

## Original Research Article

# Clinical spectrum of cerebral palsy in children aged up to 16 years using gross motor function classification system score for management at a tertiary care centre

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### ABSTRACT

**Background:** Cerebral palsy is the most common and costly form of chronic motor disability that begins in childhood. Cerebral palsy is a well-recognised neurodevelopment condition beginning in early childhood and persisting through the lifespan. In India prevalence of cerebral palsy ranges between 1.4 to 3.1 per 1000 live births. Gross motor function classification system (GMFCS) score for cerebral palsy is based on self-initiated movement with emphasis on sitting, transfer and mobility.

**Methods:** This is observational cross-sectional study with sample size of 45 patients aged up to 16 years (taken according to inclusion and exclusion criteria). A detail history regarding prenatal, natal and postnatal events were asked and etiology was grouped under antenatal, natal, postnatal or idiopathic. Past history of admission (NICU) or any events will be noted. Severities of grading will be classified according to GMFCS.

**Results:** The mean age of the children studied was 3.31 years, with a greater prevalence in males (68.9%) than females (31.1%). A significant number of children were born preterm (26.7%), with most deliveries occurring in hospitals (75.6%). Key risk factors identified included low birth weight (46.7%), prematurity (28.9%) and birth asphyxia (17.8%). Spastic cerebral palsy was the most common type, affecting 93.4% of the children in the study.

**Conclusions:** The Present study suggests that early diagnosis and assessment of the GMFCS score are crucial for optimizing the ambulatory management of children with cerebral palsy, potentially improving their functional outcomes. In this study, spastic quadriplegic cerebral palsy has a statistically significant association with GMFCS score. The GMFCS Score is instrumental in setting rehabilitation goals for cerebral palsy, catering to various ages and severity levels. It is key in assessing functional outcomes in diverse settings, enhancing quality of life.

**Keywords:** Cerebral palsy, GMFCS score, Spastic quadriplegic cerebral palsy

### INTRODUCTION

Cerebral palsy stands as the most common and financially burdensome type of chronic motor disability in children. Recognized as a significant neurodevelopmental disorder, it originates in early childhood and persists throughout an individual's life. This condition profoundly affects the functional abilities and the health-related quality of life of those affected and their caregivers.<sup>1,2</sup> Cerebral palsy encompasses a range of

permanent movement and posture difficulties that limit activities. These are due to non-progressive disruptions in the brain during fetal development or infancy. Alongside motor issues, cerebral palsy is frequently associated with challenges in sensory, perceptual, cognitive, communicative and behavioural domains, as well as seizures and secondary problems related to the musculoskeletal system.<sup>3,4</sup> Data from the centers for disease control and prevention indicate that cerebral palsy affects approximately 3.6 in every 1,000 children.<sup>5,6</sup> In

India, the occurrence rate ranges between 1.4 and 3.1 per 1,000 live births. Over the past two decades, there has been a rise in the incidence and prevalence of cerebral palsy. This increase could be linked to advancements in neonatal medical care, improved recording of cases in national databases, or other contributing factors.<sup>1-7</sup>

Accurately identifying the etiology of cerebral palsy is crucial, involving an assessment of malformations, genetic factors, or injuries and determining whether the injury is acquired, antenatal, natal, or postnatal. This information holds significant implications for assessing recurrence risk, counselling families and implementing prevention programs. The resultant motor defects, stemming from brain injury, persist throughout the affected individual's lifetime. Beyond mobility issues and locomotor developmental delays, these individuals may grapple with "seizure disorders, gastrointestinal complications, learning difficulties, perceptual challenges, visual and hearing impairments, and growth deficiencies."<sup>2,8,9</sup>

Cerebral palsy encompasses a broad range of motor impairments resulting from damage to the developing brain. The clinical spectrum is characterized by varying degrees of motor dysfunction, which may involve spasticity, dyskinesia, ataxia or a combination. The severity of symptoms can range from mild, where the child may only have subtle coordination difficulties, to severe, where significant impairments in movement and posture are evident.<sup>1-10</sup> Spastic cerebral palsy is the most common type, affecting approximately 70-80% of individuals with CP. This form is characterized by increased muscle tone, stiffness and difficulty with voluntary movements. Dyskinetic cerebral palsy involves involuntary, uncontrolled movements affecting the entire body or specific muscle groups. Ataxic cerebral palsy, the least common type, manifests as problems with balance and coordination.<sup>11,12</sup>

The gross motor function classification system (GMFCS), is a tool that classifies cerebral palsy by evaluating self-generated movements, particularly focusing on abilities related to sitting, transferring and mobility, through a comprehensive five-tier system. While treatments for cerebral palsy are not curative, they are designed to reduce disability, prevent physical deformities and improve abilities in areas such as communication, mobility, self-reliance and learning to facilitate a life that is as normal as possible. This integrated treatment strategy requires the active involvement of parents and covers a wide range of needs, including motor skills, cognitive development, speech, vision, hearing and emotional well-being.<sup>13-15</sup> Surgical approaches are utilized in cerebral palsy management, focusing on reducing spasticity and improving movement. Innovative treatments such as stem cell therapy, hippotherapy, and the Adeli suit are being explored, though they currently lack robust evidence to support their widespread use. Instrumented gait analysis

is crucial in guiding surgical decisions, including implementing single-event multilevel surgery. Additionally, the development of Orthopedic selective spasticity control surgery (OSSCS) marks a significant advancement in treating cerebral palsy.<sup>16,17</sup>

## **METHODS**

### ***Study type***

These was an observational prospective (cross-sectional) study.

### ***Study duration***

Study duration was six-months (July 2023 to December 2023).

### ***Study participants***

All patients clinically diagnosed with cerebral palsy who were presented to the study setting were screened for eligibility criteria.

### ***Inclusion criteria***

All children up to 16 years of age with non-progressive motor disease are diagnosed with cerebral palsy and who had a persistent disorder of movement and posture appeared early in life due to a non-progressive disorder of the brain.

### ***Exclusion criteria***

Children with progressive neurological disease, with congenital anomalies were not included in study and also, if parents do not give consent.

### ***Sample size***

The sample size required for the present study was obtained by using the hypothesis testing method and the calculated minimum sample is 45.

### ***Methodology***

The data collection was started after ethical approval from the Institutional Ethical Committee (IEC). Eligible participants were enrolled purposively in the study. All selected patients were provided with a participant's information sheet in the language they understood before they gave consent. Information from the participants was collected as per proforma. A comprehensive history encompassing prenatal, natal and postnatal events was gathered, with aetiology categorized into antenatal, natal, postnatal, or idiopathic factors. Past admissions and events were documented, particularly in the NICU. A thorough examination of the central nervous system, encompassing the motor system and muscle coordination, was performed. The evaluation also included determining

the GMFCS score for cerebral palsy, focusing on self-initiated movements and emphasizing sitting, transfer, and mobility abilities.

**Statistical analysis**

Epi info CDC 7 version was used to enter and analyse data. Mean and standard deviations were used to represent continuous variables. Proportions were used for categorical variables. A p value less than 0.05 was considered statistically significant.

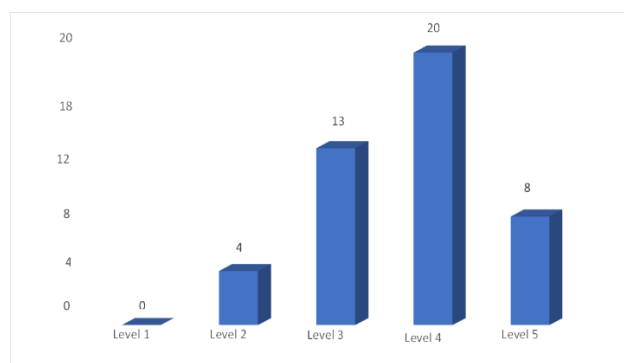
**RESULTS**

Table 1 shows mean age of these children, which is 3.31 years, with a standard deviation of 3.45 years, indicating a range in ages. A total of 68.9% (31) are male and 31.1% (14) are female was studied. Socioeconomic background of the children's families: 48.9% (22 children) in the lower class, 22.2% (10 children) in the middle class and 28.9% (13 children) in the upper class.

**Table 1: Socio-demographic data.**

Socio-demographic data	No. of patients	Percentage (%)
<b>Gender</b>		
Male	31	68.9
Female	14	31.1
<b>Social class</b>		
Lower	22	48.9
Middle	10	22.2
Upper	13	28.9

Table 2 presents the frequency and percentage of various risk factors for cerebral palsy among 45 children. Antenatal factors include maternal age below 20 or above 35 years in 5 children (11.1%), pregnancy-induced hypertension (PIH) in 7 children (15.6%) and chorioamnionitis in 4 children (8.9%).



**Figure 1: GMFCS distribution of study participants.**

Intranatal factors are represented by low birth weight (LBW) in 21 children (46.7%), prematurity in 13 children (28.9%), birth asphyxia in 8 children (17.8%),

intracranial hemorrhage in 1 child (2.2%), prolonged rupture of membranes in 4 children (8.9%) and intrauterine growth restriction (IUGR) in 3 children (6.7%). Septicemia was seen among 15.6%, while CNS infection was observed among three children (6.7%). Other postnatal factors like hypoglycemia with neonatal convulsion in 14 children (31.1%), kernicterus in 1 child (2.2%) and genetic malformation also in 1 child (2.2%) were reported.

**Table 2: Risk factor distribution for cerebral palsy among study participants (n=45).**

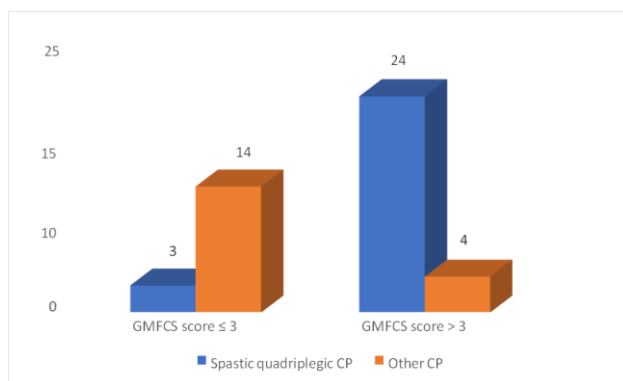
Risk factors	Frequency (N)	Percent (%)
<b>Antenatal factors</b>		
Maternal age <20/>35 years	05	11.1
PIH	07	15.6
Chorioamnionitis	04	8.9
<b>Intranatal factors</b>		
LBW	21	46.7
Prematurity	13	28.9
Birth asphyxia	08	17.8
Intracranial hemorrhage	01	2.2
Prolonged rupture of membrane	04	8.9
IUGR	03	6.7
<b>Post natal factors</b>		
Septicemia	07	15.6
CNS infection	03	6.7
Hypoglycemia with neonatal convulsion	14	31.1
Kernicterus	01	2.2
Genetic malformation	01	2.2

**Table 3: Type of cerebral palsy among study participants (n=45).**

Types of cerebral palsy	Frequency (N)	Percent (%)
<b>Spastic</b>	42	93.4
<b>Quadriplegic</b>	27	
<b>Diplegic</b>	11	
<b>Hemiplegic</b>	03	
<b>Hypotonic</b>	02	4.4
<b>Dyskinetic</b>	01	2.2

Table 3 highlights that 93.4% (42 children) have spastic cerebral palsy, categorized. Figure 1 shows GMFCS distribution among 45 children with cerebral palsy.

It indicates that no children are at Level 1 (0%), four children are at Level 2 (9%), 13 children at Level 3 (29%), and the majority, 20 children, are at Level 4 (44%), and eight children are at Level 5 (18%). Further, with a smaller proportion having hypotonic (4.4%) and dyskinetic (2.2%) types.



**Figure 2: Relation of type of cerebral palsy and GMFCS score among study participants.**

As per Figure 2, Among the participants, 17 had a GMFCS score of 3 or less and 28 had a score greater than 3. For those with spastic quadriplegic CP, 3 participants had a GMFCS score of 3 or less, while 24 had a score greater than 3. This contrasts with participants having other types of CP, where 14 had a GMFCS score of 3 or less, and only 4 had a score greater than 3. The statistical significance of these findings is underscored by a p value of less than 0.001, indicating a strong association between the type of cerebral palsy and the GMFCS score.

## DISCUSSION

Cerebral palsy, a neurological disorder, primarily affects motor function due to abnormal brain development or damage to the developing brain. This condition, manifesting in early childhood, leads to varied physical symptoms, ranging from mild motor skill delays to severe motor impairments, often accompanied by coexisting sensory, cognitive and perceptual challenges. The etiology of cerebral palsy is multifactorial, involving genetic, environmental and perinatal influences.<sup>2,3</sup>

The present study aims to evaluate the clinical spectrum and etiological factors of cerebral palsy and to determine the association between the GMFCS score and the type of cerebral palsy in individuals.

In a comparative analysis of the mean age of children diagnosed with cerebral palsy, the current study presents a mean age of 3.31 years with a standard deviation of 3.45.

CP is typically identified during early childhood, but its onset is not age- dependent, as it can manifest at any point in life. Most CP cases are diagnosed in infancy or early childhood, often before age 2 or 3, when developmental and motor challenges appear.

It is worth emphasizing that CP can have diverse etiologies, including prenatal, perinatal or postnatal factors, making it possible for individuals of various ages to develop the condition. Furthermore, individuals living with CP may change their health status and may require

evolving forms of medical and therapeutic assistance throughout their lifespan.

In the present study, 11.1% of mothers were either under 20 years old or over 35 years old. Pregnancy-induced hypertension (PIH) was noted in 15.6% of cases, indicating its potential contribution to cerebral palsy development. Additionally, chorioamnionitis was observed in 8.9% of pregnancies.

In our study, 46.7% of cases involved low birth weight (LBW), while 28.9% were associated with prematurity. Birth asphyxia was identified in 17.8% of cases, highlighting its potential impact on cerebral palsy development. Furthermore, other intranatal factors, such as intracranial hemorrhage (2.2%), prolonged rupture of membranes (8.9%) and intrauterine growth restriction (IUGR) at 6.7% were also evident.

In the research conducted by Reddy et al, it was observed that perinatal asphyxia occurred in 40% of cases, preterm or low birth weight in 33%, prolonged labour in 4%, while premature rupture of membranes and birth injuries were noted in 4% and 2% of the instances, respectively.<sup>22</sup>

Our research identified septicemia in 15.6% of cases, while CNS infection was present in 6.7%. A noteworthy risk factor was hypoglycemia with neonatal convulsions, accounting for 31.1% of cases. Additionally, kernicterus and genetic malformations each represented 2.2% of cases. In the study by Reddy et al, neonatal seizures accounted for 34 % of the total cases.<sup>22</sup> Neonatal jaundice was present in 6% of the total cases and neonatal sepsis/meningitis comprised 5% of the total cases.

In the present study, 93.4% (42 children) had spastic cerebral palsy, while 4.4% had a hypotonic and 2.2% had dyskinetic types. Spastic quadriplegia was seen among 64.3% of the cases. Spastic Diplegia, primarily affecting the lower limbs, accounts for 26.2%. Spastic hemiplegia, involving unilateral body impairment, is observed in 9.5% of the cases.

In the present study, among the group with GMFCS scores of 3 or lower, 16 individuals had spastic CP, while no cases of hypotonic CP were observed. In the group with GMFCS scores greater than 3, 26 individuals had spastic CP and two individuals had hypotonic CP. Dyskinetic CP was rare, with one case in the group with GMFCS scores of 3 or lower and none with GMFCS scores greater than 3. This data highlights the varying prevalence of CP subtypes, with spastic CP being the most common overall, particularly in individuals with more significant motor impairment.

In research conducted by Abas et al, individuals with hemiplegic-type cerebral palsy predominantly fell within GMFCS levels I to III.<sup>20</sup> In contrast, those with quadriplegia exhibited higher disability levels between GMFCS levels III to V. A statistically significant

difference in GMFCS scores was identified among the various spastic subtypes.

**Table 4: GMFCS score ≤ 3 and GMFCS score > 3.**

Type of CP	GMFCS score ≤3 (n=17)	GMFCS score >3 (n=28)	P value
Spastic quadriplegic CP	03	24	<0.001
Other CP	14	04	

**Table 5: GMFCS score ≤3 and GMFCS score >3.**

Type of CP	GMFCS score ≤3 (n=161)	GMFCS score >3 (n=82)	P value
Spastic quadriplegic CP	20	65	<0.001
Other CP	141	17	

In our study, Among the participants, 17 had a GMFCS score of 3 or less, and 28 had a score greater than 3. For those with spastic quadriplegic CP, 3 participants had a GMFCS score of 3 or less, while 24 had a score greater than 3. This contrasts with participants having other types

of CP, where 14 had a GMFCS score of 3 or less and only 4 had a score greater than 3. The statistical significance of these findings is underscored by a p value of less than 0.001, indicating a strong association between the type of cerebral palsy and the GMFCS score. In research conducted by Michael et al, association between type of CP and GMFCS score shows statistically significant which was similar to our study.<sup>19</sup>

**GMFCS**

The GMFCS is a widely used clinical tool in pediatric rehabilitation. It categorizes individuals with cerebral palsy into five levels based on their gross motor function abilities. Level I represents the highest level of function, with individuals able to walk independently, while Level V indicates severe limitations in motor function, often requiring assistive mobility devices. The GMFCS assists healthcare professionals in assessing and planning interventions tailored to the specific needs of children with cerebral palsy, contributing to improved outcomes and quality of life.

In a comparative analysis of the GMFCS levels in children with cerebral palsy, distinct variations are evident across different studies. In this study, Level 1 0%, Level 2 found 9%, Level 3 found 29%, Level 4 found 44% and Level 5 found 18%.

**Table 6: Comparison of GMFCS level with various study.**

GMFCS Level	Current study	Kumar R, et al <sup>21</sup>	Park EY, et al <sup>18</sup>	Abas O, et al <sup>20</sup>	Michael IS, et al <sup>19</sup>
Level 1	0%	21%	15%	9%	44%
Level 2	9%	15%	13%	23%	10%
Level 3	29%	19%	11%	34%	12%
Level 4	44%	15%	15%	20%	18%
Level 5	18%	30%	46%	14%	16%

**CONCLUSION**

The Present study suggests that early diagnosis and assessment of the GMFCS score are crucial for optimizing the ambulatory management of children with cerebral palsy, potentially improving their functional outcomes. In this study, spastic quadriplegic cerebral palsy has a statistically significant association with GMFCS score.

The GMFCS Score is instrumental in setting rehabilitation goals for cerebral palsy, catering to various ages and severity levels. It is key in assessing functional outcomes in diverse settings, enhancing quality of life. Cerebral palsy, a non-progressive central motor disorder, varies in severity. Early diagnosis and intervention, facilitated by the GMFCS score and multi-disciplinary clinics, improve ambulatory management and patient compliance. Early engagement in occupational therapy for NICU graduates is recommended to mitigate disability. Such data aids in understanding the burden of

cerebral palsy and informs policy for prevention and management. It is recommended that larger, multi-centric studies be conducted to substantiate these preliminary findings. Such expanded research could provide more robust data, enabling a more comprehensive understanding of the intricate relationships between GMFCS scores, types of cerebral palsy and associated comorbidities. Furthermore, these studies could facilitate the development of tailored therapeutic strategies and interventions, ultimately enhancing patient care and quality of life for individuals with cerebral palsy.

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## REFERENCES

1. Patel DR, Neelakantan M, Pandher K, Merrick J. Cerebral palsy in children: a clinical overview. *Transl Pediatr*. 2020;9(1):S125-35.
2. Graham HK, Rosenbaum P, Paneth N, Dan B, Lin JP, Damiano DL, et al. Cerebral palsy. *Nat Rev Dis Primers*. 2016;2:15082.
3. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol Suppl*. 2007;109:8-14.
4. Colver A, Fairhurst C, Pharoah PO. Cerebral palsy. *Lancet*. 2014;383(9924):1240-9.
5. National Guideline Alliance (UK). Cerebral palsy in under 25s: assessment and management. London: National Institute for Health and Care Excellence (NICE). 2017. Available at: <https://www.nice.org.uk/guidance/ng6>. Accessed on 11 May 2026.
6. Vitrikas K, Dalton H, Breish D. Cerebral palsy: an overview. *Am Fam Physician*. 2020;101(4):213-20.
7. Paul S, Nahar A, Bhagawati M, Kunwar AJ. A Review on Recent Advances of Cerebral Palsy. *Oxid Med Cell Longev*. 2022;2022:2622310.
8. Lee RW, Poretti A, Cohen JS, Levey E, Gwynn H, Johnston MV, et al. A diagnostic approach for cerebral palsy in the genomic era. *Neuromolecular Med*. 2014;16(4):821-44.
9. Abd Elmagid DS, Magdy H. Evaluation of risk factors for cerebral palsy. *Egypt J Neurol Psychiatry Neurosurg*. 2021;57:13.
10. Cans C. Surveillance of cerebral palsy in Europe: a collaboration of cerebral palsy surveys and registers. *Dev Med Child Neurol*. 2000;42(12):816-24.
11. Sadowska M, Sarecka-Hujar B, Kopyta I. Cerebral Palsy: Current Opinions on Definition, Epidemiology, Risk Factors, Classification and Treatment Options. *Neuropsychiatr Dis Treat*. 2020;16:1505-18.
12. Bar-On L, Molenaers G, Aertbeliën E, Van Campenhout A, Feys H, Nuttin B, et al. Spasticity and its contribution to hypertonia in cerebral palsy. *Biomed Res Int*. 2015;2015:317047.
13. Paulson A, Vargus-Adams J. Overview of Four Functional Classification Systems Commonly Used in Cerebral Palsy. *Children (Basel)*. 2017;4(4):30.
14. Palisano R, Rosenbaum P, Bartlett D, Livingston M, Walter S, Russell D. CanChild Centre for Childhood Disability Research, McMaster University. CanChild. Hamilton (ON): McMaster University. 2007.
15. Rosenbaum PL, Palisano RJ, Bartlett DJ, Galuppi BE, Russell DJ. Development of the Gross Motor Function Classification System for cerebral palsy. *Dev Med Child Neurol*. 2008;50(4):249-53.
16. Parveen S. Management and Treatment for Cerebral Palsy in Children's. *Indian J Pharm Pract*. 2018;11(2):104-9.
17. Roberts A. Surgical management of spasticity. *J Child Orthop*. 2013;7(5):389-94.
18. Park EY, Kim WH. Relationship between the gross motor function classification system and functional outcomes in children with cerebral palsy. *Indian J Sci Technol*. 2015;8(18):75902-7.
19. Shevell MI, Dagenais L, Hall N. The relationship of cerebral palsy subtype and functional motor impairment: a population-based study. *Dev Med Child Neurol*. 2009;51(11):872-7.
20. Abas O, Abdelazeim F, Kilany A. Clinical spectrum of cerebral palsy and associated disability in South Egypt: a local survey study. *Open Access Maced J Med Sci*. 2017;5(1):37-41.
21. Kumar R, Gupta AK, Runu R, Pandey SK, Kumar M. Clinical profile of cerebral palsy: a study from multi-disciplinary clinic at tertiary care centre. *Int J Contemp Pediatr*. 2018;5:1626-30.
22. Reddy B. A study of clinical spectrum and risk factors of cerebral palsy in children. *IOSR J Dent Med Sci*. 2018;17(1):9-52.

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