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Correlation Between Trunk Control and Gross Motor Function in Sitting among Children with Unilateral Spastic Cerebral Palsy: An Observational Study

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Abstract: ***Background: Cerebral Palsy (CP) is prevalent disability starting in early childhood characterized as a series of difficulties caused by Central Nervous System Lesion. Motor and secondary musculoskeletal problems are seen in CP. The trunk plays an important role in maintaining the postural control mechanism and subjects with CP may be challenged by difficulties in maintaining trunk control. Sitting abilities can be described using the Trunk Control Measurement Scale (TCMS) and Gross Motor Function Measurement (GMFM). Aim: The purpose of this study is to assess relationship between trunk control and gross motor function in sitting children with unilateral spastic Cerebral palsy using the GMFM and TCMS. Materials and Methodology: An Observational study was conducted in which 20 children in sitting with Unilateral Spastic CP from hospitals of Surat city were taken. Children diagnosed with Unilateral Spastic CP and gender aged 1 to 18 years. Children with CP who had head control were included and spine and pelvic surgery, neuromotor disorder and metabolic disorder were excluded in this study by convenient sampling. After obtaining consent, the TCMS and GMFM scales were filled up by therapist. The correlation of TCMS and GMFM had done by Karl Persons correlation coefficient. Result: This study investigates the correlation between trunk control and Gross motor function in children with unilateral Spastic cerebral palsy. Using the Trunk Control measurement scale (TCMS) and Gross motor function measurement (GMFM), we evaluated 20 children aged 1 to 18 years from Surat. Our findings shows a significant positive correlation r=0.89, p <0.01 between trunk control and Gross motor function, suggesting that improving trunk control can enhance Gross motor function in these children. Conclusion: This study demonstrates a significant positive correlation between trunk control and gross motor function in children with unilateral spastic cerebral palsy. Enhancing trunk control through targeted training could significantly improve gross motor function, underscoring the need of focused physiotherapy and neuro - rehabilitation interventions.***

Keywords: Cerebral palsy, trunk control, children, gross motor function, sitting.

1. Introduction

Cerebral palsy is an umbrella term covering a group of non - progressive but frequently changing motor disorder syndromes that may or may not involve components that are caused by a chronic defect lesion, or anomaly of the developing brain and that can be in part a developmental diagnosis.1 It causes muscle paralysis, muscle loss, and coordination issues, all of which delay the proper development of the motor system.2 In children with CP, this problem with movement and posture results in a proportional loss in mobility, self - care, and social function.3 Mental retardation, vision problems, speech difficulties, sensory problems, and emotional disorders may occur with these physical disabilities.2 Numerous studies have demonstrated a strong correlation between motor function and a variety of abnormalities, including spasticity, movement quality, postural stability, involvement distribution, strength, range of motion restrictions, and decreased endurance.3

According to studies, 3.8 percent of people in India and 10% of the world's population overall are disabled in some way. Cerebral palsy affects between 15–25% of children who are physically disabled. An estimated 3/1000 live births are affected in India.4 Infant survival rates have increased over time, but during the past 40 years there has been minimal change in the prevalence of cerebral palsy. This is likely to be a result of the rise in cerebral palsy in preterm and extremely preterm infant populations.1 Typically, risk factors that could indicate a future issue can be seen in the new born or pregnancy (through medical testing). Risk factors might exist due to or during pregnancy, during labor and delivery, and in the period immediately following the baby's birth.1 CP is categorized in a number of ways. Clinical classification is divided into four categories: spastic, dyskinetic, ataxic, and hypotonic. The majority of children with CP are of the spastic type; this percentage is around 70%. At least two of the following describe CP of the spastic type: - abnormal movement and/or stance. - A growth in muscle tone (not required to be constant). - Pathological reflexes, such as the Babinski response. It is possible for CP to be unilateral or bilateral. When one side of the body's extremities are affected, spastic unilateral CP is diagnosed.5 The first movement a new born learns is head control, which is required for the development of other motor abilities including sitting, crawling, and walking.6 The development of head control is crucial because a child's head position has a big impact on how well they can interact with their surroundings, access their environment, and satisfy their academic goals.6

The capacity to maintain one's balance while keeping the centre of gravity inside the base of support is known as trunk control.7 Children, teenagers, and adults with cerebral palsy (CP) often have poor trunk control, which can interfere with daily activities.8 Early in childhood, the development of postural control is a difficult and lengthy process.9 Children

with spastic unilateral CP try to maintain static trunk control, which can impair their ability to sit and stand as well as perform other movements like reaching and walking.7 In this developing phase, the trunk is crucial for maintaining the postural control mechanism as well as for organizing the balance reactions. In order to perform functional tasks for limb motions, a strong base of support is necessary as well as trunk control.9 Not only does postural control impact sitting and standing, but it also has an impact on how well the movements can be coordinated.1^0 Because a stable sitting position promotes the development of eye - hand coordination, upper - extremity functions, functional abilities and self - care, cognitive development, and social interaction, there is increased interest in how children with cerebral palsy sit.1^0The Gross Motor Function Measure is a tool for assessing how changes in gross motor function over time or in response to treatment affect children with cerebral palsy.1^1 The TCMS was employed to assess children with spastic CP and found to have excellent psychometric properties. The only scale that assesses the two most crucial aspects of trunk control during functional activities - (a) The trunk as a secure foundation of support, (b) The trunk as an actively moving body segment.9

2. Methodology

Inclusion Criteria:

- Age group 1year to 18 years
- Gender: Both boys and girls
- Patients diagnosed with Unilateral Spastic Cerebral palsy by a certified Paediatrician and medical person.
- Only children with head control are taken.

Exclusion Criteria:

- Other types of CP
- Severely disable CP children
- Individuals were excluded if they had a neuromotor disorder different from CP.
- Children who had undergone spinal surgeries, had a history of spine and pelvic injuries, were using medicine such as anti - spastic drug, had a progressive neurological issue, a genetic or metabolic disorder, or had a severe current sickness or disease that was not typically associated with CP.

Outcome Measures:

- Trunk Control Measurement Scale (TCMS)
- Gross Motor Function Measure (GMFM)

Procedure: All the subjects were assessed as per assessment format. Those who fulfill inclusion and exclusion criteria are taken up for the study. The procedure was explained to all the subjects. A written informed consent had taken from all the sample. This observational study has done on children of 1 year to 18 years. The sample was estimated to be of 20 participants. Data had been collected from hospitals of Surat and pedia clinic. The Trunk Control Measurement Scale (TCMC) was used to assess the trunk control during sitting. The scale considered static (sitting) balance, dynamic (sitting) balance. Children were tested by TCMS consisting of 12 questions, and a total score 48 and higher scores indicating achievement of sitting. The Gross Motor Function Measurement Scale (GMFM) was to evaluate change in gross motor function in children with cerebral palsy. Children were tested by GMFM consisting of 54 questions, and a total score 111 and higher score indicate good sitting. There were 17 and 20 questions within each of lying rolling and sitting dimensions; with a maximum score of 3 for each item. All the questionnaires were tested on the patients and then the scales were filled.

Statistical Analysis

The data were collected and analyzed using statistically package social sciences (SPSS) version 21. We selected children with unilateral spastic CP for this study, aged from 1 to 18 years. Based on inclusive and exclusive criteria, we selected children from various hospitals in Surat. Relationship between trunk control and gross motor function and other demographic data were analyzed by descriptive analysis. To assess the relation between TCMS & GMFM Karl Pearson correlation coefficient for parametric test was calculated. A p - value <0.01 was considered as statistically significant.

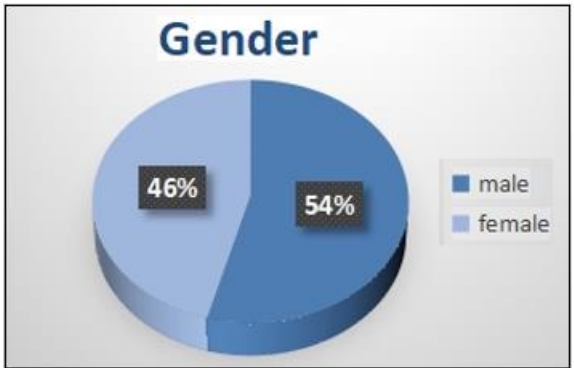
3. Result

The Relation between trunk control and gross motor function in sitting in children with unilateral spastic CP was analyzed by using descriptive statistics. This data was tested by Trunk Control Measurement Scale and Gross Motor Function Measurement Scale. The correlation between trunk control and gross motor function in CP children was analyzed by using Karl Pearson test.

Table 1: Mean age of participants according to gender.

Age group	N	Mean age	Standard deviation
Male	9	3.33	+1.98
Female	11	2.81	+1.84

Table 1 Display for age distribution among 20 children out of which 11 are female and 09 are male. The mean age of the male is 3.33 with standard deviation + 1.98 and mean age of the female is 2.81 with standard deviation is + 1.84.



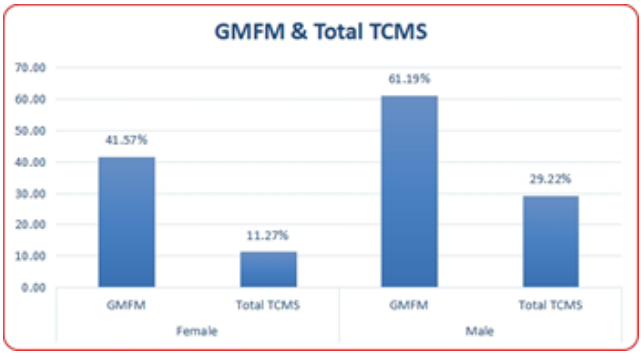
Graph 1: Participants according to Gender.

Graph 1 show that male mean age is 3.33 (54%) and female mean age is 2.81 (46%).

Table 2: Descriptive analysis for outcome measurement.

Outcome Measurement	N	Mean	Standard Deviation
TCMS Static	20	8.10	+9.41
TCMS Dynamic	20	11.25	+13.03
Total TCMS	20	19.35	+22.43
GMFM	20	50.39	+38.64

Table 2 shows that the mean of the TCMS static is 8.10 with standard deviation is +9.41 and the mean of TCMS dynamic is 11.25 with standard deviation +13.03, and the mean of total TCMS is 19.35 with standard deviation is +22.43 and the mean of GMFM is 50.39 with standard deviation is +38.64.



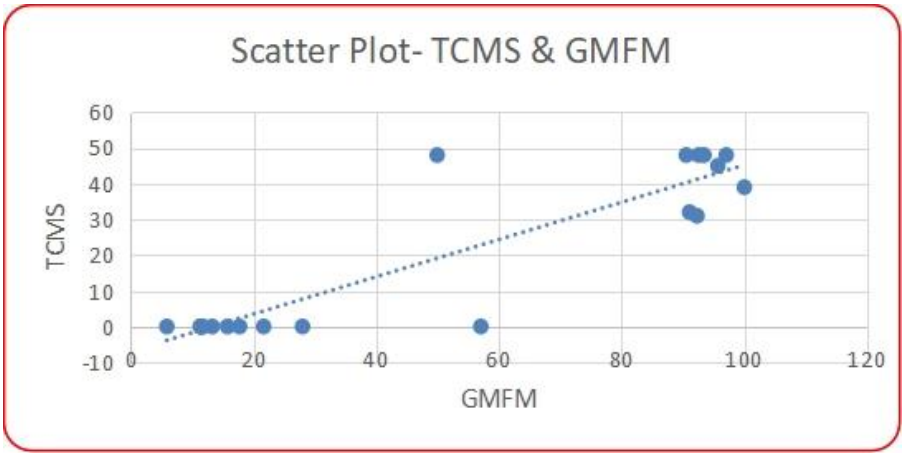
Graph 2: Total percentage of GMFM & TCMS according to Gender.

Graph 2 shows that female have higher score of GMFM (41.57%) than TCMS (11.27%) and in the same male have higher score of GMFM (61.19%) than TCMS (29.22%). There is a difference of 19.62 between GMFM score in female & male, and the difference of 17.95 between TCMS score in female & male. In this study our age population is 1 to 18 years with unilateral spastic CP. There are 20 children in our study out of which 11 are female and 09 are male.

Table 3: Correlation between TCMS & GMFM in children with spastic CP.

Parametric test	N	"r" value	p value
Karl Pearson	20	0.89	<0.01

Table 3 shows the correlation between TCMS and GMFM by using Pearson test. "r" value is 0.89 and p value is <0.01 which show the strong correlation between TCMS and GMFM.



Graph 3: Scatter Plot shows correlation between TCMS and GMFM

Graph 3 is shows positive correlation between TCMS and GMFM and our age population is 1 to 18 years with unilateral spastic CP. There are 20 children in our study out of which 11 are female and 09 are male.

4. Discussion

The study aimed to identify the relationship between trunk control and gross motor function in sitting in children with unilateral spastic CP. Trunk control ability assessed by Trunk Control Measurement Scale and gross motor function ability assessed by Gross Motor Function Measurement Scale.20 children with unilateral spastic CP were involved in this investigation. The data was gathered through assessment and direct observation on a total of 20 children. In 20 children there were 9 boys and 11 girls. Moreover, children with spastic cerebral palsy have weak trunk muscles, which directly affect how well they can carry out activities of daily life. To examine the construct validity of the TCMS, the GMFM was applied.2

According to neurodevelopmental principles, the trunk plays an important part in controlling the movement of the extremities as well as the functional mobility. Movements of the extremities are controlled in a proximodistal fashion with the trunk. The stability of the trunk to support the movements of the upper and lower extremities is a requirement for carrying out functional tasks. It is therefore predicted that trunk - targeted treatment for enhancing TCMS scores will result in an increase in gross motor function. [9]

Özal et al. discovered that children with unilateral CP had great trunk control. literature has shown that it is especially important to increase understanding to role of trunk control with their voluntary function and postural control during Neurorehabilitation planning for children with CP.1[2] The mean of the static and dynamic components of the TCMS in this study is essentially equal; the mean of the static component is 8 and the mean of the dynamic component is 11, and the total sample size is 20, so the static score is 40 and the dynamic score is 39, proving that the static and dynamic scores are nearly identical. Static balance is defined as when an individual can maintain equilibrium between the body and its environment while stationary. Static balance is a key ingredient for everyday situations.

Dynamic balance refers to the ability of an individual to establish and maintain equilibrium between the body and its environment while in motion. Dynamic balance plays an important role during all loco motor activities. Good psychometric characteristics were identified when the scale was examined. The median total scores for TCMS (static &

dynamic) and GMFM (lying, rolling & sitting) were 48 & 111. In our study we have only used static & dynamic component for trunk control and lying rolling & sitting components for gross motor function. Out of 20 children in our study 8 children performed well on static & dynamic components of TCMS & GMFM. From a total population of 20 children, the highest score in static component of TCMS is 20 in 05 children, it includes 03 males and 02 females. Similarly, from a total population of 20 children, the highest score in dynamic component of TCMS is 28 in 04 children it includes 03 males and 01 females, Overall TCMS score for male is 72% while female score is 28%, which shows that the total TCMS score is higher in male than female. Out of 20 children, the maximum score of GMFM was observed in 08 children, it includes 05 males and 03 females, and overall GMFM score for male is 60% while female score is 40%, which shows that the total score of GMFM is higher in male than female.

The outcomes of this research supported the reliability and validity of the TCMS by demonstrating a strong significant correlation between the overall score of the GMFM (lying rolling & sitting) and the total score of the TCMS as well as its two subscales. All dimension scores also correlated significantly with the total TCMS and the subscales. The TCMS & sitting component of the GMFM have the strongest expected correlation. This study showed kids with CP perform gross motor functions more successfully when they have sufficient trunk control. At last, children who can maintain a sitting position can use the TCMS & GMFM. Beside these restrictions, the distribution over the first two TCMS components score and the range of GMFM (lying rolling & sitting) score both indicated that there was variance in functional ability in our patient population. There are synonyms reports regarding relationship between trunk control & gross motor function in sitting in children with unilateral spastic CP.

5. Conclusion

This study demonstrates a significant positive correlation between trunk control and gross motor function in children with unilateral spastic cerebral palsy. Enhancing trunk control through targeted training could significantly improve gross motor function, underscoring the need of focused physiotherapy and neuro - rehabilitation interventions in children with cerebral palsy.

6. Limitations

- It is difficult to verify the general representation of the data from this study because the data were only collected from one city and other cities were not considered as well.
- In this study we included children who already had head control.
- Children with severe CP disabilities and children with other types of CP were excluded from the study.

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