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A Comparative Study of Sleep Disturbances in Children with Cerebral Palsy and the Age- and Gender-Matched Controls

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Abstract

Background: Children with cerebral palsy (CP) are reported to experience various sleep problems more often than typically developing children.
Objectives: This study aimed to determine the rate and pattern of sleep problems among children with cerebral palsy attending a developmental clinic in Lagos, Nigeria, compared with age- and gender-matched typically developing children. The sociodemographic and clinical factors associated with sleep problems in cerebral palsy were also assessed.
Methods: The study design was a comparative, cross-sectional study conducted among 75 children with CP (study group) aged 6 to 18 years and typically developing children of the same age and gender as the controls. Data collection was conducted using a sociodemographic and clinical questionnaire, as well as the Sleep Disturbance Scale for Children (SDSC), to assess sleep problems.
Results: The prevalence of sleep problems in children with CP was 62.7% as compared with 33.3% in the TD children. The common patterns of sleep disorder were Disorders of Initiating and Maintaining Sleep (DIMS), Sleep Breathing Disorders (SBD), and Sleep-Wake Transition Disorders (SWTD) in both groups.
Conclusion: This study found that sleep problems are significantly more common in children with cerebral palsy compared to their typically developing peers. These findings underscore the importance of routine screening and targeted management of sleep disturbances in children with cerebral palsy to improve their overall health and quality of life.

Keywords: Cerebral palsy, Children, Developmental disorders, Motor deficits, Sleep Disturbance Scale for Children.

Introduction

Sleep disturbances in children and adolescents can significantly impact their overall functioning. They can experience daytime sleepiness due to inadequate sleep. Inadequate sleep in children does not manifest as yawning or drowsiness, as it does in adults, but rather with mood and behavioural disturbances, such as inattention, hyperactivity, irritability, and problems with learning. Cognitive functions such as attention, memory and abstract thinking can also be affected. Physical health can also be affected by

effects on the cardiovascular, immune and metabolic systems. Parents of children who have problems with sleep also experience distress from this. [1]

Children with cerebral palsy, which is primarily a neurodevelopmental disorder, are more predisposed to sleep disturbances than their typically developing counterparts. [2,3] Several factors have been suggested from various research to be related to sleep disorders in cerebral palsy. Lelis *et al.*[4], in an integrative review of 12 articles to explore the factors related to sleep disturbances in cerebral palsy, classified these factors into extrinsic and intrinsic factors. Intrinsic factors refer to the associated comorbidities in cerebral palsy, while extrinsic factors encompass socio-familial and environmental variables that may influence clinical, surgical, and pharmacological interventions. Correlation has also been established between the clinical subtype of cerebral palsy and the presence of sleep problems. [5] The observations include the fact that the more severe the cerebral palsy phenotype, the more likely the sleep problems. [2, 6] The presence of epilepsy has also been associated with disturbed sleep in children with cerebral palsy. [7, 8]

Children with cerebral palsy are vulnerable to respiratory problems, which are attributed to upper airway muscle tone and laryngeal dystonia. The presence of respiratory problems can increase the likelihood of pulmonary aspiration and lead to excessive snoring, ultimately causing sleep disturbances in affected children. [9, 10] Children with behavioural problems can resist going to bed at appropriate times and also lack bedtime routines. [11] About 20 to 50% of children with cerebral palsy have cortical impairment, which can affect melatonin secretion and light perception, which in turn affects timing and maintenance of sleep. [12] Other comorbidities that have been identified to be associated with sleep problems in cerebral palsy are gastroesophageal reflux diseases, and auditory, visual and cognitive impairments. [8,13,14]

Pharmacological interventions such as anticonvulsants and benzodiazepines can also affect sleep. [15,16] The presence of pain and discomfort can affect sleep in children with cerebral palsy. [9] Environmental and socio-cultural variables that can affect sleep include environmental noise, high room temperature, sharing a bed with other siblings or parents, and poor sleep hygiene. [17]

The study aimed to assess and compare the pattern of sleep problems among children with cerebral palsy and their age- and gender-matched typically developing children at a selected school in Lagos State.

Methods

Study setting

The research was carried out at the Child and Adolescent Mental Health Service (CAMHS) Centre of the Federal Neuro-Psychiatric Hospital (FNPH), Yaba, Lagos, Nigeria. The centre serves mainly children aged 18 years and below. The Command Day Primary and Secondary Schools are located within the Nigerian Armed Forces Resettlement Centre Barracks, Oshodi, Lagos State. School activities run from Mondays through Fridays, with periods of midterm break and open day activities once in a term. The school teachers comprise military officers and civilians.

Study design

The study design was a comparative, cross-sectional study.

Study population

The participants in this study comprised a study and a comparative group. The study group consisted of children with cerebral palsy attending the outpatient clinic of the CAMHS

Centre, Oshodi, the Annexe of the FNPH, Yaba, Lagos, aged 6 to 18 years. The control group were age- and gender-matched peers, typically developing children from the Command Children's School and Command Day secondary school.

Children with the clinical diagnosis of cerebral palsy, as defined by the presence of motor impairment or activity limitation attributed to disturbances in the developing brain and who have had a documented delay in motor milestones with no comorbid cardiorespiratory problems, were recruited into the study. Their age- and gender-matched, typically developing children attending Command Children's School and Command Day Secondary School were also recruited. For children with cerebral palsy on antiepileptic medications, they must be on a stable dosage of antiepileptic medications as defined by being seizure-free on a stable dose of antiepileptics for at least three months. [18, 19] It was ensured that the primary caregiver of children with CP must be able to provide detailed antenatal and perinatal history and also give consent for recruitment.

Sample size

The sample size of this study was determined using Kish's sample size formula for a cross-sectional study. [20, 21] A sample size of 75 in each arm was estimated for the study.

Sampling technique

Participants were recruited into the study using a total sampling method. On each outpatient clinic day, the case notes of children with a diagnosis of CP were selected. The inclusion and exclusion criteria were used to select the participants consecutively on these clinic days till the sample size was complete over the period of data collection. The interviews were conducted on the days the participants attended their clinic in a consulting room, one-on-one, at the CAMHS Centre.

A stratified sampling technique was used. Each arm of the classes represented a stratum of homogenous subpopulations. The strata that were sampled were chosen using simple random sampling. The study participants who met the inclusion criteria were selected from the chosen strata using simple random sampling. For each child with cerebral palsy, two age- and gender-matched typically developing children were identified. This was to make allowance for non-response from any parent. Invitation letters were sent to the parents of identified participants for the school's open day events, where the parents filled out the questionnaires after the study procedure had been adequately explained.

Ethical consideration

Ethical Considerations

Ethical clearance for this study was obtained from the Research and Ethics Committee of the Federal Neuropsychiatric Hospital, Yaba, Lagos, with approval number FNPHY/HREC/2022/001/007/026 and the Education Department of the Nigerian Armed Forces Resettlement Centre Primary and Secondary School.

Informed consent was obtained from the caregivers of participants. In contrast, assent was obtained from all children under the age of 18 in both groups, who were capable of understanding the research process, depending on the severity of their disabilities. Anonymity and confidentiality were also assured.

Data collection

Data was collected from October 2022 to April 2023, with the use of the following instruments:

Sociodemographic and clinical questionnaire

The sociodemographic questionnaire was designed to show the sociodemographic characteristics of the participants. The sociodemographic variables were divided into the child and caregiver variables. The child variables

included the child's age, gender, educational level (class or school year), ethnicity, place of delivery, mode of delivery, and gestational age at delivery. The caregiver variables included the educational level and relationship with the child. The clinical questionnaire identified intrinsic and extrinsic variables, such as the presence of comorbidities that can affect sleep in children, including epilepsy, visual or auditory impairment, anticonvulsant medication, and bed-sharing. [4]

Sleep Disturbance Scale for Children (SDSC)

The Sleep Disturbance Scale for Children is a 26-item Likert-type scale designed to evaluate specific sleep disturbances in children. It is an overall measure of sleep disturbance in the clinical setting[22] and is used to assess sleep disturbance in children with cerebral palsy and typically developing children in this study. Subscale 1 measures the child's average sleep duration, and subscale 2 measures the child's average time to fall asleep. The remaining 24 subscales are rated on a 5-point Likert scale, from 1 ('Never') to 5 ('Always'). [23] The items are likewise divided into six categories representing some of the most common sleep disorders affecting children and adolescents, which are disorders of initiating and maintaining sleep (DIMS), sleep breathing disorders (SBD), disorders of arousal (DA), sleep-wake transition disorders (SWTD), disorders of excessive somnolence (DOES), and sleep hyperhidrosis (SHY). [22]

DIMS is interpreted with subscales 1, 2, 3, 4, 5, 10, and 11 with a score of >10 indicative of DIMS present. SBD is interpreted using subscales 13, 14, and 15, with a score of greater than 3 indicating the presence of SBD. DA is interpreted using subscales 17, 20, and 21, with a score of >3 indicating the presence of DA. SWTD is interpreted using subscales 6, 7, 8, 12, 18, and 19, and it is present with a score of greater than 8. DOES is interpreted with subscales 22, 23, 24, 25, and 26, and DOES is present with a score of >7. SHY is interpreted with subscales 9 and 16 with a score of >2 indicative of SHY presence. The psychometric evaluation of the scale revealed internal consistency ranging from 0.71 to 0.79, a test-retest reliability of 0.71, and a diagnostic accuracy of 0.91. [24] In scoring, 1 means 'never' while 5 means 'always. To obtain results, scores are tallied with the six categories of sleep disorders. [22]

Data analysis

The Statistical Package for Social Sciences (SPSS) version 26 was used for the statistical analysis of the data. Socio-demographic characteristics were presented using frequency tables. Means and standard deviations were calculated for continuous variables. Chi-square was used to compare proportions of categorical variables. Student's t-test was used to compare the sleep patterns in the study and the comparative groups. Regression analysis was done to identify the predictors of sleep problems in children with cerebral palsy. The level of statistical significance was set at 0.05.

Results

A total of 150 children comprising 75 children with cerebral palsy (study group) and 75 age- and gender-matched typically developing children (control group) participated in this study.

The sociodemographic characteristics of the participants are presented in Table I. The ages ranged from 6 to 18 years, with a mean age of 10.03 ± 3.37 years. In both groups, most participants (64%) were school-aged children, while 36% were adolescents, and more than half (56%) of them were male. The children in the study group either had no formal education (76%) or were in primary school (24%), whereas the comparative group participants had either primary (73.3%) or secondary (26.7%) levels of education. The difference in their educational levels was statistically significant ($p < 0.001$).

Table I: Sociodemographic characteristics of the children

Variable	*Study Group*	*Control Group*	*Total*	*χ2*	*p-value*
	n (%)	n (%)	N (%)		
Age (years)					
6 – 11	48 (64.0)	48 (64.0)	96 (64.0)	0.000	1.000
12 – 18	27 (36.0)	27 (36.0)	54 (36.0)		
Gender					
Male	42 (56.0)	42 (56.0)	84 (56.0)	0.000	1.000
Female	33 (44.0)	33 (44.0)	66 (44.0)		
Education					
No formal education	57 (76.0)	0 (0.0)	57 (38.0)		
Playgroup	14 (18.7)	0 (0.0)	14 (9.4)		<0.001*
Primary	4 (5.3)	55 (73.3)	59 (39.3)		
Secondary	0 (0.0)	20 (26.7)	20 (13.3)		
Birth Order					
Low birth order	43 (57.3)	57 (76)	100 (66.7)	7.264	0.026
High birth order	32 (42.7)	18 (24.0)	50 (33.3)		

***Fisher's Exact Test**

The sociodemographic characteristics of caregivers of children are shown in Table II. The majority of caregivers in both the study and comparative groups were female; however, there was a slightly higher proportion of female caregivers in the study group (93.3%) compared to the comparative group (81.3%), with statistical significance (p = 0.027).

Most fathers of the children in both groups had a tertiary level of education, with a higher proportion in the comparative group (70.7%) compared to the study group (52%). Secondary education was the most common level of education for mothers in the study group (38.7%). In contrast, tertiary education was the most common level of education for mothers in the comparative group (60%). The difference in the maternal educational level was statistically significant (p<0.001). More than half (56%) of the primary caregivers in the study group were unemployed compared to about a third (36%) of the primary caregivers in the comparative group (p = 0.014).

Clinical and sleep-related characteristics of the children

Table III presents a summary of the clinical characteristics of the children in both groups. Among the participants in the study group, 62.7% were on antiepileptics, 9.3% were on antipsychotics, and 76% were on cognitive enhancers, compared to the typically developing children who were not on any of these medications (p < 0.001).

Seizure disorder was a comorbidity in 49.3%, and other psychiatric comorbidities were present in 6.7% of the participants in the study group. Still, none of the children in the control group had any of those comorbidities. The children in the study group who had a psychiatric comorbidity all had Attention Deficit and Hyperactivity Disorder (ADHD).

Table II: Sociodemographic characteristics of Caregivers

Variable	*Study Group*	*Control Group*	*Total*	*χ2*	*p-value*
	n (%)	n (%)	n (%)		
Gender of primary caregiver					
Male	5 (6.7)	14 (18.7)	19 (12.7)	4.881	0.027
Female	70 (93.3)	61 (81.3)	131 (87.3)		
Age of Father					
20 – 39	12 (16.0)	8 (10.6)	20 (13.3)		0.199*
40 – 59	55 (73.3)	63 (84.0)	118 (78.7)		
≥60	1 (1.3)	2 (2.7)	3 (2.0)		
Deceased	7 (9.4)	2 (2.7)	9 (6.0)		
Age of Mother 20 – 39	39 (52.0)	34 (45.3)	73 (48.7)		0.704*
40 – 59	34 (45.4)	40 (53.4)	74 (49.3)		
≥ 60	1 (1.3)	0 (0.0)	1 (0.7)		
Deceased	1 (1.3)	1 (1.3)	2 (1.3)		
Educational level of the Father					
No formal education	4(5.3)	2(2.6)	6(4.0)		0.068*
Secondary	32(42.7)	20(26.7)	52(34.7)		
Tertiary	39 (52.0)	53 (70.7)	92 (61.3)		
Educational level of the mother					
No formal education	26 (34.6)	3 (4)	29(19.3)		<0.001*
Secondary	29 (38.7)	27 (36.0)	56 (37.3)		
Tertiary	20 (26.7)	45 (60.0)	65 (43.4)		
Employment status					
Employed	33 (44.0)	48 (64.0)	81 (54.0)	6.039	0.014
Unemployed	42 (56.0)	27 (36.0)	69 (46.0)		

***Fisher's Exact Test**

None of the participants in either group had hearing or visual impairment. The results also reveal the sleep-related characteristics of the children in the study and the comparative group. Medically reported sleep problems were recorded in 20% of children in the study group, compared to 1.3% of the children in the comparative group ($p < 0.001$). A higher proportion of children in the study group (84%) shared a bed with someone, compared to 54.7% of the children in the comparative group ($p < 0.001$). Among the children who shared a bed, more than half (56%) of the children in the study group shared a bed with either their mother or both parents, in contrast to 9.4% of the children in the comparative group ($p < 0.001$).

Sleep problems in the study and comparative group

The prevalence of sleep problems in the study and comparative groups is shown in Table V. Sleep problems were present in 62.7% of children with cerebral palsy, compared with only 33.3% of the control group ($p < 0.001$). The pattern of sleep disorders in the comparative groups is shown in Figure 1. The most common sleep disorders in

both groups were disorders of initiating and maintaining sleep 61.3% in the study group and 24% in the control group). Disorders of arousal were also present in 24% of the participants.

Table III: Clinical characteristics of the children

Variable	Study Group	Control Group	Total	$\chi 2$	p-value
	n (%)	n (%)	n (%)		
Seizure disorder					
Yes	37 (49.3)	0 (0.0)	37(24.7)		<0.001*
No	38 (50.7)	75 (100.0)	113(75.3)		
Antiepileptics					
Yes	47 (62.7)	0 (0.0)	47(31.3)		<0.001*
No	28 (37.3)	75 (100.0)	103(68.7)		
Cognitive enhancers					
Yes	57 (76.0)	0 (0.0)	57(38.0)		<0.001*
No	18 (24.0)	75 (100.0)	93(62.0)		
Co-existing developmental disorders					
Yes	5 (6.7)	0 (0.0)	5(3.3)		0.029*
No	70 (93.3)	75 (100.0)	145(96.7)		
Type of developmental disorder					
ADHD	5 (6.7)	0 (0.0)	5(3.3)	-	
No developmental disorder	70 (93.3)	75 (100.0)	145(96.7)		
Antipsychotic therapy					
Yes	7 (9.3)	0 (0.0)	7(4.7)		0.007*
No	68 (90.7)	75 (100.0)	143(95.3)		
Hearing/visual impairment					
Yes	0 (0.0)	0 (0.0)	0(0)	-	-
No	75 (100.0)	75 (100.0)	150(100.0)		

***Fisher's Exact Test; ADHD - Attention Deficit and Hyperactivity Disorder**

Table VI shows that children with cerebral palsy had significantly higher rates of sleep disorder patterns for DIMS (61.3%), SBD (56%), and SWTD (57.3%) compared with the comparative group, which had rates of 24%, 21.3%, and 22.7%, respectively. In each situation, the differences in the patterns of their sleep disorders were statistically significant ($p < 0.001$).

A comparison of the mean scores for sleep disorders between the study and control group is shown in Table VII. Children in the study group had higher mean scores for Disorders of Initiating and Maintaining Sleep, Sleep Breathing Disorders, Sleep-Wake Transition Disorders, and total sleep scores than the age- and gender-matched controls ($p < 0.001$ in each case). In contrast, the study group had lower mean scores for Disorders of Arousal than the controls ($p = 0.040$).

Table IV: Sleep-related characteristics

Variable	Study Group	Control Group	Total	χ2	p-value
	n (%)	n (%)	n (%)		
Sleep report to doctor					
Yes	15(20.0)	1 (1.3)	16 (10.7)	13.713	<0.001
No	60(80.0)	74(98.7)	134(89.3)		
Child shared a bed					
Yes	63(84.0)	41(54.7)	104(69.3)	15.176	<0.001
No	12(16.0)	34(45.3)	46 (30.7)		
Who the child shared a bed with					
Parents	21(28.0)	2 (2.7)	23 (15.3)	42.309	<0.001
Mother	21(28.0)	5 (6.7)	27 (18.0)		
Father	2 (2.7)	0 (0.0)	2 (1.3)		
Siblings	19(25.3)	34(45.3)	53 (35.3)		
None	12(16.0)	34(45.3)	43 (28.7)		

Table V: Prevalence of sleep problems in the study and control groups

Variable	Study Group	Control Group	Total	χ2	p-value
	n (%)	n (%)	n (%)		
Sleep problems					
Present	47 (62.7)	25 (33.3)	72 (48)	12.927	<0.001
Absent	28 (37.3)	50 (66.7)	78 (52)		

Sociodemographic characteristics of caregivers associated with sleep problems in the study participant

Table VIII shows that lower maternal educational level was significantly associated with sleep problems in children in the study group (p = 0.007).

Clinical and sleep-related characteristics associated with sleep problems in children with cerebral palsy

Table IX shows that the presence of seizure disorder and psychiatric comorbidity were significantly associated with sleep problems (p = 0.031 and p = 0.041). The use of antipsychotics was also significantly associated with sleep problems in the study participants (p = 0.01).

Binary logistic regression analysis was conducted to identify independent factors associated with sleep problems in children with cerebral palsy. As shown in Table X, maternal educational level emerged as a significant predictor. Compared to children whose mothers had no formal education, those whose mothers attained secondary education were significantly less likely to have sleep problems (OR = 0.154, 95% CI: 0.036–0.667, p = 0.012), and the odds were even lower for those whose mothers had tertiary education (OR = 0.086, 95% CI: 0.018–0.404, p = 0.002). The presence of a seizure disorder was also significantly associated with sleep problems, with affected children more likely to have sleep disturbances (OR = 2.271, 95% CI: 0.065–0.788, p = 0.020). The use of antipsychotics and coexisting developmental disorders were not significantly associated with sleep problems in

this model. The model demonstrated good explanatory power with a Nagelkerke R^2 of 0.817 and Cox and Snell R^2 of 0.599, suggesting a strong fit.

Table VI: Comparison of the pattern of sleep disorders in the study and control groups

Variable	Study Group	Control Group	Total	$\chi 2$	p-value
	n (%)	n (%)	n (%)		
DIMS					
Present	46 (61.3)	18 (24.0)	64 (42.7)	21.366	<0.001
Absent	29 (38.7)	57 (76.0)	86 (57.3)		
SBD					
Present	42 (56.0)	16 (21.3)	58 (38.7)	19.003	<0.001
Absent	33 (44.0)	59 (78.7)	92 (61.3)		
DA					
Present	10 (13.3)	18 (24.0)	28 (18.7)	2.810	0.094
Absent	65 (86.7)	57 (76.0)	122 (81.3)		
SWTD					
Present	43 (57.3)	17 (22.7)	60 (40.0)	18.778	<0.001
Absent	32 (42.7)	58 (77.3)	90 (60.0)		
DOES					
Present	16 (21.3)	16 (21.3)	32 (21.3)	0.000	1.000
Absent	59 (78.7)	59 (78.7)	118 (78.7)		
SHY					
Present	9 (12.0)	13 (17.3)	22 (14.7)	0.852	0.356
Absent	66 (88.0)	62 (82.7)	128 (85.3)		

DIMS – Disorders of initiating and maintaining sleep; SBD – Sleep breathing disorders; DA – Disorders of arousal; SWID – Sleep-wake transition disorders; DOES – Disorders of excessive somnolence; SHY - Sleep hyperhydrosis

Table VII: Comparison of the mean scores of sleep disorders in the study and control groups

Variable	Study Group	Control Group	T	p-value
	Mean ± SD	Mean ± SD		
Disorders of initiating and maintaining sleep	13.93 ± 6.68	9.19 ± 4.60	5.067	<0.001
Sleep breathing disorders	4.89 ± 2.23	3.49 ± 1.50	4.505	<0.001
Disorders of arousal	3.19 ± 0.61	3.52 ± 1.26	-2.069	0.040
Sleep wake transition disorders	10.07 ± 3.83	7.51 ± 3.43	4.315	<0.001
Disorders of excessive somnolence	6.28 ± 2.13	6.49 ± 3.22	-0.478	0.633
Sleep hyperhydrosis	2.36 ± 1.31	2.55 ± 1.40	-0.843	0.400
Total sleep score	40.77 ± 10.09	33.56 ± 11.37	4.109	<0.001

Discussion

The prevalence of sleep problems reported in this study was 62.7% in children with cerebral palsy, compared with 33.3% in typically developing children. Previous studies have consistently documented sleep problems to be commoner in

children with cerebral palsy than in typically developing children. [2, 25] A prevalence rate of 62.7% for sleep disorders in children with cerebral palsy in the current study is higher than many of the reported rates for sleep problems in this population of children. [6,16,25–30]

Table VIII: Sociodemographic characteristics of caregivers associated with sleep problems

Variable	Sleep problem		Total	χ2	p-value
	Present n (%)	Absent n (%)	n (%)		
Gender of caregiver					
Male	2 (40.0)	3 (60.0)	5		0.356*
Female	45 (64.3)	25 (35.7)	70		
Educational level of the father					
No formal education	2 (50.0)	2 (50.0)	4		0.113*
Secondary education	24 (75.0)	8 (25.0)	32		
Tertiary education	21 (53.8)	18 (46.2)	39		
Educational level of the mother					
No formal education	17 (65.4)	9 (34.6)	26	10.059	0.007
Secondary education	23 (79.3)	6 (20.7)	29		
Tertiary education	7 (35.0)	13 (65.0)	20		
Employment status					
Employed	20 (60.6)	13 (39.4)	33	0.107	0.744
Unemployed	27 (64.3)	15 (35.7)	42		

***Fisher's Exact Test**

Table IX: Clinical characteristics associated with sleep problems

Variable	Present	Absent	Total	χ2	p value
	n (%)	n (%)	n (%)		
Seizure disorder					
Yes	28 (75.7)	9 (24.3)	37		0.031*
No	6 (75.0)	2 (25.0)	8		
Antiepileptics					
Yes	33 (70.2)	14 (29.8)	47		0.080*
No	14 (50.0)	14 (50.0)	28		
Co-existing developmental disorders					
Yes	1 (20.0)	4 (80.0)	7		0.041*
No	46 (67.6)	22 (32.4)	68		
Antipsychotic Therapy					
Yes	1 (14.3)	6 (85.7)	7		0.010*
No	46 (67.6)	22 (32.4)	68		
Cognitive enhancers					
Yes	37 (64.9)	20(35.1)	57		0.578*
No	10 (55.6)	8 (44.4)	18		

***Fisher's Exact Test**

Table X: Binary logistic regression of factors associated with sleep problems in children with cerebral palsy

Factor	B-coefficient	Odds ratio	95% CI	p-value
Constant	1.434	4.197		0.035
Educational level of mother				
No formal education (Reference)				
Secondary education	-1.869	0.154	0.036 – 0.667	0.012
Tertiary education	-2.45	0.086	0.018 – 0.404	0.002
Antipsychotic Use				
Use of Antipsychotics	20.963	1.275	1.27E+9	0.999
No use of Antipsychotics (reference)				
Seizure Disorder				
Presence of Seizure Disorder	-1.484	2.271	0.065 – 0.788	0.02
No seizure disorder (reference)				
Coexisting developmental disorders				
Presence of coexisting developmental disorders	-18.323	0	0.000 – 0.000	0.999
No coexisting developmental disorders (reference)				

Nagelkerke r^2 = 0.817; Cox and snell r^2 = 0.599; Empty cells - Reference

In a telephone-based interview, Lowing *et al.* reported a rate of 41% for sleep problems in a clinical population of children with cerebral palsy. In another study among 82 children aged 6 to 15 years with cerebral palsy recruited at a special school in the Netherlands, Mol *et al.*[28] reported a 20.7% rate of sleep problems. Adiga *et al.*[26] reported a sleep problem rate as high as 36% among 50 children aged 6.5 to 16 years with cerebral palsy from a neurology clinic in India. In Nigeria, Badaru *et al.*[30] documented 31.5% of the prevalence of sleep problems in 200 clinical populations of children with cerebral palsy between the ages of 1 to 15 years with cerebral palsy.

Although many of the studies mentioned above used similar instruments for the assessment of sleep disorders as the current study, the variations in the reported rates for sleep disorders could be due to other methodological differences such as the setting of the study, the ages of the sampled population and severity of the cerebral palsy across studies. Moreover, the current study was conducted in a developmental clinic of a child and adolescent mental health centre, where many severe cases are referred for specialist management. In contrast, previous studies were mainly conducted in special schools or neurology clinics.

In this study, the most common sleep disturbances among children with cerebral palsy were difficulties with initiating and maintaining sleep (61.3%), followed closely by sleep-wake transition disorders (57.3%), and sleep-related breathing disorders (56%). In contrast, arousal disorders and sleep hyperhidrosis were observed less frequently. Musculoskeletal pain and the descreased ability to change body positions at night may contribute to the higher prevalence of

DIMS in children with cerebral palsy, especially with higher GMFCS levels. A systematic review and meta-analysis had identified disorders of initiating and maintaining sleep (DIMS) as the most common pattern of sleep problems in children with cerebral palsy with a prevalence of 11.6-50% while sleep hyperhidrosis (SHY) was the least common with a prevalence of 2.4-10.4% in that series. [2]

In a study by Adiga *et al.*,[26] conducted to identify sleep disorders in 50 children with cerebral palsy, aged 6.5 years to 15 years in India, using the sleep disturbance scale for children (SDSC), a similar finding for DIMS (50%) was reported as the most common while sleep hyperhidrosis (6%) was the least common. In another study to determine the prevalence of sleep problems in 135 children with cerebral palsy aged 2 to 12 years attending a neurology clinic in Uganda using SDSC, Munyumu *et al.*[27] reported similar findings of the most common sleep disorder as DIMS (27%) while DA (4.4%) was the least common. For the typically-developing children in this study, the most common sleep problems were disorders of initiating and maintaining sleep (24%) and disorders of arousal (24%). The least occurring sleep disorder was sleep hyperhydrosis (SHY) in 17.3% of children. Other sleep problems were sleep-wake transition disorders (SWTD) in 22.7%, sleep breathing disorders (SBD) in 21.3%, and disorders of excessive somnolence (DOES) in 21.3%.

The pattern of sleep disorders in typically developing children in the current study is comparable to previous studies. In a survey by Atmawidjaja *et al.*[25] on sleep disturbances among 109 typically developing Malaysian children between the ages of 4 and 18 years, the most common and least sleep problems identified were disorders of initiating and maintaining sleep (DIMS) and sleep hyperhydrosis (SHY), respectively.

Similarly, a study by Blunden *et al.*[31] used SDSC to determine the frequency of sleep problems in 361 typically developing children in Australia aged 4.6 to 16.5 years. DIMS was reported as the most common pattern (24.1%), while the least common was SHY (8%). The common finding of DIMS in typically developing children may be because these children have learnt to sleep only under certain conditions or with specific parental interventions, which may delay sleep onset or cause frequent nighttime waking. Also, in adolescents, poor sleep hygiene or an irregular sleep-wake schedule could contribute to their delayed sleep onset. [32]

The finding on the comparative pattern of sleep disorders between children with cerebral palsy and typically developing children in this study is similar to the finding in a study by Atmawidjaja *et al.* [25] that compared the mean scores of the pattern of sleep disorders in children with cerebral palsy aged 4 to 18 years with their healthy siblings in Malaysia. The study reported significantly higher mean scores for total sleep time, DIMS, SBD, and SWTD in children with cerebral palsy compared with their siblings. The study also reported a lower mean score for DA in children with cerebral palsy. [25] Similarly, the findings of the current study are similar to the study by Badaru *et al.* [30] that compared mean scores of patterns of sleep disorders among Nigerian children with cerebral palsy and their healthy siblings. Their study reported significantly higher mean scores for total sleep score, DIMS, SBD, and SWTD and lower mean scores for DA in children with cerebral palsy compared to their healthy siblings. [30] The main areas of concern for the comparative pattern of sleep disorders between children with cerebral palsy and those with normal development are related to DIMS, SBD, and SWTD. The findings may be consistent with the complexity of the clinical presentation of cerebral palsy and associated multiple comorbidities. The

complexity ranges from its epidemiology to its aetiopathogenesis and to the timing of interventions.

Although no significant sociodemographic factor was associated with sleep problems in children with cerebral palsy in this study, the findings showed that sleep problems were more common in school-aged children than in adolescents. Additionally, there was no significant relationship between age and sleep problems in children with cerebral palsy. Older age may be associated with better reporting of sleep problems among children, thereby increasing the rate of sleep problems in the older age group.

This study identified a significant association between the lower educational level of mothers and sleep problems in children with cerebral palsy. In a population-based study conducted by Bøe *et al.*[33] to investigate the association between familial socioeconomic status and sleep problems in children aged 11 to 13 years in public and private schools in Norway, a similar finding was observed: a lower maternal educational level was associated with sleep problems in the study. [33] In a longitudinal study to evaluate the association between familial irregularity and sleep problems in children aged 2 to 10 years in the Netherlands, familial irregularity was defined as a lack of day-to-day family routines or lack of consistency in household routines. A similar finding of the lower maternal educational level was identified as a factor that could predict the presence of familial irregularity due to its associated features, such as the possibility of being a housewife or not having a routine job. Family irregularity was also reported as a predictor of sleep problems in children. [34] The paucity of studies on the association between the educational level of mothers or other sociodemographic factors of caregivers and sleep problems in children with cerebral palsy highlights the need for more research into this relationship.

Clinical characteristics significantly associated with sleep disorders in cerebral palsy in this study include the presence of seizure disorder, the presence of psychiatric comorbidity, and the use of antipsychotics. This finding is consistent with previous studies that have identified similar factors associated with cerebral palsy. [30] Seizures can modify the circadian sleep-wake rhythms, disrupt nighttime sleep structure, and affect the total duration of sleep. Antiepileptic drugs were prescribed for participants who had clinical seizures, as well as for those who, despite not having clinical seizures, showed burst epileptiform activity on their electroencephalogram (EEG) that was worsening or interfering with their response to therapy. The use of antiepileptics can also cause daytime sleepiness, which in turn affects nighttime sleep. This finding in this study highlights the importance of early diagnosis and management of seizures in children with cerebral palsy to ensure sound sleep.

Studies have reported a high prevalence of sleep problems in children with neurodevelopmental disorders. This has been associated with the presence of snoring due to enlarged adenoids and tonsils, as well as restless leg syndrome, which is a component of the neurodevelopmental disorder. [17] Also, children with attention deficit hyperactivity disorder have more sleep problems because ADHD and sleep share a feature of delayed maturation of the neural circuitry, leading to the association of ADHD with sleep problems. [35] hyperactivity in children with ADHD can lead to reluctance to go to bed, identified in this study as a risk factor for sleep problems in children with cerebral palsy. Sleep problems can impair cognitive development in children with neurodevelopmental disorders. Hence, efforts have to be made to prompt the identification and management of sleep problems.

One limitation of this study was the use of a self-reported questionnaire, which could be prone to recall bias by the caregivers. The study employed a cross-sectional design, which could limit its ability to conclude causality. The study also relied on sleep questionnaires to determine the presence of sleep problems.

However, the strength of this study lies in the use of healthy controls who were matched for age and gender for comparison, thereby taking into account age-specific sleep requirements. The findings from this study have identified various associations with sleep problems in children with cerebral palsy that subsequent studies could further explore.

Finally, this study makes some unique contributions to the literature on sleep problems in children with cerebral palsy, particularly within the sub-Saharan African context, with a focus on Nigeria. This research integrates both sociodemographic and clinical factors, providing a more holistic understanding of the determinants of sleep disturbances.

Conclusion

This study has added to the existing knowledge on children with cerebral palsy that they experience more sleep problems than typically developing children. There is a need to pay more attention to the experience of sleep problems in children with cerebral palsy, as shown by the low reporting to doctors by caregivers. The study recommends that mental health professionals should be more intentional about identifying sleep problems in children with cerebral palsy and other neurodevelopmental disorders. Mothers of children with cerebral palsy should be educated on the identification and reporting of sleep problems in their children. Early identification and management of seizure disorder and other comorbidities and cerebral palsy are essential to prevent or reduce the rate of sleep problems in children with cerebral palsy.

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