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Original Research Article

Prevalence and clinical patterns of epilepsy in children with spastic cerebral palsy: a cross-sectional study in South India

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ABSTRACT

Background: Cerebral palsy (CP) is frequently accompanied by epilepsy, a comorbidity that exacerbates motor and cognitive impairment. Among the CP subtypes, spastic CP exhibited the highest association with seizures. However, the prevalence and clinical patterns of epilepsy in these children, particularly in the Indian context, remain under-characterized. Objective was to determine the prevalence and characterize the clinical patterns of epilepsy among children with spastic CP in a tertiary care setting in South India.
Methods: This cross-sectional study was conducted over 18 months in the pediatric department of a tertiary hospital. A total of 218 children aged 2-14 years with spastic CP were recruited. Epilepsy diagnosis and seizure types were confirmed using ILAE criteria through clinical history and caregiver interviews. Gross motor function was assessed using the gross motor function classification system (GMFCS). Statistical associations were evaluated using chi-square tests and odds ratios (OR) with 95% confidence intervals (CI).
Results: Epilepsy was prevalent in 52.2% of the patients. The most common type of seizure was tonic-clonic (31.3%), followed by myoclonic (9.6%) and complex partial seizures (8.7%). Children with quadriplegic (36.5%) and diplegic (35.7%) CP exhibited a higher epilepsy prevalence. Epilepsy was most frequent in GMFCS levels II and III. No significant sex differences were observed.
Conclusions: Epilepsy is common in children with spastic CP, particularly among those with quadriplegia, diplegia, and moderate-to-severe motor impairment. Early neurological surveillance and risk-based screening, especially among patients with GMFCS II-IV, may improve detection and long-term outcomes.

Keywords: Spastic cerebral palsy, Epilepsy, Seizure type, Quadriplegia, GMFCS, South India

INTRODUCTION

Cerebral palsy (CP) is a complicated neurodevelopmental disorder typified by non-progressive brain damage that occurs during birth or early infancy, resulting in motor deficits and a number of related comorbidities.[1] One of these comorbidities that has the biggest impact on clinical care and quality of life is epilepsy.

In children with CP, epilepsy results from underlying brain damage that interferes with normal neural networks, frequently affecting the cortical and subcortical areas that regulate motor control and electrical brain activity. CP subtype, severity, and research methods all affect the prevalence of epilepsy in children with CP, which varies from study to study.[1]

According to systematic reviews and meta-analyses, approximately 28% of individuals with CP have epilepsy; considering the developmental characteristics of the condition, this rate may be comparable to or slightly higher in children. According to population-based data, between 25% and 33% of children with CP may experience seizures at some point in their lives. Patients with more severe motor deficits and related brain abnormalities are at a significantly higher risk.[2]

According to meta-analytic statistics, approximately 27% of survivors of perinatal stroke, a major cause of hemiplegic CP, acquire epilepsy after a follow-up period of 10 years on average.[3] This emphasizes the significant overlap between perinatal brain damage that causes CP and subsequent epileptogenesis.

Higher healthcare requirements and worse functional outcomes are associated with epilepsy in patients with CP. Early onset epilepsy in CP may complicate developmental trajectories and is frequently resistant to treatment. Although they belong to a different group, genetic epilepsies are less frequently directly linked to CP unless there is an underlying genetic condition, including brain damage or abnormalities.[4,5]

In newborns and children with drug-resistant epilepsy, some of whom have CP or similar neurodevelopmental abnormalities, recent developments in epilepsy treatment, such as ketogenic diets and innovative antiseizure drugs, have shown promise.[6,7] However, because seizure patterns and comorbidities vary widely, managing epilepsy in patients with CP remains difficult.

With prevalence estimates of 25-30%, epilepsy is generally supported as a prevalent and clinically significant comorbidity in children with CP. This emphasizes the necessity of early diagnosis, careful screening, and specialized management techniques to enhance outcomes in this susceptible group.[8]

METHODS

This cross-sectional observational study was conducted in the department of pediatrics at a tertiary care teaching hospital in South India from July 2022 to January 2024. This study included 218 children aged 2-14 years with spastic CP. The sample size was calculated using an estimated 50% prevalence of epilepsy among children with CP, a 95% confidence level, and a 10% margin of error, resulting in 196. To improve the power, the final sample included 218 children.

Children with progressive neurological disorders or syndromic CP were excluded from the study. Data on age, sex, seizure type, CP subtype, and GMFCS levels were collected using standardized forms and caregiver interviews. Seizures were classified using ILAE clinical definitions, and motor function using the GMFCS.

Ethical approval was obtained from the institutional ethics committee (Ref: IEC/SBMCH/2022/PED-EP/087), and informed consent was obtained from parents or the guardians. Data were analyzed using SPSS v21. Associations were tested using chi-square and OR with 95% CI. Statistical significance was set at $p<0.05$.

RESULTS

The 115 children who visited the pediatric outpatient department of Sree Balaji medical college and hospital participated in the study. Participants in the study ranged in age from 2 to 14. In this study, the ratio of men to women was 1:0.8. The study participants were 8.9 years old on average. The 52.2% of children between the ages of 2 and 14 were found to have epilepsy.

Table 1 presents the overall prevalence of epilepsy among children diagnosed with spastic CP. Of the 218 children enrolled, 115 were diagnosed with epilepsy, indicating a prevalence rate of 52.8%. This high burden highlights the need for early neurological assessment and routine seizure surveillance in patients with spastic CP.

Table 1: Prevalence of epilepsy in children with spastic CP.

Total children	Children with epilepsy	Prevalence (%)
218	115	52.8

Table 2 presents the age distribution of individuals with epilepsy across three age groups: 2-5 years, 6-10 years, and 11-14 years. The 6-10 year age group comprises the largest proportion, with 50 individuals (43.5%), followed by the 2-5 year age group, which includes 43 individuals (37.4%). The 11-14 year group represents the smallest segment, with 22 individuals (19.1%). These figures suggest that epilepsy is most frequently identified or managed in early to mid-childhood, with a declining prevalence noted in later childhood. This pattern may reflect both the natural history of epilepsy in children with CP and the timing of clinical diagnosis.

Table 2: Distribution of epilepsy by age group.

Age (in years)	N	Percentage (%)
2-5	43	37.4
6-10	50	43.5
11-14	22	19.1

Table 3: Gender-wise distribution.

Gender	N	Percentage (%)
Male	60	52.6
Female	55	47.8

Table 3 shows gender distribution of individuals with epilepsy. Total 115 individuals affected, 60 are male (52.6%) and 55 female (47.8%), indicating slightly higher

prevalence of epilepsy among males. While difference is modest, near-equal distribution suggests that epilepsy affects both genders relatively equally in this population, with no significant gender-based disparity observed.

Table 4: Distribution by CP subtype.

CP subtype	N	Percentage (%)
Quadriplegia	42	36.5
Diplegia	41	35.7
Hemiplegia	32	27.8

Table 4 presents distribution of epilepsy across different subtypes of CP, including quadriplegia, diplegia, and hemiplegia. Quadriplegia is the most commonly associated CP subtype with epilepsy, accounting for 42 individuals (36.5%), closely followed by diplegia, with 41 individuals (35.7%). Hemiplegia shows the lowest association, with 32 individuals (27.8%) affected by epilepsy.

Relatively high prevalence of epilepsy among individuals with quadriplegia and diplegia suggests a potential link between more extensive motor involvement and the development of seizure disorders, possibly reflecting greater underlying brain injury/ dysfunction in these subtypes.

Table 5 summarizes the distribution of epilepsy types among individuals with different forms of motor impairments: quadriplegia, hemiplegia, and diplegia, based on a total sample of 115 individuals with epilepsy. The most prevalent type of epilepsy observed is tonic-clonic seizures, affecting 49 individuals (42.6%), with the highest occurrence in those with diplegia (24 cases), followed by quadriplegia (16 cases), and hemiplegia (9 cases). Myoclonic seizures were reported in 28 individuals (24.3%), occurring most frequently in those with diplegia (12 cases) and quadriplegia (10 cases), and to a lesser extent in hemiplegia (6 cases). Partial complex seizures were present in 25 individuals (21.7%), with a notable predominance in those with hemiplegia (17 cases), suggesting a potential link between this seizure type and unilateral motor impairment. Focal seizures (tonic/clonic) were least common, identified in 13 individuals (11.3%), and were primarily associated with quadriplegia (9 cases). Overall, the data indicate that different types of epilepsy may exhibit distinct patterns of association with specific motor impairments, potentially reflecting underlying neurological differences in brain injury patterns.

Table 5: Seizure type distribution.

Type of epilepsy	Quadriplegia	Hemiplegia	Diplegia	Total, n (%)
Focal (tonic or clonic)	9	0	4	13 (11.3)
Partial complex	7	17	1	25 (21.7)
Tonic clonic	16	9	24	49 (42.6)
Myoclonic	10	6	12	28 (24.3)
Total with epilepsy	42	32	41	115 (100)

Table 6: GMFCS distribution.

GMFCS level	N	Percentage (%)
I	3	2.6
II	42	36.4
III	31	26.9
IV	25	27.1
V	12	13

Table 6 outlines the distribution of epilepsy among individuals classified by the GMFCS levels I through V. The majority of individuals with epilepsy fall into GMFCS level II, accounting for 42 individuals (36.4%), indicating a high prevalence of epilepsy among those with moderate motor function. This is followed by level III, with 31 individuals (26.9%), and level IV, with 25 individuals (27.1%), both representing substantial portions of the cohort. In contrast, level V, which denotes the most severe motor impairment, includes 12 individuals (13%) with epilepsy. The lowest number of cases is seen in level I, which includes only 3 individuals (2.6%), reflecting minimal motor involvement. These findings suggest that epilepsy is more commonly associated with moderate to severe motor impairment in individuals with CP, particularly those classified under levels II to IV.

DISCUSSION

This study examined the prevalence and characteristics of epilepsy among children with CP, providing a detailed breakdown by CP subtype, motor function classification, age, gender, and seizure type. Among the 218 children assessed, epilepsy was observed in 115, indicating a prevalence of 52.8%, which aligns with previous reports suggesting a high burden of epilepsy in children with CP. For instance, a systematic review by Gururaj et al noted that epilepsy affects between 15% to 55% of children with CP, depending on the population and diagnostic criteria used.[9] Our finding sits at the upper end of this range, potentially reflecting more severe neurological impairment in our cohort.

In terms of CP subtype, quadriplegia was most commonly associated with epilepsy (36.5%), closely followed by diplegia (35.7%), and hemiplegia (27.8%). These findings

are consistent with the literature indicating a higher risk of seizures in children with more extensive motor involvement. For example, a study by Zafeiriou et al found that children with quadriplegic CP had the highest incidence of epilepsy, correlating with diffuse brain damage patterns on imaging.[10] Similarly, our data echo the observations by Sellier et al who reported increased epilepsy prevalence in children with bilateral spastic CP subtypes.[11]

The analysis by GMFCS level revealed a higher prevalence of epilepsy in children with GMFCS levels II to IV, peaking at level II (36.4%) and maintaining significant representation in level III (26.9%) and level IV (27.1%). Interestingly, the lowest prevalence was observed at level I (2.6%). This nuanced finding departs slightly from existing literature, where epilepsy is most commonly associated with GMFCS levels IV and V.[7,11] One possible explanation for our results could be related to sampling differences or local clinical referral patterns emphasizing moderate disability groups.

When classified by seizure type, tonic-clonic seizures were the most frequent (42.6%), followed by myoclonic (24.3%), partial complex (21.7%), and focal seizures (11.3%). This pattern aligns with studies like that of Kwong and Wong which emphasized the predominance of generalized seizures, particularly tonic-clonic and myoclonic, in pediatric CP populations.[9] Moreover, the association between seizure type and motor impairment in our data-such as focal seizures predominantly seen in quadriplegia-warrants further investigation, potentially reflecting underlying focal brain lesions.

Age distribution revealed the highest frequency of epilepsy in children aged 6-10 years (43.5%), followed by 2-5 years (37.4%), and a drop in the 11-14-year group (19.1%). These findings are consistent with the natural history of epilepsy onset in CP, where seizures often begin in early childhood and may decline in frequency or severity with age.[12] However, the dip in adolescence might also reflect underdiagnosis or misclassification in older children who experience subtler seizure activity.

The gender distribution in our cohort showed a near-equal split between males (52.6%) and females (47.8%), consistent with reports indicating no significant gender predisposition for epilepsy in CP. However, a slight male predominance has been observed in some studies, likely reflecting overall trends in CP incidence rather than epilepsy-specific risk.[13,14]

Together, these findings reinforce the multifactorial nature of epilepsy in CP and underscore the importance of early neurological assessment, particularly in children with bilateral motor impairment and moderate to severe functional limitations. The data also support integrating epilepsy surveillance into routine CP care, especially between the ages of 2 and 10 years.

CONCLUSION

Epilepsy is prevalent in 52.8% of children with spastic CP, especially those with quadriplegic and diplegic subtypes and those classified as GMFCS Levels II and III. Tonic-clonic seizures are the most common presentations of this condition. This study emphasizes the importance of routine seizure screening in high-risk CP phenotypes and suggests that motor severity scales, such as the GMFCS, could serve as indirect indicators for epilepsy risk stratification. However, this study has limitations, including its cross-sectional design, potential recall bias, and single-center nature. Future studies should be multicentric and longitudinal, tracking seizure evolution and treatment response over time and integrating EEG and neuroimaging findings for a deeper understanding. Early neurological evaluation, particularly in children with moderate-to-severe CP, is vital for improving developmental outcomes. Future research should incorporate findings from EEG and brain imaging to better understand the different subtypes of epilepsy and the effects of early seizure control on cognitive and motor outcomes.

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