International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 4, April 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.4. 2025.25

ORIGINAL RESEARCH

Assessment of Impact of Environment on Motor Function and Methods of Mobility in Children with Cerebral Palsy

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Received: 28 February, 2025 Accepted: 23 March, 2025 Published: 03 April, 2025

ABSTRACT

Background: One of the most prevalent developmental disabilities, cerebral palsy (CP), is brought on by a lesion in the central nervous system (CNS) that happens prior to, during, or following birth. The present study was conducted to assess impact of environment on motor function and methods of mobility in children with Cerebral Palsy. **Materials & Methods:** 65 children aged between 4-12 years with Cerebral Palsy of both genders were enrolled. Parameters such as the type of CP, gross motor function, gait speed, and methods of mobility were evaluated at home, community, and school. Gross Motor Function Measurement (GMFM 88-E) was also recorded. **Results:** Out of 65 patients, 35 were boys and 30 were girls. The highest proportion of children (38.5%) was in the 7–9 years age group. Equal numbers of children (30.8%) were in the 4–6 years and 10–12 years categories. GMFM-88 (E) score at home was 78.4 ± 5.2, at community was 27.5 ± 1.7 and at school was 59.2 ± 4.3. The mean gait speed (m/sec) at home was 0.29 ± 0.12, at community was 0.17±0.18 and at school was 0.26 ± 0.11. Types were spastic-hemiplegia in 28, spastic-diplegia in 27 and spastic-quadriplegia in 10 patients. The difference was significant (P< 0.05). At home, community and school level, patients who walked alone were 52, 0 and 4, takes steps with walls/furniture were 11, 5 and 19, walks with walking aid in 2, 9 and 12, takes steps with adult hand were 0, 10 and 14, rolls, creeps, crawls were 0, 5 and 9, carried by adult were 0, 36 and 5, pushed by adult were 0, 0 and 2 respectively. The difference was significant (P< 0.05). **Conclusion:** Home was superior to school in terms of gross motor function, gait speed, and mobility strategies compared to the community. Being carried by an adult in the community and walking alone at home are the most popular modes of mobility. Physiotherapists should focus on physical examinations in various contexts and recognize contextual elements that improve mobility techniques.

Keywords: Central nervous system, Cerebral palsy, Gross motor function measurement

INTRODUCTION

One of the most prevalent developmental disabilities, cerebral palsy (CP), is brought on by a lesion in the central nervous system (CNS) that happens prior to, during, or following birth. It is typified by deficits in motor control that lead to functional restrictions in posture and movement.[1] In children with cerebral palsy, the degree of neuromuscular and musculoskeletal abnormalities varies greatly and varies over the

DOI: 10.69605/ijlbpr_14.4. 2025.25

course of the person's life. Mobility is important because shifts in it may have an impact on people's ability to participate in society generally, including their access to future work, education, and community.[2] Mobility may be impacted by changes in body form and function between middle childhood and early adolescence, as well as contextual aspects of environmental situations.[3]

To raise the standard of living, environmental impediments must be identified. The relationship between CP children's performance and functional ability can be better understood with the use of the person-environment interaction concept.[4] A person's interactions with their surroundings have an impact on how they carry out an activity. The physical, temporal, and social contextual aspects of a child's home, school, and community are likely to have a big influence on how well they move. Contextual elements include things like carpeting and stairs as well as social aspects like peer coping mechanisms and age-appropriate mobility expectations.[5] Few studies have looked at how children with cerebral palsy move differently in different environments. Most standardised assessments were performed in a controlled setting without environmental disturbances. Reducing contextual influences aids in assessing a child's aptitude, but it might not accurately represent how well they do in real-world situations.[6,7]

AIM AND OBJECTIVES

The present study was conducted to assess impact of environment on motor function and methods of mobility in children with Cerebral Palsy.

MATERIALS AND METHODS

Study Design

This study is an observational cross-sectional study aimed at assessing the impact of the environment on motor function and mobility methods in children with Cerebral Palsy (CP). Data were collected at a single time point without intervention.

Study Population

The study was conducted on 65 children diagnosed with Cerebral Palsy (CP) between the ages of 4 and 12 years from both genders. The participants were selected based on predefined inclusion and exclusion criteria.

Study Place

The study was conducted in the Department of Physical Medicine and Rehabilitation (PM & R), Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India in collaboration with Department of Physical Medicine and Rehabilitation (PM & R), Patna Medical College and Hospital, Patna, Bihar, India and special schools catering to children with CP. Data collection also included observations at home, in the community, and at school.

Study Duration

The study was carried out over a period one year and two months from January 20, 2024, to February 19, 2025, ensuring adequate time for participant recruitment, data collection, and analysis.

Inclusion Criteria

Children diagnosed with Cerebral Palsy (CP) were included if they met the following conditions:

1. Age group: Between 4 to 12 years
2. Diagnosis: Clinically confirmed CP (any type)
3. Cognitive ability: Able to follow basic instructions
4. Parental consent: Provided written consent to participate
5. Mobility status: Able to participate in at least one of the assessment tests

Exclusion Criteria

Children were excluded if they had:

1. Severe cognitive impairment preventing participation in assessments
2. Recent orthopaedics surgery or botulinum toxin injections (within the last 6 months)
3. Other neurological or muscular disorders apart from CP
4. Severe visual or hearing impairments affecting participation
5. Lack of parental consent

Ethical Considerations

- Ethical approval was obtained from the Institutional Ethics Committee before the commencement of the study.
- Written informed consent was obtained from the parents or legal guardians of all participating children.
- Participants' privacy and confidentiality were maintained throughout the study.
- The study followed ethical guidelines as per the Declaration of Helsinki for human subject research.

Study Procedure

Each participant underwent assessments at home, in the community, and at school to evaluate their motor function and mobility. The following parameters were assessed:

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1. Classification of CP Type
- Children were classified based on their type of CP (spastic, dyskinetic, ataxic, or mixed) according to standard diagnostic criteria.

2. Gross Motor Function Assessment
- Gross Motor Function Classification System (GMFM-88, Dimension E) was used to assess walking, running, and jumping abilities.
- Scores were recorded based on observed movement performance.

3. Mobility Methods and Walking Ability
- One-Minute Walk Test (1MWT) was performed to evaluate gait speed and endurance.
- A parent checklist was used to gather information on the child's preferred mobility methods (independent walking, walker, wheelchair, or assisted mobility).

4. Environmental Assessment
- The child's mobility was assessed in three different environments:
  - Home: Indoor and outdoor movement capability
  - School: Ability to move in classrooms and playgrounds
  - Community: Accessibility and mobility in outdoor settings (roads, parks, shops)

Surgical Technique

(Not applicable unless the study included a surgical intervention. If the study evaluated children post-surgery, details on surgical interventions would be included.)

Outcome Measures

The primary outcomes assessed were:
1. Gross motor function using GMFM-88
2. Walking speed and endurance using 1MWT
3. Methods of mobility across different environments
4. Effect of environmental factors on functional mobility

Statistical Analysis
- Data were analyzed using SPSS software version 25.0.
- Descriptive statistics (mean, standard deviation) were used for demographic and clinical variables.
- **Inferential statistics**:
  - Paired t-tests or ANOVA were used to compare motor function and gait parameters across different environments.
  - Chi-square test was used for categorical data (e.g., mobility method preference).
  - P-value < 0.05 was considered statistically significant.

RESULTS

The study was included 65 children diagnosed with Cerebral Palsy (CP) between the ages of 4 and 12 years from both genders.

Table 1: Gender wise distribution of patients

Total- 65		
Gender	**Boys**	**Girls**
Number, %	35 (53.85%)	30 (46.15%)

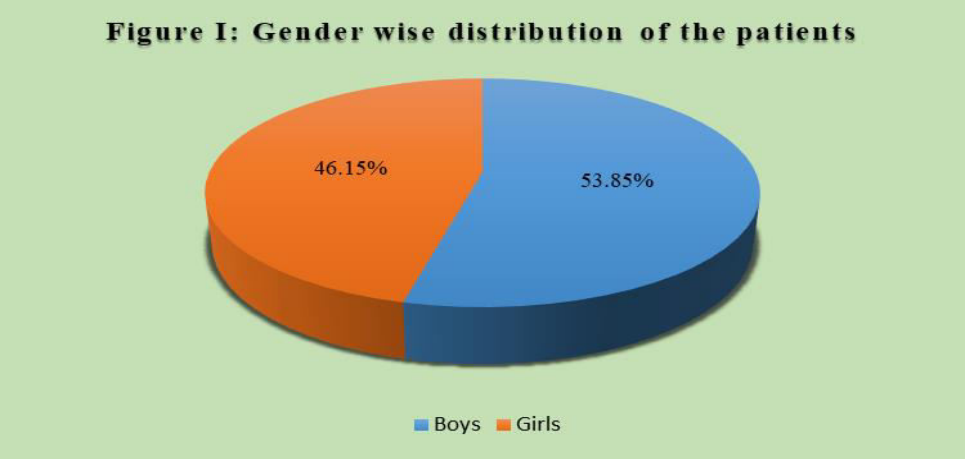

Table 1 and figure I, shows that out of 65 patients, 35 (53.85%) were boys and 30 (46.15%) were girls.

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Table 2: Age wise distribution of the patients

Age Group (Years)	Number of Children (n)	Percentage (%)
4 – 6	20	30.8%
7 – 9	25	38.5%
10 – 12	20	30.8%
Total	**65**	**100%**

Table 2 show the highest proportion of children (38.5%) was in the 7–9 years age group. Equal numbers of children (30.8%) were in the 4–6 years and 10–12 years categories.

Table 3: Anthropometric Measurements

Measurement	Mean ± SD	Minimum	Maximum	p value
Weight (kg)	18.2 ± 4.1	12.3	32.1	0.164
Height (cm)	104.7 ± 12.6	85.2	138.3	0.012
BMI (kg/m²)	16.5 ± 2.3	12.1	22.4	0.225

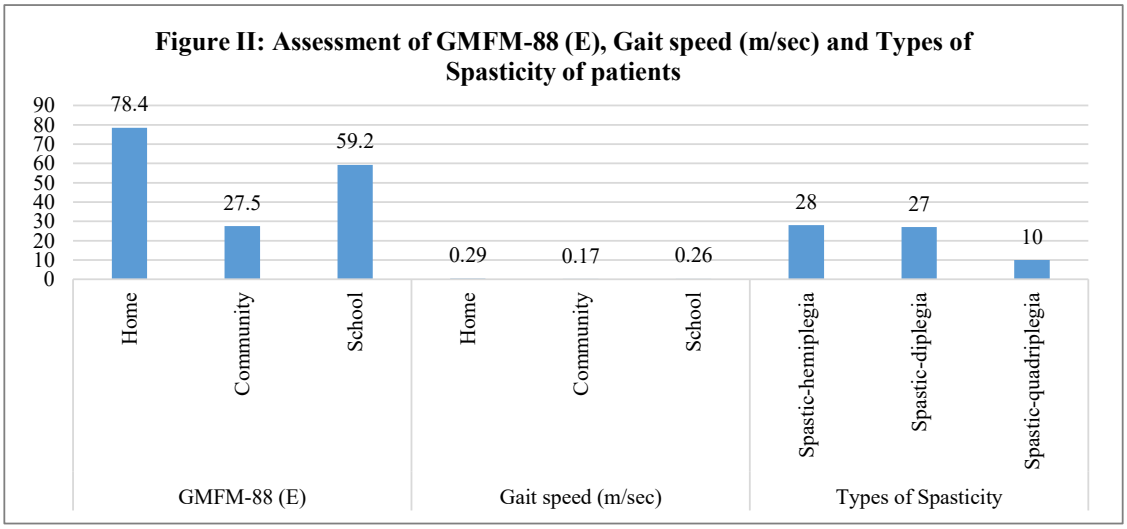
**p-Value <0.05indicate significant*

Table 3 show the mean weight was 18.2 kg, with a range between 12.3 kg and 32.1 kg. The average height was 104.7 cm, showing variations based on the severity of CP and growth restrictions. Height shows a significant difference (p = 0.012), indicating that height varies meaningfully across age groups, which is expected due to growth patterns in children. The mean BMI was 16.5 kg/m², indicating potential malnutrition or underweight tendencies in some children. Weight (p = 0.164) and BMI (p = 0.225) do not show significant differences, suggesting that weight and BMI might not vary significantly between age groups in this CP population.

Table 4: Assessment of parameters

Parameters	Variables	Number	P value
GMFM-88 (E)	Home	78.4±5.2	0.02
	Community	27.5±1.7	
	School	59.2±4.3	
Gait speed (m/sec)	Home	0.29±0.12	0.05
	Community	0.17±0.18	
	School	0.26±0.11	
Types of Spasticity	Spastic-hemiplegia	28	0.05
	Spastic-diplegia	27	
	Spastic-quadriplegia	10	

Figure II: Assessment of GMFM-88 (E), Gait speed (m/sec) and Types of Spasticity of patients



DOI: 10.69605/ijlbpr_14.4. 2025.25

The table 4 and figure II presents data on GMFM-88 (E) scores, gait speed, and types of spasticity, comparing different environments (Home, Community, and School). GMFM-88 (E) refers to the Gross Motor Function Measure, Section E (Walking, Running, and Jumping), used to assess mobility in children with cerebral palsy. GMFM-88 (E) score at home was 78.4±5.2, at community was 27.5±1.7 and at school was 59.2±4.3. Motor function is highest at home, followed by school, and lowest in the community. The mean gait speed (m/sec), walking speed is assessed at home was 0.29±0.12, at community was 0.17±0.18 and at school was 0.26±0.11. Walking speed is highest at home, lowest in the community, and moderate in school. Three types of spasticity are reported in Cerebral Palsy with spastic-hemiplegia in 28, spastic-diplegia in 27 and spastic-quadriplegia in 10 patients. Spastic hemiplegia is the most common type, followed by spastic diplegia, while spastic quadriplegia is the least common. The difference was significant (P< 0.05).

Table 5: Types of mobility

Mobility	Home	Community	School	P value
Walks alone	52	0	4	0.01
Takes steps with walls/furniture	11	5	19	0.05
Walks with walking aid	2	9	12	0.02
Takes steps with adult hand	0	10	14	0.05
Rolls, creeps, crawls	0	5	9	0.05
Regular wheelchair	0	0	0	0
Battery-powered wheelchair	0	0	0	0
Carried by adult	0	36	5	0.01
Pushed by adult	0	0	2	0.06

Table 5 shows that at home, community and school level, patients who walked alone were 52, 0 and 4, takes steps with walls/furniture were 11, 5 and 19, walks with walking aid in 2, 9 and 12, takes steps with adult hand were 0, 10 and 14, rolls, creeps, crawls were 0, 5 and 9, carried by adult were 0, 36 and 5, pushed by adult were 0, 0 and 2 respectively. The difference was significant (P< 0.05).

DISCUSSION

Cerebral palsy (CP) is the most common physical disability in childhood. Deformity, spasticity, weakness, poor balance, and impaired selective motor control combine to affect both the appearance of the child and the child's functional ability.[8,9] Knowledge of the effect of environmental settings on the usual mobility methods of children with CP would provide basic information for further inquiry into specific environmental factors that either facilitate or constrain the mobility of children with CP.[10] The present study was conducted to assess impact of environment on motor function and methods of mobility in children with Cerebral Palsy.

We found that out of 65 patients, 35 were boys and 30 were girls. Chinniah H et al.[11] studied the differences in motor function and gait speed at different environmental settings and find out the usual mobility methods of children with CP in home, school and community settings. The mean age of the study population was 8.34±1.62 years, which included 29 (58%) male children and 21 (42%) female children. Gross motor function and gait speed varied across the environment, and statistically significant differences (p-value=<0.001) were observed in the home, community, and school. Results related to methods of mobility showed that most of the children, 38 (76%), walked alone at home and were carried by adults in the community 30 (60%), while they used all mobility methods in school.

The age distribution in the present study indicates that the majority of children with Cerebral Palsy (CP) (38.5%) were in the 7–9 years age group, while the 4–6 years and 10–12 years age groups each accounted for 30.8% of the study population. This distribution aligns with previous epidemiological studies suggesting that CP diagnosis and assessment of motor function become more pronounced in early childhood, particularly between 4 and 9 years of age where interventions have the most impact (Novak et al., 2017).[12]

Children in the 4–6 years group represent the early intervention phase, during which therapies such as physiotherapy and assistive mobility devices are introduced to optimize functional

DOI: 10.69605/ijlbpr_14.4. 2025.25

independence (Rosenbaum et al., 2014).[13] The 7–9 years group comprises the largest proportion, possibly reflecting increased clinical follow-ups and interventions aimed at addressing evolving motor challenges. By 10–12 years, children often reach a plateau in motor development, and focus shifts toward maintaining function and preventing secondary complications such as contractures and scoliosis (Palisano et al., 2018).[14]

The anthropometric measurements of children with Cerebral Palsy (CP) in this study reveal significant variations, particularly in height, while weight and BMI do not show statistically significant differences across age groups. These findings align with existing literature on growth patterns in children with CP, where stunted growth, lower body weight, and altered BMI are commonly observed due to nutritional challenges and motor impairments (Kuperminc et al., 2018).[15]

The mean weight of 18.2 kg (range: 12.3–32.1 kg) did not show significant differences between age groups ($p = 0.164$), suggesting that weight gain may not follow a uniform trajectory across different ages in children with CP. Studies indicate that weight gain in CP is often influenced by feeding difficulties, energy expenditure, and muscle tone abnormalities, rather than chronological age alone making weight alone an unreliable growth marker (Krick et al., 2017).[16]

The mean height of 104.7 cm (range: 85.2–138.3 cm) was found to be significantly different among age groups ($p = 0.012$). This aligns with research showing that growth restriction is a common concern in CP, influenced by factors such as nutritional intake, hormonal dysregulation, and severity of motor dysfunction and they highlighted that height growth in CP is significantly impacted, with children often falling below standard growth curves (Stevenson et al., 2015).[17] The significant difference in height across age groups suggests that growth patterns vary more predictably with age than weight or BMI in CP-affected children.

The mean BMI of 16.5 kg/m² (range: 12.1–22.4 kg/m²) suggests that a subset of children may be underweight or at risk of malnutrition. However, BMI did not show significant differences across age groups ($p = 0.225$). This may be due to the fact that both weight and height are affected in CP, leading to variable BMI values that do not necessarily correlate with age alone (Day et al., 2019).[18] In CP, BMI interpretation is complex due to differences in body composition, muscle atrophy, and varying levels of physical activity (Bell & Davies, 2010).[19]

We found that GMFM-88 (E) score at home was 78.4±5.2, at community was 27.5±1.7 and at school was 59.2±4.3. The mean gait speed (m/sec) at home was 0.29±0.12, at community was 0.17±0.18 and at school was 0.26±0.11. Types were spastic-hemiplegia in 28, spastic-diplegia in 27 and spastic-quadriplegia in 10 patients. Diwan S et al.[20] on analysis of motor capacity 42.85% children were walking without support, 15.87% were able to crawl & 26.98% were able walk with support in clinical setting. Spearman's Correlation was done between GMFM item 70 with FMS 5 (home setting) to check correlation of capacity with performance & was found to be significantly correlated ($r=0.586$, $p=0.04$). All three GMFM items were correlated with FMS 5, 50, 500 & found positively correlated. For community setting (FMS 500), 52.38% children were lifted by parents & only 6.34% were using wheel chair mobility. A total of 21.87% patients were able to walk with or without support & still lifted by parents in school or community setting.

We found that at home, community and school level, patients who walked alone were 52, 0 and 4, takes steps with walls/furniture were 11, 5 and 19, walks with walking aid in 2, 9 and 12, takes steps with adult hand were 0, 10 and 14, rolls, creeps, crawls were 0, 5 and 9, carried by adult were 0, 36 and 5, pushed by adult were 0, 0 and 2 respectively. Pirpiris M et al.[21] ascertained whether function and wellbeing in children with cerebral palsy are significantly correlated. The Gillette Functional Assessment Questionnaire, Gross Motor Function Classification System, Gross Motor Function Measure, and walking speed are validated measures of function that the authors used to ascertain this. They then correlated these measures with measures of health-related quality of life (HRQOL) (Pediatric Outcomes Data Collection Instrument, Pediatric Quality of Life instrument). When compared to normative data, mild to moderate declines in function were observed in ambulatory children with mild to moderate cerebral palsy who were 10.2 +/- 3.2 years old. The authors chose to identify the part of well-being they were referring to because the evaluation of HRQOL includes both functional and psychosocial well-being. It was found that the child's function was not correlated to psychosocial well-being. The children with mild cerebral palsy had greater

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effects on their psychosocial well-being than would be predicted by their functional disability. Functional measures were good at predicting the functional well-being but were weak at predicting the psychosocial arm of well-being.

LIMITATIONS OF THE STUDY

1. Small sample size (65 children) may limit the generalizability of the findings.
2. Variability in home, school, and community environments could introduce bias.
3. Self-reported mobility data from parents might have subjective biases.
4. Lack of long-term follow-up prevents assessment of changes over time.
5. Differences in accessibility and resources across settings may affect results.

CONCLUSION

Authors found that the majority were in the 7–9 years age group (38.5%), a critical period for intervention. Height showed significant variation ($p = 0.012$), while weight and BMI did not, reflecting growth restrictions common in CP. These findings emphasize the need for individualized nutritional support, physiotherapy, and mobility aids to optimize growth and function. Authors also observed that home was superior to school in terms of gross motor function, gait speed, and mobility strategies compared to the community. Being carried by an adult in the community and walking alone at home are the most popular modes of mobility. Physiotherapists should focus on physical examinations in various contexts and recognize contextual elements that improve mobility techniques. Further research with larger samples and long-term follow-up is essential to enhance clinical management strategies for CP.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who have contributed to the successful completion of this study. First and foremost, we wish to thank the participants of this study, without whose willingness and cooperation this research would not have been possible. Their time, effort, and trust in the process were invaluable. We also extend our heartfelt thanks to Dr. (Prof.) Anil Kumar, Head of Department, Department of Physical Medicine and Rehabilitation, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, and Dr. (Prof.) Arun Kumar, Head of Department, Department of Physical Medicine and Rehabilitation, Patna Medical College and Hospital, Gaya, Bihar, India, for providing the necessary facilities and support to conduct this study. The guidance and encouragement of our faculty and mentors have been pivotal in the execution of this work.

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