



Original Article

## Prevalence of Sleep Disorders in Children and Adolescents with Cerebral Palsy

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### ABSTRACT

**Introduction:** Sleep plays vital role in physical, emotional and cognitive development of children. Children with cerebral palsy (CP), sleep disturbances are frequent but often unrecognized and may exacerbate existing functional limitations.

**Objective:** To evaluate prevalence and pattern of sleep-related disturbances in children with CP and to analyse their association with CP type and clinical severity based on Gross Motor Function Classification System (GMFCS) level.

**Materials and Methods:** A cross sectional study conducted in paediatric department of tertiary care hospital. A total of 43 children aged 6 years to 15 years with established diagnosis of CP were included. Clinical and demographic details, including GMFCS level and CP subtype, were recorded. Sleep disturbances were assessed using the Sleep Disturbance Scale for Children (SDSC), a validated parent-reported questionnaire that evaluates six domains of sleep disturbances. Statistical analysis performed using the Kruskal–Wallis H-test and chi-square tests, with  $p < 0.05$  considered statistically significant.

**Results:** Initiating and maintaining sleep was most affected domain (prevalence 30.2%), followed by wake transition disorders (27.9%) and excessive day time somnolence (27.9%). Significant associations were found between sleep disturbance scores and CP subtype as well as GMFCS level. Children with spastic quadriplegia, extrapyramidal CP, and GMFCS Grade 5 had highest sleep disturbance scores ( $p < 0.05$ ). Arousal disorders showed no significant association.

**Conclusion:** Sleep disturbances are common in children with CP and correlate significantly with clinical severity. Routine sleep screening and tailored interventions should be integral to CP management.

**Keywords:** Cerebral palsy, Sleep Disturbance Scale for Children (SDSC), Gross Motor Function Classification System (GMFCS), clinical severity, daytime somnolence.

### INTRODUCTION

Sleep is an essential biological function that plays a crucial role in the physical growth, neurocognitive development and emotional regulation of children and adolescents [1]. Sleep disturbances during this critical period can have wide-ranging consequences on health, behaviour and academic performance [2]. These challenges are particularly concerning in children with neurodevelopmental disorders such as cerebral palsy (CP), where sleep problems may further exacerbate functional impairments [3]. Cerebral palsy is a group of permanent disorders affecting movement and posture, caused by non-progressive disturbances in the developing fetal or infant brain [4]. It is the most common physical disability in childhood, with a global prevalence of approximately 2 per 1,000 live births [5]. Its prevalence ranges from 1.3 to 4.4 per 1,000 live births. CP often arises in association with preterm birth, perinatal hypoxia or brain injury, with periventricular leukomalacia being a common cause in preterm infants [5-7]. Although CP is not progressive, its clinical manifestations evolve with age.

It is classified based on motor type (e.g., spastic hemiplegia, diplegia, quadriplegia) and severity, commonly graded using the Gross Motor Function Classification System (GMFCS) [8]. In addition to motor dysfunction, children with CP frequently experience comorbidities such as seizures, feeding difficulties, and notably, sleep disturbances [8]. Studies suggest that 23% to 46% of children with CP suffer from sleep problems, including difficulty initiating and maintaining sleep, sleep-disordered breathing and daytime somnolence [8]. These may result from spasticity, pain, immobility, or associated conditions like epilepsy and gastroesophageal reflux. Higher GMFCS levels and severe CP subtypes are often linked to greater sleep disruption [9].

Despite their prevalence, sleep disturbances in CP often remain underrecognized and undertreated. Therefore, this study aims to evaluate the prevalence and patterns of sleep disturbances in children and adolescents with cerebral palsy and to analyse their correlation with clinical severity based on CP subtype and GMFCS level, to do early interventions and improve quality of life.

## **MATERIALS AND METHODS**

### **Study Design and Setting**

This cross-sectional observational study was conducted in the outpatient department (OPD) of a tertiary care hospital. The primary objective was to assess the prevalence and pattern of sleep disturbances in children and adolescents diagnosed with cerebral palsy (CP) and to evaluate their association with clinical severity indicators such as CP subtype and Gross Motor Function Classification System (GMFCS) level.

### **Study Population**

The study included a total of 43 children aged between 6 and 15 years who had a established diagnosis of cerebral palsy. Participants were selected through consecutive sampling during their routine follow-up visits to the paediatric OPD. Written informed consent was obtained from the parents or legal guardians prior to enrolment in the study.

### **Inclusion and Exclusion Criteria**

Children aged 6 to 15 years with a clinical diagnosis of cerebral palsy were included in the study. Children were excluded if they were currently on medications known to affect sleep, had acute illnesses at the time of evaluation, or if their parents or caregivers declined to provide consent.

### **Data Collection**

Detailed demographic and clinical data were recorded using a structured proforma. This included age, sex, address, socioeconomic status (as per the modified Kuppaswamy scale), weight, height, body mass index (BMI) and head circumference. Clinical variables such as type and aetiology of CP, GMFCS level, daytime and night-time sleep duration, comorbidities, bed-sharing practices, and history of medications affecting sleep were also documented.

### **Sleep Assessment Tool**

Sleep disturbances were assessed using the Sleep Disturbance Scale for Children (SDSC), a validated parent-reported questionnaire consisting of 26 items rated on a five-point Likert scale (1 = never to 5 = always). The SDSC evaluates six major domains of sleep disturbances: disorders of initiating and maintaining sleep (items 1, 2, 3, 4, 5, 10, 11), sleep breathing disorders (items 13, 14, 15), disorders of arousal (items 17, 20, 21), sleep-wake transition disorders (items 6, 7, 8, 12, 18, 19), disorders of excessive somnolence (items 22, 23, 24, 25, 26), and sleep hyperhidrosis (items 9, 16). Domain-specific scores were calculated by summing the scores of the corresponding items. Higher scores indicated greater severity of disturbance in that domain.

### **Statistical Analysis**

All collected data were entered in Microsoft Excel and analysed using IBM SPSS version 25.0. Descriptive statistics such as mean and standard deviation were used for continuous variables, while categorical variables were expressed as frequencies and percentages. The Kruskal–Wallis H-test was applied to compare sleep domain scores across different CP types and GMFCS levels. Chi-square tests were used to evaluate associations between categorical and ordinal variables where appropriate. A p-value of less than 0.05 was considered statistically significant.

## **RESULTS:**

The study included 43 children with cerebral palsy aged between 6 and 15 years. The age group distribution showed that the majority of participants were in the 6–11 years range, with 32.6% in the 9–11 years group and 30.2% in the 6–8 years group (Table 1). The study had a male predominance (62.8%) (Table 1). Socioeconomic status evaluation revealed that the largest group belonged to Class 4 (55.8%) (Table 1). With respect to the type of cerebral palsy, spastic hemiplegia was most commonly observed (44.2%), followed by spastic quadriplegia and diplegia (23.3% each), and extra pyramidal type (9.3%) (Table 1). The distribution of GMFCS levels showed that 41.9% of the participants were classified as Grade 5, indicating the most severe motor impairment, followed by Grade 1 (27.9%), Grade 2 (18.6%), and Grade 3 (11.6%) (Table 1). Among clinical factors, 32.6% of children had a history of seizures. Bed-sharing was reported in 60.5% of cases. Analysis of sleep disturbance domains based on SDSC scores showed that the highest mean scores and prevalence were noted in initiating

and maintaining sleep ( $16.88 \pm 5.84$ , 30.2%), followed by excessive somnolence ( $8.23 \pm 3.24$ , 27.9%) and wake transition disorders ( $8.09 \pm 3.40$ , 27.9%). The lowest average scores were found in arousal disorders ( $3.09 \pm 0.43$ , 4.7% and 16.3 %) (Table 2 and 3). When analysed by type of CP, statistically significant differences were observed across groups in several sleep domains. Spastic quadriplegic and extra pyramidal CP types showed the highest mean scores for initiating and maintaining sleep, wake transition disorders, excessive somnolence, and sleep hyperhidrosis. The result confirmed that these differences were significant ( $p < 0.05$ ) in all domains except arousal disorders ( $p = 0.5019$ ), indicating that the type of CP has a strong influence on the severity and pattern of sleep disturbances (Table 4). In a similar analysis by GMFCS level, children classified as Grade 5 exhibited the most pronounced sleep problems across all domains except for arousal disorders and sleep hyperhidrosis. The difference in domain scores was statistically significant for initiating and maintaining sleep ( $p = 0.0002$ ), wake transition disorders ( $p < 0.0001$ ), and excessive somnolence ( $p = 0.0003$ ). Sleep hyperhidrosis showed a borderline association ( $p = 0.0536$ ), while arousal disorders were not significantly different across grades ( $p = 0.7988$ ) (Table 5). Overall, the findings demonstrate a strong association between clinical severity—both in terms of CP type and GMFCS level—and the presence of sleep disturbances. Children with more severe motor involvement (spastic quadriplegia, extra pyramidal types, and GMFCS Grade 5) experienced significantly greater difficulties with sleep initiation, maintenance, and daytime sleepiness. These results underscore the importance of routine sleep assessment in children with CP, particularly those with greater motor impairment.

**Table 1: Demographic Distribution**

Parameter	Subcategory	Number (n)	Percentage (%)
Age Group (years)	6–8	13	30.2%
	9–11	14	32.6%
	12–14	11	25.6%
	15–16	5	11.6%
Sex	Male	27	62.8%
	Female	16	37.2%
Socioeconomic Status (SES)	Class 2	5	11.6%
	Class 3	14	32.6%
	Class 4	24	55.8%
GMFCS Level	Grade 1	12	27.9%
	Grade 2	8	18.6%
	Grade 3	5	11.6%
	Grade 5	18	41.9%
Type of Cerebral Palsy	Spastic Hemiplegic	19	44.2%
	Spastic Quadriplegic	10	23.3%
	Spastic Diplegic	10	23.3%
	Extra Pyramidal	4	9.3%
	Mixed	0	-

**Table 2: Prevalence of Sleep-Related Problems in Children with Cerebral Palsy**

Sleep Problem Domain	Number Affected	Percentage (%)
Initiating & Maintaining Sleep	13	30.2%
Breathing Disorders	7	16.3%
Arousal Disorders	2	4.7%
Wake Transition Disorders	12	27.9%
Excessive Somnolence	12	27.9%

**Table 3: Type of CP-wise Analysis Association of Sleep Disturbance Scores**

Sleep Domain	Spastic Hemiplegic (Mean $\pm$ SD)	Spastic Diplegic (Mean $\pm$ SD)	Spastic Quadriplegic (Mean $\pm$ SD)	Extra Pyramidal (Mean $\pm$ SD)	Test Statistic (H)	P-value
Initiating & Maintaining Sleep	$13.63 \pm 2.75$	$13.50 \pm 2.55$	$23.90 \pm 4.89$	$23.25 \pm 4.19$	24.89	<0.0001
Breathing Disorders	$3.37 \pm 0.50$	$3.60 \pm 0.97$	$5.10 \pm 0.99$	$3.00 \pm 0.00$	20.38	0.0001
Arousal Disorders	$3.00 \pm 0.00$	$3.20 \pm 0.63$	$3.20 \pm 0.63$	$3.00 \pm 0.00$	2.36	0.5019
Wake Transition Disorders	$5.84 \pm 1.86$	$8.50 \pm 3.78$	$10.30 \pm 2.58$	$12.25 \pm 2.50$	21.38	0.0001

Excessive Somnolence	6.74 ± 1.73	7.00 ± 2.83	11.50 ± 3.75	10.25 ± 1.50	17.03	0.0007
Sleep Hyperhidrosis	2.68 ± 0.89	2.90 ± 1.29	4.20 ± 1.48	4.00 ± 0.00	10.73	0.0132

**Table 4: GMFCS Level-wise Association of Sleep Disturbance Scores**

Sleep Domain	Grade 1 (Mean ± SD)	Grade 2 (Mean ± SD)	Grade 3 (Mean ± SD)	Grade 5 (Mean ± SD)	Test Statistic (H)	P-value
Initiating & Maintaining Sleep	12.58 ± 1.31	13.88 ± 2.30	14.00 ± 2.35	21.89 ± 5.78	19.25	0.0002
Breathing Disorders	3.50 ± 0.52	3.25 ± 0.46	3.20 ± 0.45	4.39 ± 1.29	8.52	0.0364
Arousal Disorders	3.17 ± 0.58	3.00 ± 0.00	3.00 ± 0.00	3.11 ± 0.47	1.01	0.7988
Wake Transition Disorders	6.17 ± 2.33	5.38 ± 0.00	6.20 ± 0.00	11.11 ± 2.78	27.02	<0.0001
Excessive Somnolence	5.83 ± 0.94	6.75 ± 0.74	7.60 ± 1.10	10.67 ± 3.45	19.16	0.0003
Sleep Hyperhidrosis	3.00 ± 0.95	2.12 ± 0.35	3.20 ± 1.30	3.83 ± 1.38	7.66	0.0536

## DISCUSSION

Our study demonstrated a significant association between GMFCS level and sleep disturbance domains such as initiating and maintaining sleep ( $p = 0.0002$ ), wake transition disorders ( $p < 0.0001$ ), and excessive somnolence ( $p = 0.0003$ ). This suggests that more severely affected children experience greater sleep disruption. In contrast, Dhivya et al. and Adiga et al. [13] did not find a statistically significant association between GMFCS level and sleep disturbance ( $p = 0.448$  in Dhivya et al.) [10]. However, Domenico Romeo et al. did report a significant correlation between GMFCS level 5 and poor sleep quality, aligning more closely with our findings [15]. In the current study, spastic hemiplegia was the most common subtype (44.2%), followed by spastic quadriplegia and diplegia (23.3% each), and extrapyramidal type (9.3%). However, when analysing sleep disturbance severity, children with spastic quadriplegia and extra pyramidal CP had the highest mean scores in most domains. This association was statistically significant in domains such as initiating and maintaining sleep, wake transition disorders, excessive somnolence and sleep hyperhidrosis ( $p < 0.05$ ). Dhivya et al. [10] also found spastic quadriplegia to be significantly associated with higher total pathological SDSC scores (42.85%,  $p = 0.02$ ), echoing our results. These findings suggest that children with widespread motor involvement are more susceptible to poor sleep due to increased dependency, immobility, contractures, bed sores, pathological fractures and associated comorbidities. In our study, 32.6% of children had a history of seizures. In contrast, Dhivya et al. [10] reported a much higher seizure prevalence at 74.28%. However, both studies agree that epilepsy is an important comorbidity in children with CP, which can significantly impair sleep. While our study did not analyse seizure presence with SDSC scores, Dhivya et al. found a significant association between seizure history and total sleep disturbance ( $p = 0.0315$ ) [10]. Bed sharing was reported in 60.5% of our participants, closely resembling Dhivya et al.'s [10] report of 74.29%. Although not directly assessed for correlation in our study, bed sharing may be influenced by functional dependency or seizure monitoring. Our study revealed that the most common sleep disturbance domain was initiating and maintaining sleep (30.2%), followed by wake transition disorders (27.9%) and excessive somnolence (27.9%). These findings are similar to Dhivya et al., where Disorders of Initiating and Maintaining Sleep (DIMS) were present in 31.43%, followed by sleep breathing disorders (21.43%), excessive sleepiness (14.29%), and sleep hyperhidrosis (11.43%). In comparison, Adiga et al. [13] reported DIMS in 50% of their study and a total pathological score in 36%, which was higher than our total prevalence (24.28%). Newman et al. [11] observed DIMS in 24.3% of children, which is lower than our study but still identifies this domain as a common issue in CP children. Our results reinforce the fact that sleep initiation and maintenance are disproportionately affected in this population, potentially due to discomfort, spasticity, positioning issues, and caregiver-dependent sleep environments. Although our study did not assess caregiver sleep patterns, Dhivya et al. reported that 32.86% of caregivers had poor sleep quality (PSQI  $>5$ ), which was significantly associated with child sleep disturbance scores in multiple domains including DIMS, SWTD, and SHY. This highlights the bidirectional impact of sleep health in children and caregivers, emphasizing the need for family-centered sleep assessments in future studies.

## CONCLUSION

This study highlights a high prevalence of sleep disturbances in children with cerebral palsy, particularly in domains of initiating and maintaining sleep (30.2%), wake transition disorders (27.9%), and excessive somnolence (27.9%). Spastic hemiplegia was the most common CP type (44.2%), with Grade 5 being the most frequent GMFCS level (41.9%). Significant associations were found between sleep disturbances and both CP type and GMFCS level, especially among children with spastic quadriplegia, extrapyramidal CP and those in GMFCS Grade 5. Arousal disorders showed no significant variation. These findings underscore the importance of incorporating routine sleep assessments and targeted management strategies into CP care.

## Limitations

The study's small sample size and cross-sectional design limit the generalizability and causal inference of findings. Sleep disturbances were assessed through caregiver-reported questionnaires without objective sleep measures like polysomnography. The absence of a control group and unmeasured factors such as pain, environmental influences, sensory impairment, cognitive impairment, and detailed seizure characteristics may have affected the accuracy of sleep disturbance assessment.

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