

Factors Associated with Sleep Disorders in Children with Cerebral Palsy

Afni Yusnita^{1*}, Sri Sofyani¹, Rosmayanti S Siregar¹

afnyusnita@gmail.com

¹Department of Pediatric, Faculty of Medicine, University of Sumatra Utara, Medan, Indonesia
 Jl. Dr. Mansyur No.5 Padang Bulan, Medan Baru, Medan, North Sumatera, Indonesia

Abstract

Children with sleep disorders are children whose sleep quality and quantity are disturbed. This situation often occurs in children with chronic diseases such as cerebral palsy (CP). Sleep disorders in CP children can disrupt physical, emotional and cognitive development and can affect parents' physical and psychological health. Therefore, it is important to screen for sleep disorders in CP children. This study aims to determine the prevalence and factors associated with sleep disorders in children with CP. **Methods:** Cross-sectional design analytical study on CP children aged 4-10 years at Haji Adam Malik Hospital Medan during March-August 2023. Sleep disorders were assessed using the Children's Sleep Habit Questionnaire (CSHQ). Data regarding CP type, motor function disorders based on the Gross Motor Functional Classification System (GMFCS), epilepsy, anti-epileptic drugs (AEDs), and anti-spastic drugs were obtained from medical records. Bivariate analysis to determine the relationship between demographic characteristics and sleep disorders. Multivariate analysis to analyze the relationship of various variables with sleep disorders. **Results:** Sixty children with CP were included in this study, the majority were of the spastic type (75.3%) and did not use anti-spastic drugs (85%). Based on the degree of motor function impairment, 63.4% were non-ambulatory CP. Most subjects had epilepsy (63.3%) and used AED monotherapy (73.7%). Sleep disorders occur in 80% of CP children, with the highest proportion of sleep disorders being breathing disorders during sleep (58,2%). The bivariate analysis obtained that spastic CP and non-ambulatory CP significantly correlated with sleep disorders in CP children ($p=0.025$; $p=0.001$). The multivariate analysis obtained that non-ambulatory CP children had a 4.28 times risk to sleep disorders (OR 4.23; 95% CI 1.92-15.84; $p=0.03$). **Conclusion:** Sleep disorders are common in children with CP, with the majority experiencing sleep disordered breathing. Cerebral palsy children with severe motor disorders (non-ambulatory) are more at risk of experiencing sleep disorders.

Keywords: Sleep disorders; Cerebral palsy; Children; CSHQ

Cerebral palsy is a disorder of motor function and posture, resulting from impaired brain development, and is a group of neurological developmental disorders in children that are heterogeneous, non-progressive, and cause lifelong disability. (1) Recent population-based studies from around the world report prevalence estimates of CP ranging from 1 to almost 4 per 1,000 live births or per 1,000 children. (2) In Indonesia, the incidence of CP cannot be studied with certainty, currently, there is no data on the prevalence of CP. (3) Cerebral palsy is

characterized by disturbances in movement, tone, and abnormal posture, and is often accompanied by cognitive, behavioral, and communicative disabilities, epilepsy, difficulty eating, recurrent respiratory infection, hearing loss, vision problems and sleep disorders.(4)

Sleep helps the development of neuropsychological functions and learning abilities in childhood. Sleep disorders are reported to occur in 30 to 60 percent of children with CP.(5-7). Studies in Indonesia shows that the prevalence of sleep disorders in CP children is quite high, ranging from 67 to 85 percent. (8,9). Etiology of sleep disorders in CP children are multifactorial and are related to a combination of physical conditions and medical comorbidities. Various factors associated with sleep disorders in CP children include breathing problems, general muscle weakness, motor disorders, epilepsy, anti-epileptic drugs, and pain due to spasticity. (10,11)

Sleep disorders in PCP children affect physical, emotional and cognitive development as well as quality of life and psychosocial outcomes, so it is important to detect sleep disorders in CP children early. Caring for children with CP places an additional burden on parents and increases the risk of psychological stress and physical health problems for parents, especially mothers. A higher incidence of depression has been reported in mothers of children with CP. Management of sleep disorders in CP children is important to improve not only the child's welfare but also the welfare of the parents.(5,7)

1. Methods

We performed an analytic study with a cross sectional design to determine factors associated with sleep disorders in children with CP. The study was conducted at the Growth and Development and Social Pediatrics Outpatient Clinic and Neuropediatric Outpatient Clinic at Haji Adam Malik Hospital, Medan, from January 2024 to June 2024. The subjects were children aged 4 to 10 years who were diagnosed with cerebral palsy by a neuro-pediatrician. Exclusion criteria were CP children with chronic diseases (cardiovascular disease, malignancy, chronic obstructive pulmonary disease, and diabetes mellitus).

Data collection was carried out using consecutive sampling. The socio demographic data were collected during outpatient clinic visits and from patients medical reports. The data included age, gender, nutritional status, type of CP, presence of epilepsy, using anti-epileptic drugs (AED), using anti-spastic drugs and severity of functional motor disorders based on the GMFCS. Primary data collected from the CSHQ filled by parents. The GMFCS was the classification system to describes gross motor function for children with cerebral palsy on the basis of self-initiated movement abilities, it has five classifications from I to V. Children who can walk without any limitation are included in levels I. Level II children can walks with limitation, while children with assistive mobility devices and orthoses to walk are included in level III. Level IV children can function in a sitting position with limited self-mobility. Level V children cannot walk and require support to maintain their sitting position. Moreover, GMFCS levels I, II, and III are categorized as ambulatory, and GMFCS levels IV and V are categorized as non-ambulatory.

Children's Sleep Habit Questionnaire (CSHQ) was parent-rated questionnaire screening method for sleep behavior problems in school-aged children approximately 4 to 10 year-old based on the International Classification of Sleep Pediatric Disorder Diagnostics. The CSHQ consisted of 33 questions and 8 types of sleep disorder, namely (1) bedtime resistance, (2) sleep onset delay, (3) sleep duration, (4) sleep anxiety, (5) night waking, (6) parasomnias, (7) sleep disordered breathing, and (8) daytime sleepiness. The questionnaire were assessed with three-point scale ranging from 1 to 3. Number 1 for rarely (if it occurs 0-1 times a week), 2 for sometimes (if it happens 2-4 times a week), 3 for always (if it happens 5-7 times a week). A total score more than or equal 41 is classified as a sleep disorder, while total score below 41 classified as no sleep disorder.

The data collected was processed and analyzed using the help of the Statistical Package for Social Science (SPSS) computer software version 21.0. Descriptive or univariate analyses were performed to measure frequency and distribution of subjects' characteristics. Bivariate analyses were Chi-square or Fischer's exact

tests. Multivariate analysis with logistic regression was performed to analyze independent and dependent variables. This study was approved by the Ethics Committee for Medical Research at Medical faculty Universitas Sumatera Utara.

2. Results

A total of 60 children with cerebral palsy fulfilled the inclusion criteria. The mean age of subjects was 5,55 (SD 1,46) years and consisted of 29 male subjects and 31 female subjects. The majority of subjects are spastic type (75%), with spastic diplegia being the most common subtypes. There were 73,7% of the subjects consumed AED monotherapy. Most of the subjects (63,4%) were non-ambulatory CP. The majority of subjects have sleep disorders (80%). The characteristics of the research subjects can be seen in **Table 1**.

Table 1. Demographic characteristics of subjects

Characteristics	Results (n = 60)
Age (SD), years	
Mean (SD)	5,55 (1,46)
Median (Min-Max)	5 (4 – 10)
Gender, n (%)	
Male	31 (51,7)
Female	29 (48,3)
Type of CP, n (%)	
Dyskinetic	2 (3,3)
Hypotonic	13 (21,7)
Spastic	45(75)
Spastic hemiplegic	2 (4)
Spastic diplegic	24 (53,3)
Spastic quadriplegic	19 (42,2)
Epilepsy, n (%)	
Yes	38 (63,3)
No	22 (36,7)
Anti-epileptic drugs (AED)	
Politherapy	10 (26,3)
Monotherapy	28 (73,7)
Anti spastic drugs	
Yes	9 (15)
No	51 (85)
GMFCS	
I	0
II	3 (3,5)
III	25 (29,4)
IV	28 (32,9)
V	29 (34,1)
Ambulatory (GMFCS I-III)	22 (36,6)
Non-ambulatory (GMFCS IV-V)	38 (63,4)
Sleep Disorders	
Yes	48 (80)
No	12(20)

Table 2 shows the bivariate analysis results to analyze factors associated with sleep disorders in children with CP. From CP children who experienced sleep disorders, a significant relationship was found between the variable type of spastic CP ($p=0.027$) and GMFCS levels ($p=0.001$) with the occurrence of sleep disorders.

Table 2. Factors associated with sleep disorders in children with CP

Variables	Sleep disorders		<i>p</i>
	Yes n=48	No n=12	
Age, year			
Mean	5,56(1,54)	5,50 (1,09)	0,731
Gender			
Male	24 (77,4)	7 (22,6)	0,605
Female	24 (82,8)	5 (17,2)	
Type of CP, n (%)			
Dyskinetic	1 (50)	1 (50)	0,027
Hypotonic	8 (61,5)	5 (38,5)	
Spastic	39 (86,7)	6 (13,3)	
GMFCS levels			
Ambulatory	11 (50)	11 (50)	0,001
Non-ambulatory	37 (97,4)	1 (2,6)	
Epilepsy			
Yes	29 (76,3)	9 (23,7)	0,507
No	19 (52,8)	9 (25)	
Anti-epileptic drug (AED), n (%)			
Polytherapy	10 (100)	-	0,063
Monotherapy	19 (67,9)	9 (32,1)	
Anti spastic drugs, n (%)			
Yes	9 (100)	-	0,282
No	39 (76,5)	12 (23,5)	

An in-depth study using ordinal logistic regression indicated that only GMFCS non-ambulatory which significantly influenced sleep disorders in this study (OR 4,28, CI 95% 1,92-15,84; p -value 0,03). (**Table 3**).

Table 3. Ordinal logistic regression of sleep disorders in children with CP

Variables	OR	95% CI	<i>p</i> -value
AED polytherapy	0,48	-2,92 - 0,31	0,99
Spastic type	1,79	0,48- 8,90	0,26
GMFCS non-ambulatory	4,28	1,92-15,84	0,03

3. Discussion

In this study, the results of bivariate analysis showed that type of CP ($p=0.025$) and GMFCS levels ($p=0.001$) significantly influenced the incidence of sleep disorders in CP children. Patery et al study found that type of CP was significantly associated with sleep disorders, in that study, spastic quadriplegia increased the risk of sleep

disorders by 3.63 times (95% CI 1.82-15.94; $P=0.040$). (8)

Likewise with the results of research by Newman in Ireland who reported that spastic quadriplegia CP was significantly associated with the occurrence of sleep disorders in CP children (OR 12.9; 95% 1.9–88; $p=0.009$). (12) Cerebral palsy with spastic-type can cause posture abnormalities, growth retardation, muscle shortening, muscle tone abnormalities, joint subluxation or dislocation, contractures, involuntary movements, soft tissue stiffness, and muscle pain. (13) Spasticity causes uncomfortable positions, and reduces the child's ability to change position during sleep, resulting in pain persistent disease is associated with sleep disturbances. (14) Pain is transmitted from peripheral to central nociceptors through several steps: sensory conduction, transmission, modulation, and perception. The nociceptive signal is actively modulated by excitatory factors and endogenous inhibition from the central nervous system that involves reticular formation. These processes activate the Ascending Reticular Activating System (ARAS) that controls the sleep-wake cycle. Pain, mobility impairment, sensory integration, and interpretation disorder can cause sleep disorders in children with CP. (5)

From the multivariate analysis results, it was found that only non-ambulatory GMFCS, significantly influenced sleep disorders in CP children ($p = 0.03$; OR 4.28; 95% CI = 1.92-15.84). These results are similar to several previous studies. Study by Badaru et al revealed that the main factor influencing sleep disorders in CP children is gross motor function, the more severe the motor disorders, the higher the incidence of sleep disorders. Thus, CP children with a higher level of GMFCS (severe motor impairment) experience more frequent sleep disturbances. CP children who have severe motor limitations often experience stiffness, pain and contractures which can have a negative impact on the quality of their sleep. (15)

A Study by Karabulut et al. reported that more than 40% of CP children experienced at least one type of sleep disorder and this was associated with GMFCS V. Munyumu et al found that sleep disorders were found more frequently in CP children with GMFCS IV and V. These children had significant functional motor limitations. more severe ones are often characterized by bilateral spasticity, rigidity and contractures indicating that severe disability is associated with difficulty sleeping. (6,16)

In this study there was no significant relationship between anti-epileptic drugs mono or polytherapy and sleep disorders. This is in line with the results of research by Patery et al and research by Munyumu et al. (6,8)

The clinical application of this study can be used for early detection of sleep disorders in children with CP, so that parental education and early treatment, both pharmacological and non-pharmacological (sleep hygiene and physiotherapy), can be carried out. The limitation of this study is that the data collection is subjective based on parents' memories, so it can cause bias. This study also did not assess sleep habits and physiotherapy interventions that could affect sleep in CP children.

4. Conclusion

Sleep disorders are common in children with CP. Sleep disorders are more prevalent in CP children with non-ambulatory GMFCS.

5. References

1. Swaiman KF, Wu Y. Cerebral palsy. In : Swaimann KF, Ashwal S, Ferriero DM, editors. Pediatric neurology principles & practice. Edisi ke-5. Philadelphia: Mosby Elsevier; 2012. p. 492-501
2. Centers for Disease Control and Prevention. Cerebral Palsy. 2020.
3. Parmato Primo, Wahyuni Luh Karunia, Hendarto Aryono. Prevalens dan Faktor Prediktor dari Kemampuan Berjalan Pasien Palsi Serebral pada Masa Anak di Rumah Sakit Cipto Mangunkusumo dan Yayasan Pembinaan Anak Cacat. Sari Pediatri. 2014 ; 16(1) : 12-19.

4. Tolaymat A, Liu Z. Sleep Disorders in Childhood Neurological Diseases. *Children*. 2017; 4, 84.
5. Sandella DE, O'Brien LM, Shank LK, Warschausky SA. Sleep and quality of life in children with cerebral palsy. *Sleep Med*. 2011;12(3) : 252–6.
6. Munyumu K, Idro R, Abbo C, et al. Prevalence and factors associated with sleep disorders among children with cerebral palsy in Uganda; a cross-sectional study. *BMC Pediatrics*. 2018; 10: 186-87.
7. Petersen S, Francis KL, Reddihough DS, Lima S, Harvey A, Newall F. Sleep problems and solution seeking for children with cerebral palsy and their parents. *Journal of Paediatrics and Child Health*. 2020; 56(7).1108-113. 8.
8. Patery SWM, Sunartini and Sutomo R. Sleep disorders and associated factors in children with cerebral palsy. *Paediatrica Indonesiana*. 2021;61(4): 1-6.
9. Gamayani U, Aryani M, Lailiyya N, Puspardini I. Sleep Disorder Prevalence and Influencing Factors in Children with Cerebral Palsy. *Global Medical and Health Communication*. 2022; 10(1):28–34
10. Ritterband-Rosenbaum A, Christensen MS, Lund MC, et al. Sleep Pattern and Night-Time Muscle Activity in Children With Cerebral Palsy Compared to Typically Developing Peers. *J Sleep Med*. 2021; 18(2):106-116.
11. Hulst RY, Voorman JM, Pillen S, Ketelaar M, Visser-Meily JMA, Verschuren O. Parental perspectives on care for sleep in children with cerebral palsy: a wake-up call. *Disability And Rehabilitation*. 2022; 44(3), 458–67.
12. Newman CJ, O'Regan M, Hensey O. Sleep disorders in children with cerebral palsy. *Dev Med Child Neurol*. 2006;48(7) : 564-8.
13. Samsoddini A, Amirsalasri S, Hollisaz M, Rahimnia, Khatibi-Aghda A. Management of Spasticity in Children with Cerebral Palsy. *Iran J Pediatr*. 2014; 24(4): 345-51
14. Dutt R, Roduta-Roberts M, Brown CA. Sleep and children with cerebral palsy: a review of current evidence and environmental non-pharmacological interventions. *Children (Basel)*. 2015;2:78-88
15. Badaru UM, Hassan AM, Ahmad RY, Nuhu JM, Lawal IU. Prevalence, pattern and impact of sleep disturbance on quality of life and exercise participation among children with cerebral palsy in Kano city. *Sleep Sci*. 2021; 14(4):348-56
16. Karabulut D, Avci Ş. Relationship Between Sleep Problems and Gross Motor Function in Children With Cerebral Palsy and Investigation of Their Parents' Quality of Life. *Physiother Rehabil*. 2020; 31(2)180-87