ORIGINAL ARTICLE

Correlation of Postural Asymmetries with Gross Motor Functional Classification among Cerebral Palsy Children

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ABSTRACT

Background: Motor control and posture disorders are responsible in the development of cerebral palsy (CP). Spastic CP, the most common type of CP is associated with postural asymmetries resulting in functional limitation among children and compromising their quality of life. Therefore, the study aimed to describe the severity of postural asymmetries among special school going children with spastic cerebral palsy in correlation with Gross Motor Function Classification System levels (GMFCS).

Methods: Thirty-four subjects from Lahore who were special school going children diagnosed with spastic CP for more than 6 months and less than 1 year were recruited. Children with uncontrolled seizures, hearing and visual impairment, surgery scheduled and other types of cerebral palsy were excluded. The scale used for the assessment of postural asymmetries was Posture and Postural Ability Scale with the reliability of 0.99. ANOVA test was applied with $p < 0.05$ considered as statistically significant.

Results: Severe asymmetries were found in standing position with 5.9% ($n=2$) in frontal and 20.6% ($n=7$) in sagittal plane. There were mild asymmetries in supine position, 55.9% ($n=19$) in frontal and 50% ($n=17$) in sagittal plane. In prone position, reported asymmetries were 55.9% ($n=19$) in frontal and 44.1% ($n=15$) in sagittal plane. In sitting position 76.5% ($n=26$) accounted for both frontal and sagittal plane asymmetries. $p < 0.05$ showed significant distribution of postural asymmetries.

Conclusion: Severe postural asymmetries were found in standing position ($p < 0.05$). However, high frequency of pain, scoliosis and hip dislocation were observed at level III of GMFCS among special school going children diagnosed with spastic cerebral palsy.

Keywords: Cerebral Palsy; Children; Spastic; Muscle Spasticity.

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INTRODUCTION

Cerebral palsy (CP) is the leading cause of physical dysfunctions originating in prenatal, perinatal and early infant years of life. It is a permanent and non-progressive disorder affecting motor development and postural control¹. In cerebral palsy, the brain lesion is non-progressive in nature but it results in secondary problems affecting multiple systems of the body². Its approximated incidence is two per 1000 live births³. Whereas, as gestational age

increases its incidence decreases⁴. With increasing age, development of abnormal body postural patterns (PPs) is the hallmark in these children⁵. In CP, there are brain injuries at different levels resulting in developmental delay of motor skills, which leads to poor balance, postural asymmetries and postural control as the child ages⁶⁻⁸.

Cerebral Palsy children exhibit dysfunctions like compromised ability to balance reactions, spasticity, muscular weakness and muscle length imbal-

ance⁹. The postural asymmetries are including both motor and sensory dysfunction leads to severe disabilities¹⁰. The extent of postural impairments depends on the location and severity of brain damage¹¹. Spastic cerebral palsy children present with inability in coordinating and activating postural muscles leading to difficulty with activities of daily living (ADLs) and instrumental activities of daily living (IADLs)¹². At Gross Motor Function Classification System (GMFCS) level I, these children show more motor skills as compared to those at GMFCS level II¹³. The greater the GMFCS level more the severity in the symptoms occurs¹⁴.

The rationale of the current study was to assess postural asymmetries in spastic cerebral palsy children at GMFC (I, II and III) going to special schools. This study will also educate the medical education department, special education teachers, parents and community on development of Individualized educational plans that focuses on the physical aspects of CP children thus implementing remedial strategies at community driven special schools. Therefore, study aimed to describe the severity of postural asymmetries among special school going children with spastic cerebral palsy in correlation with Gross Motor Function Classification System (GMFCS) level.

METHODS

It was a descriptive cross-sectional study, n=34 subjects from three special education centers of Lahore were recruited. The sampling technique utilized was non-probability convenience sampling. The duration of study was from June 2018 to January 2019. The study was approved from the ethical board of Lahore College of Physical Therapy (ERC-LCPT/ 458-3029).

The inclusion criteria included children diagnosed with spastic CP, aged between six and twelve years, and both male and female subjects. Subjects those who were attending special schools for less than 1 year and more than 6 months along with Gross Motor Functional Classification System (GMFCS) level I, II and III were included in the study. GMFCS is known to classify CP children on functional basis and determines the levels of children according to their abilities and limitations in performing gross motor function activities. Level I, II and III indicates the ability of children to walk independently, with limitations and with assistive mobility devices respectively.

Written informed consent from the child's legal guardian was taken before data collection. Children with uncontrolled seizures, hearing and visual impairment, surgery scheduled in near future that can impair their sitting ability, and those were

presenting with any other type of cerebral palsy were excluded from the study.

Posture and Postural Ability Scale (PPAS) evaluated postural asymmetries. PPAS is a 7-point ordinal scale used for assessing postural ability in supine and prone, standing and sitting positions. It assesses 6 items related to quality of posture in frontal and another 6 in sagittal plane. One point for each item is given for postural symmetry and alignment whereas no point i.e. 0 is given for each deviation from midline. The total score of 0–6 points is calculated separately for each position in the frontal and sagittal plane. Postural asymmetry according to the Postural Ability Scale was categorized into mild, moderate and severe asymmetries with scoring of 5–4 points, 3–2 points and 1–0 points respectively. However, 6 points were given to full symmetry and its reliability was 0.99. Data was analyzed by using SPSS version 21. Descriptive statistics were reported and variables were presented in the form of tables and graphs. Frequency percentages were calculated and postural asymmetries in different positions within spastic CP children in relation with GMFCS was assessed through repetitive measure ANOVA.

An informal session among special education teachers and parents after assessment of postural asymmetries was arranged. The staff and parents were educated regarding improvement of ergonomic comprising of classroom furniture, proper posture guidance, proper use of assistive devices, and development of Individualized Educational Plans (IEPs).

RESULTS

In a sample of 34 children with spastic cerebral palsy, 58.8% (n=20) were males and 41.2% (n=14) were females with a mean age of 9.235 and standard deviation (SD) of 1.967. Percentage of children with different CP subtypes and Gross Motor Function Classification System GMFCS levels are presented in the form of bar graph in Figure 1.

Figure 1: Gross Motor Function Classification System (GMFCS) level and subtypes of cerebral palsy.

Quality of posture assessed in various positions (supine, prone, sitting and standing position) for asymmetries (severe, moderate, mild asymmetry

and full symmetry) in frontal and sagittal plane is presented in Table 1.

Table 1: Quality of Posture with respect to asymmetry levels.

Asymmetry Levels	Quality of Posture							
	Supine		Prone		Sitting		Standing	
	Frontal Plane n(%)	Sagittal Plane n(%)	Frontal Plane n(%)	Sagittal Plane n(%)	Frontal Plane n(%)	Sagittal Plane n(%)	Frontal Plane n(%)	Sagittal Plane n(%)
Moderate Asymmetry	1 (2.9%)	8 (23.5%)	1 (2.9%)	5 (14.7%)	4 (11.8%)	4 (11.8%)	11 (32.4%)	11 (32.4%)
Mild Asymmetry	19 (55.9%)	17 (50%)	19 (55.9%)	15 (44.1%)	26 (76.5%)	26 (76.5%)	18 (52.9%)	13 (38.2%)
Full symmetry	14 (41.2%)	9 (26.5%)	14 (41.2%)	14 (41.2%)	4 (11.8%)	4 (11.8%)	3 (8.8%)	3 (8.8%)
Severe Asymmetry							2 (5.9%)	7 (20.6%)

Out of 34 children with spastic cerebral palsy, in supine position (n=0) had severe asymmetry, 2.9% (n=1) had moderate asymmetry, 55.9% (n=19) had mild asymmetry and 41.2% (n=14) had full symmetry in frontal plane. Whereas, (n=0) had severe asymmetry, 23.5% (n=8) had moderate asymmetry, 50.0% (n=17) had mild asymmetry and 26.5% (n=9) had full symmetry in sagittal plane in supine position. In prone position (n=0) had severe asymmetry, 2.9% (n=1) had moderate asymmetry, 55.9% (n=19) had mild asymmetry and 41.2% (n=14) had full symmetry in frontal plane. While, (n=0) had severe asymmetry, 14.7% (n=5) had moderate asymmetry, 44.1% (n=15) had mild asymmetry and 41.2% (n=14) had full symmetry in sagittal plane in prone position. In sitting position (n=0) had severe asymmetry, 11.8% (n=4) had moderate asymmetry, 76.5% (n=26) had mild asymmetry and 11.8% (n=4) had full symmetry in frontal plane. However, (n=0) had severe asymmetry, 11.8% (n=4) had moderate asymmetry, 76.5% (n=26) had mild asymmetry and 11.8% (n=4) had full symmetry in

sagittal plane in sitting position. In standing position 5.9% (n=2) had severe asymmetry, 32.4% (n=11) had moderate asymmetry, 52.9% (n=18) had mild asymmetry and 8.8% (n=3) had full symmetry in frontal plane. Whereas, 20.6% (n=7) had severe asymmetry, 32.4% (n=11) had moderate asymmetry, 38.2% (n=13) had mild asymmetry and 8.8% (n=3) had full symmetry in sagittal plane in standing position.

Postural Asymmetries according to Gross Motor Classification System I-III and frequency distribution of pain, hip dislocation and scoliosis is shown in Table 2. Repeated measure ANOVA showed that the p-value was statistically significant ($p < 0.05$) for distribution of postural asymmetries in different positions (supine, prone, sitting and standing) and for pain, hip dislocation and scoliosis at Gross Motor Function Classification System (GMFCS) level I-III. Whereas, in supine and sitting position (leg separated) and in standing (legs straight relative to pelvis) $p > 0.05$.

Table 2: Postural asymmetries according to Gross Motor Function Classification System (GMFCS), Level I-III.

Positions	Items	GMFCS I n = 12	GMFCS II n = 17	GMFCS III n = 5	p-Value	Total n = 34
Supine	Head midline	3	7	1	0.01	11
	Trunk symmetry	2	3	1	0.04	6
	Legs straight related to pelvis	4	2	2	0.03	8
	Legs separated	3	2	1	0.07	6
	Arms resting by side	6	3	2	0.02	11
	Weight evenly distributed	5	4	3	0.05	12
Sitting	Head midline	7	3	1	0.00	11
	Trunk symmetry	2	6	1	0.04	9
	Legs straight related to pelvis	5	4	2	0.01	11
	Legs separated	8	8	1	0.06	17
	Arms resting by side	5	2	1	0.02	8
	Weight evenly distributed	3	3	1	0.01	7

Standing	Head midline	4	5	2	0.04	11
	Trunk symmetry	5	2	2	0.002	9
	Legs straight related to pelvis	3	3	2	0.06	8
	Legs separated	2	5	1	0.03	8
	Arms resting by side	6	5	2	0.001	13
	Weight evenly distributed	2	4	1	0.002	7
Characteristics	Pain	10	11	4	0.001	25
	Hip dislocation	1	3	3	0.000	7
	Scoliosis	1	2	4	0.02	7

DISCUSSION

The current study focused to assess the correlation of postural asymmetries with Gross Motor Function Classification System (GMFCS) level I to III among special school going children with spastic cerebral palsy. The study was the first of its kind to be conducted in Pakistan. The results showed that in standing position severe postural asymmetries were present as compared to supine, prone and sitting position. Previous literature has identified that spastic children between GMFCS level I-III exhibit pronounced difficulty while maintaining standing positions in contrast to sitting and lying supine. However, the occurrence of pain, dislocation of hip and development of scoliosis increases with increasing levels of GMFCS.

Due to the presence of impairments in extremities and lack of trunk control, CP children cannot produce enough force to sustain postural control in antigravity position, consequently develop postural asymmetries¹⁵. There is increase incidence of pain, difficulty in seating and limited functional activities as postural asymmetries increases¹⁶. Faulty postural symmetry is correlated with the occurrence of different musculoskeletal problems like developmental dysplasia of hip, reduced range of motion, spasticity, and asymmetry in chest, which severely reduced the ability to perform daily routine activities¹⁷.

CP individual exhibit limited motor activities are prone to develop structural deformities like scoliosis¹⁸. The possibility of scoliosis development is associated with age and gross motor level of these children¹⁹. The incidence of scoliosis at early age is 1% with GMFCS level I whereas it increases to 30 % at GMFCS level V²⁰. Therefore, as the child grows in age these postural asymmetries and structural deformities leads to pain, difficulty in performing motor skill, and impaired quality of life²¹. Postural asymmetries and deformities develop more frequently in non-ambulant children due to their lack of ability to alter position as they spend extended time in sitting or lying²². Dysplasia of hip and asymmetrical range of motion of hip abduction was correlated increase level of GMFCS^{23,24}.

These atypical postures because of gravity lead to the development of progressive deformities in non-ambulatory CP children²⁶. The literature also supported that a good control of posture is required for performing motor functions; whereas lack of posture control and weakness of muscles leads to the development of atypical posture in CP children²⁷. In 2015, Rodby-Bousquet et al. concluded that Posture and Posture Ability Scale (PPAS) had shown excellent reliability value; construct validity and statistics of reliability. PPAS can detect asymmetries in posture, which allow early identification of problems and provide appropriate information regarding postural support solution²⁸. The current study also assessed the postural asymmetries among special school going children with spastic cerebral palsy through PPAS, as it is a well-structured questionnaire and allow the detection of postural asymmetries in different positions.

Rodby-Bousquet et al. further conducted a survey as well to determine the association between Cerebral Palsy (CP) and postural asymmetries. They observed that at every level of the classification system of gross motor function asymmetries in posture were present in adolescents with CP, but postural asymmetries differ in different positions. Usually, control that is more postural is needed in standing position and adults with cerebral palsy at GMFCS level one to three exhibit more mal-alignment in standing position in contrast to other positions. On the contrary, at level V of GMFCS more asymmetries in posture were present in sitting and supine position in contrast to supported standing, showing absence of postural support while sitting and lying⁶. The result of the present study is consistent with this as more postural asymmetries were presented in standing position compared to other position in spastic CP children at GMFCS level I-III; severe asymmetries were present 5.9% in frontal plane and 20.6% in sagittal plane in standing position.

Ágústsson et al. conducted a survey in 2017 on cerebral palsy adults at GMFCS level I-V to find the association between lying position, duration of lying and immobility with windswept hip deformity and

scoliosis. They suggested that CP adults spend more time in a lying position due to windswept hip deformity and scoliosis. They concluded that in immobile cerebral palsy, adults preferred habitual posture leads to the development of postural asymmetries, which indicate that there is a need of early rehabilitation of posture control¹⁸.

The incidence of scoliosis at an early age is 1% at level I of GMFCS whereas it increases to 30% at level V of GMFCS. Regarding the musculoskeletal impairments, the extent of postural impairments in patients of cerebral palsy depends according to the location and severity of brain damage²⁹. The commonest dislocation in CP children is the occurrence of displacement of hip and it is correlated with the severity of motor dysfunction. Dysplasia of hip and unsymmetrical range of motion of hip abduction in CP children was correlated with pelvic obliquity than with the scoliosis³⁰. Therefore, an early rehabilitative treatment plan is necessary to prevent postural deformities and improve functional abilities.

Generalizability of the study could be questioned consequently; future studies should include more special school going children with postural asymmetries and correlating with all levels GMFCS. It is recommended to educate medical education departments, special education teachers, parents and community on development of Individualized educational plans (IEPs) and implementing awareness seminars regarding implementing remedial strategies at community driven special schools.

CONCLUSION

Severe postural asymmetries were found in standing position, mild postural asymmetries in supine, prone and sitting position. However, frequency of pain, development of scoliosis and dislocation of hip was more at GMFCS level III compared to I and II among special school going children with spastic cerebral palsy.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL

The study was approved from the ethical board of Lahore College of Physical Therapy (ERC-LCPT/458-3029).

PATIENT CONSENT

Written informed consent from the child's legal guardian was taken before the data collection procedure.

AUTHORS' CONTRIBUTION

SF designed the study, collected and assembled the data. SF, AS and SS conducted analysis and interpretation. SF performed the drafting of the article, AS and SS. HMA critically reviewed the article for important content and approved the final manuscript.

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