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Original Article

Upper Extremity Motor Performance among Spastic Quadriplegic Cerebral Palsy Patients with and without Head Control

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ABSTRACT

Background: Cerebral Palsy refers to chronic abnormalities of movement and posture resulting from non-progressive disruptions in the developing fetus or immature brain. A key component of overcoming activity restriction is head control, which is essential for locomotor abilities and motor activities including grasping and sitting.

Objective: To determine upper extremity motor performance among spastic quadriplegic cerebral palsy patients, with and without head control.

Methods: A comparative cross-sectional study with 35 participants was conducted to investigate the interplay between head control and upper extremity function in children with spastic quadriplegic cerebral palsy. Two groups were formed based on the presence or absence of head control. Inclusion criteria comprised of both genders aged 1.09-10.02 with spastic quadriplegic CP, excluding those with contractures, botulin toxin injections, orthopedic surgery, or serious medical problem/seizures. Data entry and descriptive statistical analysis were conducted using Statistical Package for Social Sciences (SPSS) version 26.

Results: There was a statistically significant difference between the groups, one including participants with control and other without it as the P value is <0.017. The group A, with head control, showed higher values of QUEST; therefore, showed significant correspondence.

Conclusion: The study found a significant positive relationship between head control and upper extremity function in children with spastic quadriplegic cerebral palsy.

Keywords: Cerebral Palsy, Spastic Quadriplegic CP, Head Control, Upper extremity Function, QUEST.

INTRODUCTION

Cerebral palsy (CP) is one of the most frequent causes of motor disability in children (1). CP describes a group of permanent disorders of movement and posture, causing activity limitation, which is attributed to non-progressive disturbances that occur in the developing fetal or immature brain (2). Alongside motor challenges, CP commonly presents medical comorbidities such as cognitive, sensory, communicative, and intellectual impairments, speech disturbances, epilepsy, and dental and nutritional issues (3). It is characterized by a range of abnormalities, including muscle tone irregularities, movement challenges, and impaired motor skills, and its root cause can be traced back to injuries sustained during brain development. Furthermore, it is an eminent cause of motor disability in children and adolescents and is often accompanied by disturbances in cognition, perception, sensation, communication, behavior, and/or a seizure disorder (4). With an estimated frequency of 2-3 instances per 1,000 live births, epidemiological data show that CP is not a rare disorder. This data also show notable variations in prevalence rates, particularly in underdeveloped nations, where the prevalence rate is typically between 1 and 6 cases per 1,000 live births, or roughly 2.5 cases per 1,000 live births (5). According to estimates, 17 million people worldwide struggle with the difficulties caused by CP, with rates of 2.2 and 1.7 per 1,000 live births for boys and girls, respectively (6). Cerebral palsy etiology is in fact a complicated and multidimensional problem. An array of risk factors that contribute to the development of CP are placental abruption, birth hypoxia, and neonatal health issues (7). Preterm birth, early membrane rupture, gestational hypertension, and emergency cesarean sections are additional risk factors (8). Cerebral Palsy (CP) is diverse, classified by motor type, topography, and motor severity. Motor types include spastic (85%), dyskinetic (7%), and ataxic (4%). Topography focuses on spastic CP, dividing it into unilateral (40%-60%) and bilateral forms, further subcategorized as diplegia (10%-36%) and quadriplegia (24%-31%). Spastic CP is the most common (70%-80%). Spastic quadriplegic CP is the most severe form, it includes spasticity and stiffness that affects all four limbs and often corresponds to GMFCS level V, indicating limited motor control. The GMFCS, assessing motor function from level I (most functional) to V (least functional), aids in evaluating motor severity, with level V indicating profound limitations (9). GMFCS is the primary tool for this purpose (10). While motor type and topography classifications can vary, GMFCS remains a reliable measure (11). Spastic CP is the most common type of overall CP, comprising up 70% to 80% of cases (12). Head control, which begins developing in the first four months of life, is a crucial prerequisite for the acquisition of locomotor skills and motor abilities like grasping, sitting, and reaching (13). It plays a fundamental role in stimulating visual and vestibular receptors with sudden head movements, contributing to motor and postural control during various activities. Additionally, head movement is essential for visual task performance (14). Also, Trunk control plays a significant role in motor development when a typically developing (TD) infant starts to move against the gravity during their first 12 months of life but is commonly delayed in infants and young children with movement disorders (15). And adequate support at the trunk facilitate better sitting posture, movement quality and hand function in young children with movement disorders(16). Developing the motor skill of head control is a gradual process, but it is essential in achieving advanced sensorimotor coordination. Controlling the eyes, hands, and trunk requires coordination, which is necessary for actions like sitting up straight or reaching for objects (17).

MATERIAL AND METHODS

The study employed a comparative cross-sectional study with 35 participants within the department of Physical therapy at Ghurki Trust and Teaching Hospital, Lahore, over the period of six months starting from June to December 2023. Before the commencement of the study, it was approved by the Committee of the Department of Physical Therapy, UBAS, and data collection permission was taken from the study setting and a written consent was taken from each participant of the study. The confidentiality of participants was maintained, and measures were taken to ensure their safety during the research and data was secured in a password protected device. To determine the sample size non-probability convenient sampling technique was acquired to select participants and Epi tool was employed to calculate sample size with prevalence 0.002, confidence interval of 95% and margin of error 0.001, the sample size calculated was N= 35. The tools used to assess head control and QUEST (Quality of Upper Extremity Skill Test) respectively. The clinical rating scale typically employs a grading system to quantify the degree of head control in prone (Grade 0-4), supine (Grade 0-3) and supported sitting and/or on reclining (Grade 0-4). The Quality of Upper Extremity Skill Test (QUEST) comprises 33 activity items, including dissociated movement, grasp, protective extension, and weight bearing. Each item is scored using specific formulas, resulting in a score ranging 0 to 100. Inclusion criteria comprised of both genders aged 1.09-10.02 with spastic quadriplegic CP, excluding those with contractures, botulin toxin injections, orthopedic surgery, or serious medical problem/seizures. Inclusion criteria comprised of both genders aged 1.09-10.02 with spastic quadriplegic CP, excluding those with contractures, botulin toxin injections, orthopedic surgery, or serious medical problem/seizures. Data analysis was conducted using SPSS version 25. Continuous variables were presented as mean and standard deviation, while study variables were presented using descriptive statistics such as graphs and tables, Two groups were made on the basis of clinical rating scale for head control, one group had participant with head control while other had participants without head control, independent T-test was applied for data computation, giving these groups a strong statistical comparison.

RESULT

Table 1: Descriptive Statistics of Age Minimum age of participants is 1 year 9 months and maximum age is 10 years 2 months with mean of 4.0771 and standard deviation of 2.48010.

	Minimum	Maximum	Mean	Std. Deviation
Age	1.09	10.02	4.0771	2.48010

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Table 2: Descriptive Statistics of Gender distribution

	Frequency		Percent
Group A	14		40.0
	Male	Female	
	9	5	
Group B	21		60.0
	Male	Female	
	8	13	
Total	35		100.0

This table indicated a statistically significant difference between the groups, one including participants with head control and other without it as the P value <0.017. The group A, with head control, showed higher values of QUEST therefore showed significant correspondence.

Table 3: Statistics of the two Groups, A: with head control, B: without head control

Outcome	Group A (With Head Control) (n=14)	Group B (Without Head Control) (n=21)	P Value
	Mean ± SD	Mean ± SD	
Quality of upper extremity skill test value	58.33 ± 13.48	26.40 ± 8.58	<0.017

DISCUSSION

The aim of our study was to investigate the upper extremity motor performance among spastic quadriplegic cerebral palsy children with or without head control. In the literature, limited studies were available that examined the relationship between head control and upper extremity functions. Generally, the movements of the head were examined during gait or the relationship between trunk control and upper extremity function was investigated.

In our study 35 children with quadriplegic cerebral palsy were included, we investigated the interplay between upper extremity function and head control using QUEST and clinical rating scale for head control, respectively. After assessing the head control using clinical rating scale for head control two groups were made one with head control and other without it and its influence on upper extremity function was assessed. The finding indicated a statistically significant difference between the two groups.

A previous comparative study investigated the movement of head during gait in children with diparetic cerebral palsy and healthy peers, and found increased head range of motion in all planes for the former during gait. The results suggested that this increased range compromises dynamic stabilization in children with diapretic CP, especially during walking (18).

Furthermore, another study highlighted the significance of head and neck positioning in motor unit activity during upper extremity functions in both healthy and neurologically impaired children. Abnormal head positions, influenced by tonic neck reflexes, including asymmetrical tonic neck reflex, were noted to influence upper extremity 18 functions (19). However, we did not assess or observe these atypical reflexes in the children involved in our study.

Another study investigated a correlation between trunk control, upper extremity functions, and head stability. This revealed that external support, such as chair support, increased trunk control. The study aimed to compare trunk control concerning the addition of external support. Children with poor trunk control faced challenges in executing isolated movements and upper extremity functions, resulting in decreased head stability. Consequently, compensatory abnormal trunk movements were observed to address the inadequacy in upper extremity functions (20). Nevertheless, our study identified a decrease in upper extremity weight bearing among children with impaired head control and simultaneously had decreased trunk control.

A parallel study involving 32 spastic cerebral palsy children revealed that decreased head extension correlated with improved upper extremity functions. Additionally, better trunk control in children with cerebral palsy led to a reduction in head extension during

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anterior reaching (21). Anyhow, our study revealed that impaired head control leads to compensatory movements and consequently compromise upper extremity function as well as the functional range.

This is evident that children with cerebral palsy face more challenges in upper extremity functions compared to typically developing children. Trunk control and head movement were identified as influential factors in upper extremity functions in upper extremity activities. To alleviate limitations in the upper extremities of children with cerebral palsy, treatments should focus on enhancing both factors trunk and head control.

CONCLUSION

The findings of this study showed a statistically significant difference between the two groups, one including participants with head control and other without it. The group with head control had a positive relationship between head control and upper extremity function in children with spastic quadriplegic CP.

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