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Original Article

Level of Participation in Daily Activities and its Association with Scoliosis among Hemiplegic Cerebral Palsy

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ABSTRACT

Background: Cerebral palsy (CP) encompasses a spectrum of permanent movement disorders that originate in early childhood, leading to lifelong physical disabilities. Hemiplegic CP, the most prevalent subtype, features notable mobility but poses significant challenges in daily function and adaptation to everyday activities.

Objective: This study aims to evaluate the level of daily activity participation and its association with scoliosis in children with hemiplegic CP.

Methods: In this correlational study, data were gathered through non-probability convenient sampling from 110 hemiplegic CP children aged 4-18 years across various private and government hospitals and special education centers. The study excluded children with severe pain, impaired mobility, other neuromuscular diseases, or recent orthopedic surgery. Assessments included the Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), and KIDSCREEN-10 for quality of life. The association of scoliosis with GMFCS and MACS was analyzed using the chi-square test on SPSS-22 software.

Results: The majority (60.9%) of participants were classified as GMFCS level II, while 46.4% ranked at MACS level I. There was a significant association between GMFCS levels and scoliosis presence ($p < 0.05$), but no significant relationship between MACS levels and scoliosis ($p > 0.05$). Scoliotic children exhibited poorer health outcomes, with 52% reporting poor health status.

Conclusion: While most children with hemiplegic CP were capable of handling objects, they faced limitations in mobility affecting their daily activities. Scoliosis was relatively uncommon but significantly associated with reduced gross motor function.

Keywords: Cerebral Palsy, Daily Activities, Hemiplegia, Quality of Life, Scoliosis.

INTRODUCTION

Cerebral palsy (CP) is a broad term used to describe a group of permanent movement disorders that arise from non-progressive disturbances in the developing fetal or infant brain. These disturbances often result in impairments in movement and posture, which limit activity, but they can also cause disturbances in sensation, cognition, communication, and behavior (1). CP, the most common cause of severe physical disability in childhood, varies widely in its etiology, motor function, and severity, affecting about 2 to 2.5 children per 1000 live births globally (2). Hemiplegic cerebral palsy, a subtype of CP, results from damage to one hemisphere of the brain, leading to paralysis on the opposite side of the body. This condition can stem from various developmental disorders, including infections, cerebral malformations, and perinatal infarctions (3, 4).

The impact of hemiplegic CP is profound, manifesting in an asymmetric gait and motor control deficits, as well as compensatory mechanisms in the uninvolved side. Clinically, this form of CP is characterized by neurological and musculoskeletal complications such as spasticity, decreased strength, and coordination issues, which contribute to severe activity limitations and participation restrictions. The severity of these impairments is often measured using scales like the Gross Motor Function Classification System (GMFCS) and the Manual Ability Classification System (MACS), which categorize the extent of disability from mild, where individuals can perform tasks independently, to severe, where they require extensive assistance (5).

Health-related quality of life (HRQOL) is a crucial measure in assessing the well-being of children with CP, integrating behavioral, emotional, social, and psychological dimensions. HRQOL is typically evaluated using instruments such as the KIDSCREEN, the 36-

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Item Short Form Health Survey (SF-36), the Duke Health Profile, and the World Health Organization Quality of Life Scale (WHOQOL-BREF) (6). These tools help quantify the broader impacts of CP beyond physical limitations.

One significant musculoskeletal complication in CP is scoliosis, a sideway curvature of the spine defined by a Cobb's angle greater than 10 degrees, which involves rotations in all three planes of view. The progression of scoliosis in CP is multifactorial and strongly linked to the levels of gross motor and manual abilities as classified by GMFCS and MACS. Studies have confirmed that higher levels on these scales correlate with an increased risk of scoliosis progression (8).

Despite extensive research on motor and manual abilities in CP, there is a gap in the literature regarding the comprehensive evaluation of day-to-day participation among children with hemiplegic CP and associated postural issues like scoliosis. Most existing studies have either focused on the impact of scoliosis on daily activity limitations, the effects of CP on day-to-day activities, or the association between scoliosis and CP without integrating these aspects.

The primary objective of this research is to assess the level of participation in daily activities and its association with scoliosis among children with hemiplegic CP. By analyzing how the combined impact of hemiplegic CP and scoliosis affects daily life activities, this study aims to contribute additional evidence regarding the walking capabilities, manual abilities, and overall well-being of this population. This investigation is critical for developing targeted interventions that could significantly improve the quality of life for children suffering from this complex condition.

METHODS

This correlational study was conducted from July 2021 to August 2022 across several sites within the twin cities of Rawalpindi and Islamabad, including Sedum Rehabilitation Center for Special Children, Fauji Foundation Hospital, Child Development Center, Al-Farabi Institute, and the National Institute of Rehabilitation and Medicines. Following the ethical approval from the Riphah International University, Islamabad, the study recruited children aged 4-18 years diagnosed with hemiplegic cerebral palsy. A non-probability convenient sampling technique was employed to select participants who did not have any other neuromuscular disease, blindness, hearing loss, severe walking impairments, pain, or a history of orthopedic surgery within the previous 12 months.

Prior to data collection, written informed consent was obtained from all participants, and permissions were granted by the heads of the respective institutions. Participants, or their caregivers, filled out a self-constructed demographic information sheet detailing gender, age, and BMI. The research team collected additional data using several diagnostic and assessment tools. The Adams forward bend test was administered to evaluate scoliosis, with its sensitivity reported at 71.1% and specificity at 97.1%, although it does have a false negativity rate of 28.9% (10). Observations of head, shoulders, and hip asymmetries were conducted, and palpation of spinous processes identified any spinal deviations. These deviations were classified according to their spinal regions, including cervical, thoracic, thoracolumbar, and lumbar curves (9).

The Gross Motor Function Classification System (GMFCS), which has a reliability of 0.97 (11), was utilized to categorize motor functions. This scale ranges from Level 1, where children can walk in all settings and climb stairs without assistance, to Level 5, where children require manual assistance in all settings. The Manual Ability Classification System (MACS), also with a reliability of 0.97 (12), was employed to assess hand movements, grading muscle tone from Grade 0 (no increased tone) to Grade 4 (no passive movements possible).

For assessing health-related quality of life (HRQOL), the KIDSCREEN-10 questionnaire was administered. This scale, which includes ten questions responded to on a Likert scale, is validated with a Cronbach alpha of 0.82, enabling the capture of various aspects of a child's behavioral quality and attitudes towards health (13).

Data analysis was conducted using IBM SPSS-22 software, where descriptive statistics such as mean, standard deviation, frequencies, and percentages were calculated. The chi-square test was applied to determine the association between scoliosis and both manual abilities and gross motor function. This approach allowed for a comprehensive assessment of how motor and manual impairments, along with scoliosis, influence the daily lives and well-being of children with hemiplegic cerebral palsy.

RESULTS

The study investigated 110 children diagnosed with hemiplegic cerebral palsy, presenting a mean age of 9.72 years with a standard deviation of 4.10 years. The cohort was stratified into three age groups: 45.5% were between 4-8 years, 35.5% from 9-13 years, and 19.1% were adolescents aged 14-18 years. Males constituted 59.1% of the sample, while females represented 40.9%. Nutritional assessments revealed that 65.5% of the children were underweight, 26.4% had a normal weight, 4.5% were overweight, and 3.6% were classified as obese. Hemiplegia affected the right side in 56.4% of cases, with the remaining 43.6% suffering from left-side hemiplegia.

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Observational assessments indicated that 68.2% of the children had symmetrical head alignment, whereas 31.8% displayed head asymmetry. Similarly, shoulder symmetry was noted in 57.3% of participants, with 42.7% showing asymmetry. Hip assessments showed that 63.6% of the children had symmetrical hips, and 36.4% had asymmetrical hips. Using the Adams forward bend test, 22.7% tested positive for scoliosis, while 77.3% tested negative. Scoliometer assessments further detailed that 77.3% exhibited no scoliosis (readings less than 10 degrees), 21.8% had mild scoliosis (readings between 10-20 degrees), and only 0.9% showed moderate scoliosis (readings between 21-30 degrees).

The distribution of spinal deviations among those with scoliosis varied, with the majority (77.3%) showing no deviation, indicative of the absence of scoliosis. Among those with deviations, 0.9% presented with a cervical curve, 12.7% with a thoracic curve, 6.4% with a thoracolumbar curve, and 2.7% with a lumbar curve. Spasticity, as measured by the Modified Ashworth Scale (MAS), was categorized as follows: 19.1% were grade 0, 35.5% grade 1, 32.7% grade 1+, 4.5% grade 2, and 7.3% between grades 3 and 4.

In terms of gross motor function, as classified by the Gross Motor Function Classification System (GMFCS), the majority (60.9%) were at level II, indicating moderate limitations in motor function, followed by 14.5% at level III. Health-related quality of life, measured by the KIDSCREEN-10 scale, showed that 42.7% of the children had low scores, suggesting poorer health-related quality of life, while 57.3% had higher scores, indicative of better health-related outcomes. When comparing children with and without scoliosis, those without scoliosis generally reported better health outcomes, with 35.3% rated as having very good health and only 2.4% as having poor health, in contrast to those with scoliosis, where only 12% rated as having very good health and 4% as poor.

The chi-square test revealed no significant association between the level of scoliosis and manual abilities as classified by MACS, with a p-value greater than 0.05. This finding suggests that the presence of scoliosis does not significantly affect manual abilities among children with hemiplegic cerebral palsy.

Table 1: Table shows frequency and percentage of in different levels for motor function on GMFCS among hemiplegic CP children

GMFCS LEVELS	n (%)
I	10 (9.1%)
II	67 (60.9%)
III	16 (14.5%)
IV	4 (3.6%)
V	13 (11.8%)

Table 2: Table shows distribution between levels of manual ability (MACS) among hemiplegic CP children

MACS LEVELS	n (%)
I	51 (46.4%)
II	36 (32.7%)
III	19 (17.3%)
IV	2 (1.8%)
V	2 (1.8%)

Table 3: Table shows frequency distribution of individual items of Kidscreen 10

	never n (%)	Seldom n (%)	quite often n (%)	very often n (%)	Always n (%)
1.Has your child fit and well	8 (7.3%)	54 (49.1%)	40 (36.4%)	8 (7.3%)	0 (0%)
2.Has your child felt full of energy	16 (14.5%)	58 (52.7%)	25 (22.7%)	10 (9.1%)	1 (0.9%)
3.Has your child felt sad	70 (63.6%)	28 (25.5%)	8 (7.3%)	4 (3.6%)	0 (0%)
4.Has your child felt lonely	73 (66.4%)	26 (23.6%)	8 (7.3%)	3 (2.7%)	0 (0%)
5.Has your child had enough time for him/herself	17 (15.5%)	43 (39.1%)	36 (32.7%)	11 (10%)	3 (2.7%)
6. Has your child been able to do the	26 (23.6%)	40 (36.4%)	33 (30%)	8 (7.3%)	3 (2.7%)

	never n (%)	Seldom n (%)	quite often n (%)	very often n (%)	Always n (%)
things that he/she wants to do in his/her free time?					
7. Has your child felt that his/her parent(s) treated him/her fairly?	32 (29.1%)	46 (41.8%)	17 (15.5%)	13 (11.8%)	2 (1.8%)
8.Has your child had fun with his/her friends	38 (34.5%)	42 (38.2%)	20 (18.2%)	10 (9.1%)	0(0%)
9.Has your child got on well at school	23 (20.9%)	25 (22.7%)	33 (30%)	27 (24.4%)	2 (1.8%)
10.Has your child been able to pay attention	12 (10.9%)	32 (29.1%)	27 (24.5%)	35 (31.8%)	4 (3.6%)

Table 4: Association of scoliosis with manual ability

	Scoliometer Reading			
MACS	No Scoliosis	Mild Scoliosis	Moderate Scoliosis	P value
I	44	7	0	0.104
II	27	8	1	
III	13	6	0	
IV	0	2	0	
V	1	1	0	

However, gross motor function (GMFCS) had significant association with scoliosis with p value < 0.05. (Table 5)

Table 5: Association of scoliosis with gross motor function

	Scoliometer Reading			
GMFCS	No Scoliosis	Mild Scoliosis	Moderate Scoliosis	P value
I	10	0	0	0.000*
II	60	6	1	
III	12	4	0	
IV	0	4	0	
V	3	10	0	

DISCUSSION

The primary focus of the current research was to evaluate the level of participation in daily activities among children with hemiplegic cerebral palsy and its relationship with scoliosis, employing the Adams Forward Bend Test and Scoliometer readings alongside the GMFCS, MACS, and KIDSCREEN-10. This approach aligns with previous studies that have explored various aspects of functionality in hemiplegic cerebral palsy but offers a distinctive focus on the intersection of scoliosis with daily activity participation.

The sample size of this study was 110 children with hemiplegic CP, a slight increase compared to the 98 participants in a similar 2021 study which examined functional statuses using GMFCS, CFCS, and MACS within a narrower age range and found that a significant number of children exhibited moderate to severe motor impairments (14). This earlier study reported lower proportions in the higher functional levels compared to the current study, where a notable number of children were classified in level I and II on the MACS and level II on the GMFCS. These findings suggest a variation in functional impairments across different cohorts, which may be influenced by demographic variables or methodological differences in the studies.

A 2018 study by Kate L Willoughby et al. highlighted the prevalence of scoliosis in children with CP during skeletal development and identified significant associations with GMFCS levels and motor issues (8). In comparison, the present study observed a lower prevalence of scoliosis (22.7%) but similarly found a correlation with GMFCS levels, particularly noting that children at higher GMFCS

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levels were more susceptible to developing scoliosis. This correlation underscores the importance of monitoring spine health in children with greater motor function impairments.

The findings regarding the health-related quality of life, as assessed by the KIDSCREEN-10, revealed variability in perceived quality of life among the participants. In contrast, a 2022 study by Mc Ferreira et al., using the PedsQL scales, found that fatigue and psychosocial factors heavily influenced the health-related quality of life in young individuals with CP (16). The current study extended these insights by examining how health perceptions are also influenced by motor and manual abilities, and how these perceptions vary between individuals with and without scoliosis (17,18).

This study's strength lies in its comprehensive assessment tools and broad age range, allowing for a detailed analysis of how hemiplegic CP affects children's daily life activities. However, the research is not without limitations. The exclusion of the adult population and the focus solely on the twin cities of Rawalpindi and Islamabad may limit the generalizability of the findings. Additionally, the use of non-radiographic methods to assess scoliosis might have impacted the precision of the scoliosis evaluations (19,20).

Future studies should consider a more diverse demographic and include advanced diagnostic techniques such as radiographic examinations to better understand the degree of spinal rotation. Expanding the geographical scope and including a longitudinal component could also provide deeper insights into the progression of scoliosis and its long-term effects on daily participation and quality of life in this population.

CONCLUSION

Our study demonstrated that the majority of children with hemiplegic cerebral palsy could walk in most settings with some limitations and handle objects effectively. Scoliosis was observed in a smaller segment of these children, with a significant correlation identified between the presence of scoliosis and impaired gross motor function. Quality of life assessments indicated that children without scoliosis generally experienced better health outcomes compared to their scoliotic peers, who often reported only fair health. These findings underscore the need for targeted interventions focused on improving motor function and monitoring for spinal abnormalities early in life, which could potentially enhance the overall quality of life and daily activity participation in this vulnerable population.

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