosomnography, and polysomnography (PSG)) [11, 14, 15]. Many classification systems, such as the DSM-5 [12, 13], the International Classification of Sleep Problems, Third Edition (ICSD-3) [16], and the International Classification of Diseases, Tenth Edition (ICD-10) [16], have also been adopted to identify sleep problems formally.

As a result of recent advancements in the methods used for the diagnosis of psychological disorders and rising interest in the behaviors (like SDs) that are connected to these diseases, an increasing number of children are being diagnosed with ASD. The majority of prevalence studies of sleep problems in children diagnosed with ASD have been undertaken in developed countries and there are no particular data on the prevalence of sleep problems in children diagnosed with ASD in resource-constrained countries. Thus, the purpose of this study was to assess the pattern of common sleep disorders among Sudanese children who were diagnosed with ASD. It is difficult to diagnose and characterize every sleep disorder that often affects children diagnosed with ASD within the scope of this study. In light of the seven primary categories (insomnia, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, parasomnias, sleep-related movement disorders, and other sleep disorders) of the ICSD-3 [16], this study will mainly focus on sleep disorders, either as a single condition or as a common category for a variety of disorders. Interested readers are directed to the extensive book by Miano S., Giannotti F., and Cortesi F. on sleep problems and ASD for more information. [17].

Materials and methods

Study design, setting and duration

This descriptive, cross-sectional, facility-based study was carried out in Khartoum state between April and June of 2022 at four major specialized educational centres for ASD (the SAWA Center for Children with Autism and Developmental Disorders, the Ayadi la Teml Sudanese Organization for Autism and Developmental Disorders, the Early Interventional Center for Training of Autistic and Special Needs Children, and the Albraha International Centre for Training of Autistic Children).

Study population and eligibility criteria

Sudanese children, who were diagnosed with ASD, their ages between three and sixteen years and enrolled in ASD educational facilities were included in this study. Children with Rett's syndrome, tuberous sclerosis complex syndrome, fragile X syndrome, or other underlying diagnoses linked to autism were excluded.

Sample size determination

Based on information gathered from the statistical departments of the autism centers included in the study, the estimated total number of cases in the chosen centers was approximately 120. With a response rate of 76.6%, 92 primary caregivers agreed to participate in the study.

Data collection and procedure

The data were collected using the Children's Sleep Habit Questionnaire (CSHQ), a widely used sleep assessment tool for children. It is a parent questionnaire that has been used and validated retrospectively in several studies [17–21]. The original CSHQ has been modified with 25 items that cover common sleep disorders. The questionnaire was translated into the Arabic language, distributed to guardians and collected after 1 week.

Data analysis

The data were entered and organized, and the results of the statistical analysis were analysed using the Statistical

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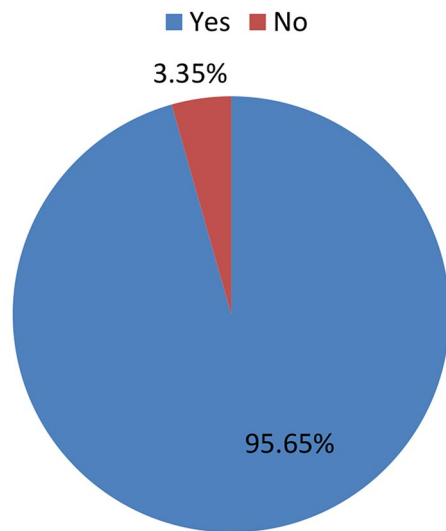
Fig. 1 The prevalence of sleep disorders among children with ASD

Table 1 The prevalence of common sleep disorders other than insomnia

Sleep disorders		Present/absent	Frequency	Percent
Parasomnias	Night terrors	Yes	16	17.4
		No	76	82.6
	Nocturnal enuresis	Yes	30	32.6
		No	62	67.4
Circadian rythm sleep –wake disorder	Delayed sleep phase	Yes	0	0
		No	92	100.0
	Advanced sleep phase	Yes	56	60.9
		No	36	39.1
Sleep-related breathing –disorder	Snoring	Yes	13	14.1
		No	79	85.9
Centeral disorder of hypersomnlence	Narcolepsy type 1	Yes	10	10.9
		No	82	89.1
	Narcolepsy type 2	Yes	40	43.5
		No	52	56.5
Sleep-related movement disorder	Non specific movements	Yes	29	31.5
		No	63	68.5
	Specific-bruxism	Yes	7	7.6
		No	85	92.4

Package for the Social Sciences (SPSS) version 26 and Microsoft Excel & Word (2016).

Results

The purpose of this study was to evaluate the patterns of sleep disorders among Sudanese children diagnosed with ASD who were receiving care at major autism institutions in Khartoum state. The study involved 92 participants. 13% were recruited from the Ayadi la Teml Center (Kafouri Branch), 30% from the Ayadi la Teml Center (Altaif Branch), 23% from the Early Interventional Center (Kafouri), 16% from the Al-Braha International Center, and 16% from the SAWA Center for Autistic Children.

Demographic data

The mean age was 6.9±2.6 years. Of these children, 63 (68.5%) were boys, accounting for a boys to girls ratio of 2.17:1. Out of the 92 (100%) participants in this study, 88 (95.65%) had at least one or more SDs every day. Figure (1).

Frequency of common sleep disorders

The most prevalent sleep problems among these children were insomnia, with a range of symptoms, including 71 (77.2%) with sleep onset-associated symptoms, 52 (56.5%) with combined symptoms, 48 (52.2%) with resistant onset to sleep, and 30 (32.6%) with limited-setting symptoms. Figure (2). In the category of circadian rhythm sleep-wake disorders, the advanced sleep phase (ASP) was the second most prevalent sleep problem in these children (60.9%). In addition, narcolepsy type 2 (43,5%), nocturnal enuresis (32.6%), sleep-related movement disorder (31.5%), snoring (14.1%), narcolepsy type 1 (10.9%), and bruxism (7.6%) were among the other frequent sleep problems that were addressed. Table (1).

Relationships of sleep disorders with gender and age

P values were greater than 0.05 for all sleep disorders (with the exception of limit-setting insomnia, circadian rhythm sleep-wake disorder (ASP type), and central disorder of hypersomnlence - (narcolepsy type 2)), according to the results of the t test used to investigate the relationship between sex and sleep disorders. Table (1). Furthermore, the association between age and sleep disorders was also examined, and P values greater than 0.05 were found for all sleep disorders (with the exception of sleep-related breathing disorder-snoring), for which the P value was 0.031. Table (2).

Discussion

This research aimed to study the pattern of common sleep disorders among Sudanese children with ASD in Khartoum State. The results of our study indicate that children with ASD are predominantly boys, with a boy-to-girls ratio of 2.17:1. This ratio is less than the 3:1 ratio reported in Loomes' R systematic review and meta-analysis [22].

According to our study findings, 95.65% of children diagnosed with ASD have aberrant sleep patterns daily. One of the most frequently reported medical conditions linked to ASD is sleep disorders, which affect 45–86% of
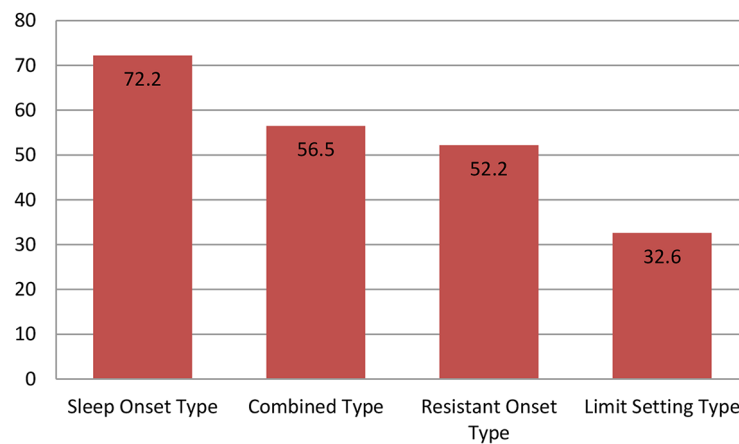
Fig. 2 The prevalence of different types of insomnia

Table 2 Association between sleep disorders, sex and age

Sleep disorders		Gender				Age	
		Male	Female	Total	P value	Mean±(SD)	P value
Sleep onset associated insomnia	Yes	47	24	71	0.387	6.96 (2.764)	0.711
	No	16	5	21		6.71 (2.148)	
Limit setting insomnia	Yes	25	5	30	**0.033***	7.57 (2.921)	0.092
	No	38	24	62		6.58 (2.433)	
Resistant onset to sleep insomnia	Yes	34	14	48	0.612	7.19 (2.848)	0.279
	No	29	15	44		6.59 (2.356)	
Combined insomnia	Yes	38	14	52	0.279	7.17 (2.881)	0.262
	No	25	15	40		6.55 (2.241)	
Night terrors	Yes	11	5	16	0.979	7.06 (2.999)	0.790
	No	52	24	76		6.87 (2.563)	
Nocturnal enuresis	Yes	22	8	30	0.486	7.43 (2.956)	0.179
	No	41	21	62		6.65 (2.437)	
Advanced sleep phase	Yes	44	12	56	**0.009***	6.93 (2.795)	0.905
	No	19	17	36		6.86 (2.380)	
Snoring	Yes	10	3	13	0.748	8.85 (3.262)	**0.031***
	No	53	26	79		6.58 (2.384)	
Narcolepsy type 1	Yes	7	3	10	1.000	7.50 (3.779)	0.596
	No	56	26	82		6.83 (2.474)	
Narcolepsy type 2	Yes	32	8	40	**0.037***	7.18 (3.046)	0.404
	No	31	21	52		6.69 (2.263)	
Non specific movement disorders	Yes	21	8	29	0.581	7.55 (3.066)	0.108
	No	42	21	63		6.60 (2.366)	
Bruxism	Yes	5	2	7	1.000	7.71 (4.192)	0.603
	No	58	27	85		6.84 (2.483)	

children with ASD [22–27]. Studies have indicated that the chronicity of these illnesses is greater than that of children with typical development [26, 27], which has a substantial negative influence on the health and quality of life of both patients and their caregivers. It has been observed that in comparison to ASD children without sleep problems, children with ASD who suffer from sleep disorders exhibit higher levels of anxiety, depression, aggression, and attention deficit during the day, as well as more social impairment and lower performance on cognitive and sensory-motor tasks [28–31]. Although there is no consensus regarding the prevalence of sleep problems in children diagnosed with ASD, our documented prevalence is among the highest in the literature. This variation between reported prevalences is likely because different diagnostic tools were used (subjective and objective) to make ASD diagnosis, or because children of different ages were included. The most common sleep disorder

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reported among our study participants was insomnia, which occurred in various forms (sleep onset-associated type 71 (77.2%), limit setting 32 (32.6%), resistant onset to sleep 48 (52.2%), and combined 52 (56.5%)). Previous studies have shown that children with ASD are ten times more likely to experience insomnia than children without ASD [32]. Moreover, several behaviors have been linked to disordered sleep in individuals with ASD, including difficulty self-settling, frequent nighttime awakenings, greater sleep onset latency, early waking, and poor sleep efficiency (the ratio of total sleep time to total time spent in bed) [6]. Advanced sleep phase disorder was identified as the second most common sleep problem documented among our study participants. Despite its high incidence, ASP disorder mostly affects adolescents and adults and it is frequently confused with insomnia and early morning awakenings [32–36]. According to our study findings, nocturnal bedwetting 30 (32.6%) and night terrors 16 (17.4%) are the most prevalent parasomnias reported among our study participants. The data from previous research on the prevalence of parasomnias in children with ASD was inconclusive. Nonetheless, documented studies show that children with autism are frequently more susceptible to insomnia [37]. Additionally, Liu X et al. reported that the prevalence of bedwetting was 26.3% and that of parasomnias in general was 53% [23]. Our study used a single question about snoring 13 (14,1%) to screen for sleep-related breathing disorders; this question may or may not represent other sleep-related breathing disorders. Mutluer et al. reported a significant frequency of snoring and sleep problems in children diagnosed with ASD [38]. Sleep-related rhythmic movement disorder, restless leg syndrome (RLS), periodic limb movements (PLM) during sleep, and periodic limb movement disorder are among the movement disorders associated with ASD. Since the diagnosis of these disorders in the pediatric population is still difficult [16], we refer to them together as nonspecific movement disorders (NSMDs) 29 (31.5%). In addition to having trouble interacting during polysomnography, which is essential for diagnosing PLM, children with ASD may also struggle to communicate their symptoms, a skill that is necessary to permit the diagnosis of RLS. Since we are just looking at past data, we are not able to determine their actual prevalence. Furthermore, we particularly referred to the specific movement of the teeth when they clench while sleeping by sleep-related movement disorder-bruxism (7.6%). Since children with ASD frequently exhibit bruxism and rhythmic movement disorders both during the day and when they sleep, these conditions are equally concerning. The mentioned factors contribute to the challenge of accurately diagnosing sleep-related movement disorders, which in turn makes it challenging to carry out studies to determine the prevalence and management of these

disorders in children diagnosed with ASD. An excessive amount of daytime sleepiness that cannot be linked to another sleep problem is referred to as a central disorder of hypersomnolence. Based on the presence or absence of cataplexy, 10 (10.9%) patients were classified as having narcolepsy type 1, and 40 (43.5%) patients were classified as having type 2 narcolepsy, respectively. There is a dearth of published research on the frequency of narcolepsy in children with ASD. This could be the result of a complex diagnosis, which was reached after a thorough physical examination, a thorough clinical history, and a neurological assessment along with a polysomnography. We cannot determine whether it is an actual prevalence or not; we are only screening for them based on history. Gender significantly influenced the likelihood of having insomnia, advanced sleep phase disorder, and type 2 narcolepsy (P values=0.033, 0.009, and 0.037, respectively). Moreover, there was no associations between age and any type of sleep problems, with the exception of snoring (p value=0.031). This is in contrast to the reported in Santapuram et al., who found no relationship between age and obstructive sleep apnea symptoms, such as snoring [39].

Conclusion

According to our study findings, there is a high frequency of sleep disorders among Sudanese children diagnosed with ASD. The most prevalent type of sleep disorder is insomnia, whereas the least common type is bruxism. Limit-setting insomnia, advanced sleep phase disorders, and narcolepsy type 2 are more prevalent in boys and have a strong gender relationship. Age-related increases have been observed in snoring.

Limitations, strengths and future prospects

There are a few limitations to our study. First, the demographic information for children with ASD is limited. Second, the sample size was relatively small, making it less representative. This may be related to the constraints imposed by the nation's economic situation, particularly during the COVID-19 pandemic, which has limited and decreased parent-child communication with autism centres. Third, there was no control group. Fourth, because the study only included parent reports of their children's sleep problems, recall bias may be a weakness. Finally, there is a lack of objective measures, such as structured in-depth interviews and objective evaluations, which may have provided greater information on sleep problems and permitted a more accurate diagnosis [40]. However, this research is the first in Sudan and most probably all of Africa that looks into the patterns of sleep disturbances in children diagnosed with ASD, which is a starting point toward a better understanding of these conditions. Future studies especially in resource-limited countries are required to develop national guidelines for

the prevalence, presentation, screening, and treatment of SDs among children diagnosed with ASD.

Author contributions
M.A.M. contributed to the study design, data collection, paper preparation and writing of the manuscript.E.M.A. contributed to the study design, analysis, interpretation, review of the scientific context and supervision.I.A.A. Contributed to the data analysis and interpretation and wrote and edited the paper.S.S.H. contributed to the data analysis and interpretation and wrote and edited the paper.H.O. contributed to the study design, review of the scientific context and cosupervision.All the authors have read and approved the final manuscript.

Data availability
The data generated in this study are available from the corresponding author upon reasonable request with a completed Materials Transfer Agreement, excluding the materials including personally identifiable information.

Declarations

Ethics approval and consent to participate
The study was approved by the paediatric council and Institutional Ethical Committee of the Sudan Medical Specialization Board. The administrative officials of the autism centers who were the subjects of the study provided written consent. Following an explanation of the goals and design of the study, informed written consent was also obtained from the participants (primary caregivers). The data and information were exclusively utilized for the study. Concerns about privacy were taken into consideration. Participation was voluntary. Every participant was free to leave the study at any time. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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