THE RELATIONSHIP BETWEEN SENSORY AND MOTOR CAPABILITIES WITH GROSS MOTOR FUNCTION IN CHILDREN WITH SPASTIC CEREBRAL PALSY

Deepak Panwar[1], Monalisa Pattnaik[2], Dr. Patitapaban Mohanty [3]

[1]Research student, Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR)
[2]Research Guide, HOD and Assistant Professor, Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR)
[3]Research Co-Guide, Director and Associate Professor, Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR)
Department of Physiotherapy
SVNIRTAR, ODISHA, INDIA

ABSTRACT

Background: Cerebral palsy is the most common physical impairment among children (CP). CP is a group of mobility and postural issues that restrict activities and are brought on by non-progressive disturbances in the developing brain of the infant or foetus. A child's functional mobility may be restricted by motor problems associated with CP. Both motor and sensory processing issues are present in cerebral palsy. CP patients who experience motor impairments frequently also experience sensory, perceptual, cognitive, communicative, and behavioural disturbances. For functional performance in daily activities and involvement that calls for motor abilities, sensory processing and motor skills are relatively crucial.

Aim of study: The objective of our study was to find the relationship between the sensory and motor capabilities with gross motor function in children with cerebral palsy.

Procedure: 101 kids with spastic cerebral palsy who met the requirements for inclusion. They were chosen using the convenience approach with written approval from their careers. Following that, GMFM, tone, voluntary control, and sensory profile were assessed. Binary logistics was used to analyse the data.

Results: Shows those sensory and motor capabilities plays a vital role in Gross motor function. As well as there was significant differences between tone by sensory profile and voluntary control by sensory profile.
Conclusion: The development of children with cerebral palsy's gross motor function depends critically on their sensory and motor abilities.

Keywords: Cerebral palsy, Sensory capabilities, Motor capabilities, Gross motor function

INTRODUCTION

Cerebral palsy (CP) is the most typical physical disability in children (Gorter, J.W et al., 2004). It is well recognised that cerebral palsy (CP) is a neurodevelopmental disorder caused by non-progressive lesions in one or more regions of the developing brain while the infant is still in the womb, at birth, or shortly after (Papavasiliou AS, 2009). A wide range of clinical symptoms were used to explain persistent posture and mobility issues. It can be identified by abnormal muscle tone, posture, and movement, all of which limit the range of motion in a child with cerebral palsy. Seizures, secondary musculoskeletal problems, and changes of sensation, perception, cognition, communication, and behaviour are usually present along with the motor deficits of CP (Rosenbaum P et al., 2007). There were three basic divisions: ataxic, dyskinetic, and spastic CP. A child's functional mobility may be restricted by motor problems associated with CP. Gross motor and fine motor manipulation skills are the two most used ways to assess motor function. The impairment of gross motor function is the primary problem with CP (Rosenbloom L, 1983). Postural control and body alignment in relation to gravity are examples of gross motor function. There is an index for fine motor manipulation function that examines the coordination of hand and upper limb function while a child performs functional daily living tasks (Hutton JL, Pharoah PO, 2006). Motor control and sensory processing problems result from CP, a central nervous system disorder (Hosseini SA et al., 2015). It is clear that these motor impairments are a result of the corticospinal tract's abnormal development (Yeo, S.S., Jang, S.H., and Son, 2014). The thalamocortical tract, one of the main sensory pathways, is frequently disturbed in CP patients, raising the possibility of substantial sensory abnormalities (Tsao, H et al., 2015). Muscle weakness, stiffness, lack of selective motor control, and a restricted range of motion are all cerebral palsy symptoms that make it challenging to complete daily chores and participate in a variety of activities (Calley A et al., 2012). Additionally, the youngster has aberrant sensory modulation, poor sensory discrimination, and poor sensory registration (Beckung E, Hagberg, 2002). Tactile and proprioceptive impairments are common in cerebral palsy (CP) patients' sensory impairment (Cooper J et al., 1995). The ability of the sensory input to provide the feedback and guidance required to correct an inaccuracy in a motor action is crucial for successful motor task performance (Papadelis, C et al., 2014).

MATERIALS AND METHODOLOGY

This was a Correlational study design with 101 subjects recruited with sample of convenience. The study was carried out from January 2022 to August 2022. Voluntary participation was obtained from each subject by getting the consent form signed by the child caretakers and the ethical approval was taken from the Institutional Ethical Review Committee. The sample size was calculated with 95% confidence interval and 5% precision.
Inclusion criteria: Children diagnosed as cerebral palsy, any sort of spastic cerebral palsy in children between the ages of 3 and 10 years, both males and females were recruited.
Exclusion criteria: Child diagnosed with intellectual disability, Child under medication of psychostimulants, Child with congenital abnormalities, Child with other concomitant chronic medical condition, Child with epilepsy were excluded from the study.
Only subjects who met all inclusion requirements were chosen for the study. All the subject's carers who are certified for this study and sufficient assessment was done will provide thorough description of the technique that is to be performed. Caretakers of all subjects endorsed the consent.

Measurement of sensory processing
The evaluation of sensory processing using the sensory profile, a standardised parent-completed questionnaire that measures sensory processing and its effects on the functioning of children between the ages of 3 and 10 years. The 125 items indicate actions that could be seen as reactions to sensory input. On a 5-point Likert scale, the parent assigns a rating to the observed frequency of these behaviours (ranging from 15 always to 55 never). The 14 components of the instrument discuss sensory processing, modulation, and behavioural and emotional responses. The tool takes about 30 minutes to complete, and scoring takes 20 to 30 minutes.

FIGURE 1: ASSESSMENT OF SENSORY PROFILE

Assessment of Motor Tone
The Modified Modified Ashworth Scale is used to evaluate muscle tone for motor abilities initially (MMAS) (N.N. Ansari, 2006).

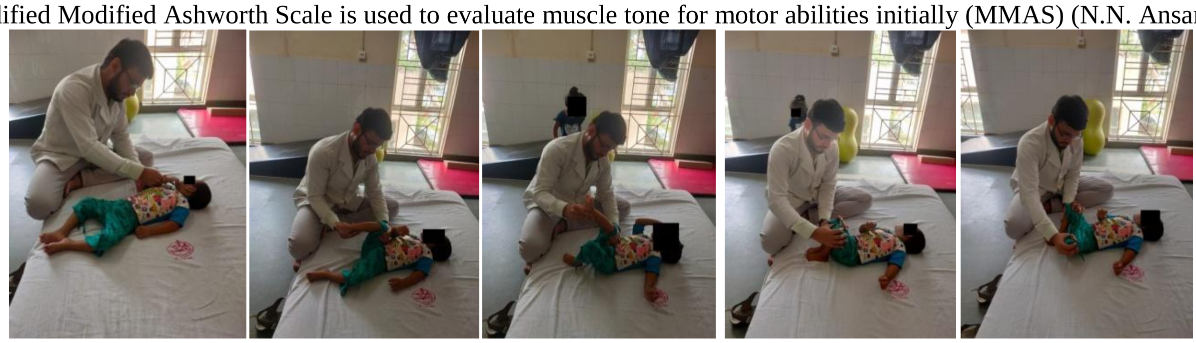

FIGURE 2: ASSESSMENT OF MUSCLE TONE

Assessment of Voluntary Control
For independent motor control a clinical test called the Selective Control Assessment of the Lower Extremity (SCALE) was created to measure the level of selective voluntary motor control in children with cerebral palsy for their lower extremities. The SCALE instrument was made to be utilised in less than 15 minutes without specialist equipment by healthcare professionals for clinical administration and grading. Joints in the hip, knee, ankle, subtalar, and toe are evaluated bilaterally. Evaluations are carried out in the sitting position, with the exception of the hip flexion test, which is conducted in the side-lying position to allow for appropriate joint excursion.

FIGURE 3: ASSESMENT OF HIP VOLUNTARY MOTOR CONTROL

Selective voluntary motor control (SVMC) for the upper extremity was measured using the Selective control of the upper extremity functions scale (SCUES). The therapist first shows the patient the joint movement that will be assessed. Three times over the whole range of motion, the therapist passively moves the joint. The patient then actively executes the movement three times at the same tempo, starting with the joint movement on the side of their body that has the least amount of neurological damage.

FIGURE 4: ASSESSMENT OF VOLUNTARY CONTROL OF UPPER LIMB

The Trunk Control Measurement Scale (TCMS) examines the trunk's ability to maintain stability as a foundation of support and to actively move as a body segment during functional activities. A static sitting balance segment and a dynamic sitting balance section make up the scale. Selective movement control and dynamic reaching are the two subscales that make up the second section. (Wagner LV, Davids JR, Hardin JW, 2016).

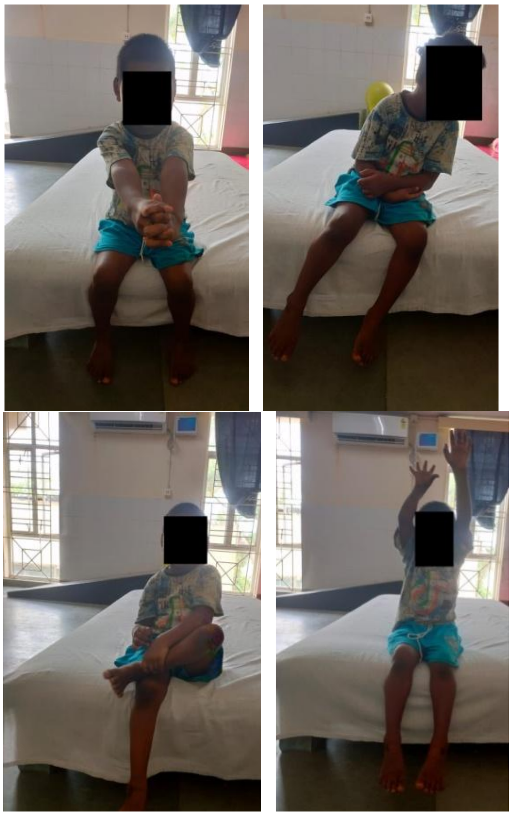

FIGURE 5: ASSESSMENT OF VOLUNTARY CONTROL OF TRUNK

Assessment of Gross Motor Function

The Gross Motor Function Measure (GMFM), an observational clinical instrument created to assess changes in gross motor function in children with cerebral palsy, measures gross motor function. There are five categories of gross motor function: lying down and rolling over, sitting, crawling on hands and knees, standing, and walking, running, and jumping (Vascakova T, Kudlacek M, Barrett U, 2015).

FIGURE 6: SUPINE TO SIT

FIGURE 7: PRONE WEIGHT BEARING & SHFTING ACTIVITES

FIGURE 8: SITTING & CRAWLING

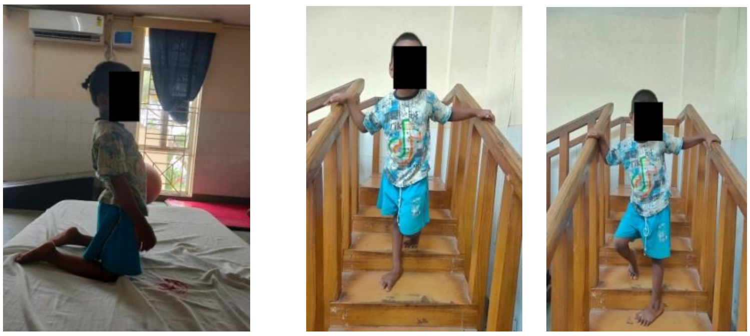

FIGURE 10: KNEELING & STAIR CLIMBING

STATISTICAL ANALYSIS

All the statistical analysis was done with the help of Statistical Package for the Social Sciences (SPSS) software version 26. Binary logistics was used to analyse the data to find the relationship between the sensory and motor capabilities with gross motor function in children with spastic cerebral palsy within group analysis. Level of significance was set at 5%.

RESULTS

For this study, 101 participants were selected. Demographic data shows mean age for spastic cerebral palsy (5.37 ± 1.922 years).

	Age (MEAN ± SD)
CEREBRAL PALSY	5.37 ± 1.922

According to wald test it showed that Tone was a negative and significant (b=-.433, s.e.=.148,p=.003) predictor of the likelihood of the intention to achieve standing. Whereas voluntary control was a positive and significant (b=.093,s.e.=.024,p=.000) predictor of the likelihood of a child expressing the intention to achieve standing & Sensory profile was a negative but non-significant (b=-.012,s.e.=.024,p=.203) predictor of the probability of expressing the intention for achieving standing.

TONE BY VOLUNTARY CONROL

According to wald test, Tone by voluntary control was a positive and non-significant (b=.002, s.e.=.001,p=.071) predictor of the likelihood of a tone by voluntary control expressing the intention to achieve standing.

SENSORY PROFILE BY TONE

According to wald test, sensory profile by tone was a negative and significant (b=-.001, s.e.=.000,p=.000) predictor of the likelihood of a sensory profile by tone expressing the intention to achieve standing.

SENSORY PROFILE BY VOLUNTARY CONTROL

According to wald test, sensory profile by voluntary control was a positive and significant (b=.000, s.e.=.000,p=.000) predictor of the likelihood of a sensory profile by voluntary control expressing the intention to achieve standing.

DISCUSSION

The goal of the current study was to ascertain how the sensory and motor skills of children with spastic cerebral palsy linked to their total motor performance. Muscle tone and the capacity to control one's voluntary movements were used to assess one's motor and sensory abilities, respectively. The overall results of the study show that tone and voluntary control were important predictors of the response variable achievable standing. We found that tone by voluntary control was a positive and non-significant factor, sensory profile by tone was a negative and significant factor, and sensory profile by voluntary control was a positive and significant factor when we examined the relationship between motor skills and sensory profile in relation to the response variable achievable standing.

Our study found that tone was a major predictor of whether a tone reflected the urge to rise up. Lower tone scores were associated with higher gross motor function and more efficient use of gross motor abilities in the children. Our research supported Jay M. Meythaler's 2001 study that revealed spasticity may also be useful while standing, where it activates leg and trunk extensors, maintains muscle size and bone density, and is helpful for kids with cerebral palsy. The child might benefit from a firmer tone. It helps to keep the legs straight, supporting the child's weight against gravity.

In the current study, voluntary control strongly influenced a child's propensity to indicate a desire to stand up. Furthermore, the study discovered that kids with better voluntary motor control scores had strong gross motor function and could carry out the gross motor function well. In cerebral palsy, corticospinal tract dysfunction affects the ability to regulate the pattern of voluntary movements as well as the strength, tempo, and timing of muscle contractions (CP). Therefore, it is believed that the decline in motor function in CP patients is significantly influenced by the loss of selective voluntary motor control (Staudt M et al., 2003).

Our current research unequivocally demonstrates that there is a strong relationship between the reach standing and the sensory profile by tone. Children with cerebral palsy have poor proprioceptive processing, according to the research (Blanche E et al, 2001). In their study, Cans C et al. (2007) stated that all CP subtypes are accompanied by abnormal muscle tone, which appears as raised tone in kids with spasticity, lowered tone in children with ataxia, or fluctuating tone in children with dyskinesia. Abnormal muscle tone has a detrimental effect on the precision of the afferent proprioceptive input coming from the muscles and joints.

According to recent research, standing achievement was favourably and strongly correlated with voluntary modulation by sensory profile. Previous research has indicated that developmental problems like low or high postural tone, difficulty with balance and motor coordination, shaky posture, and/or awkward movement can be brought on by sensory processing impairments in children. Therefore, sensory integration disorder symptoms are more common in CP (Ayres, 1980; Lee and Song, 2010).

A recent study discovered a favourable but unimportant correlation between standing achievement and tone by voluntary control. According to a previous study by Fowler E.G. (2010), two significant deficiencies include spasticity and reduced selective voluntary motor control (SVMC). Children with insufficient SVMC are required to move in more simplistic flexor and extensor "synergy" or linked patterns in order to carry out more complex movement patterns. The degrees of spasticity and selective control have an inverse relationship, according to a 2004 study by Ostensj S et al.

LIMITATIONS OF THE STUDY

A certain area of sensory processing skills wasn't taken into account & Variations in GMFCS level are not taken into account.

CONCLUSION

The ability to move can be a powerful indicator of gross motor function. Tone and voluntary motor control have an impact on the predictor of achievement standing, which measures gross motor function. Children that can process sensory information with voluntary control and tone perform better in terms of gross motor abilities.

REFRENCES

1. Beckung E, Hagberg. Neuroimpairments, activity limitations, and participation restrictions in children with cerebral palsy. Dev Med Child Neurol, 2002, 44: 309-316.
2. Blanche EI, Nakasuji B. Sensory integration and the child with cerebral palsy. Understanding the nature of sensory integration with diverse populations: Therapy Skill Builders; 2001. p. 347-84.
3. Calley A, Williams S, Reid S, Blair E, Valentine J, et al. (2012) A comparison of activity, participation and quality of life in children with and without spastic diplegia cerebral palsy. Disability and rehabilitation 34(15): 1306-1310.
4. Cooper J, Majnemer A, Rosenblatt B, Birnbaum R. The determination of sensory deficits in children with hemiplegic cerebral palsy. J Child Neurol, 1995, 10: 300-309.
5. Fowler E.G. Concepts in spasticity and selective motor control in children with spastic cerebral palsy. Technology and Disability. 2010; 22:207–214.
6. Gorter, J.W.; Rosenbaum, P.L.; Hanna, S.E.; Palisano, R.J.; Bartlett, D.J.; Russell, D.J.;Walter, S.D.; Raina, P.;Galuppi, B.E.; Wood, E. Limb distribution, motor impairment, and functional classification of cerebral palsy. Dev. Med. Child Neurol. 2004, 46, 461–467.
7. Hosseini SA, Ghoochani BZ, Talebian S, et al. investigating the effects of vestibular stimulation on balance performance in children with cerebral palsy–A Randomized Clinical Trial study. JRSR. 2015;2(2):41-6.
8. Hutton JL, Pharoah PO. Life expectancy in severe cerebral palsy. Arch Dis Child. 2006; 91:254-8.
9. N.N. Ansari, S. Naghdi, H. Moammeri and S. Jalaie, Ashworth scales are unreliable for the assessment of muscle spasticity,*Physiother Theory Pract***22** (2006), 119–125.
10. Ostensjø S, Carlberg EB, Vøllestad NK (2004) Motor impairments in young children with cerebral palsy: relationship to gross motor function and everyday activities. Developmental medicine and child neurology 46(9): 580-589.
11. Papadelis, C.; Ahtam, B.; Nazarova, M.; Nimec, D.; Snyder, B.; Grant, P.E.; Okada, Y. Cortical somatosensory reorganization in children with spastic cerebral palsy: A multimodal neuroimaging study. Front. Hum. Neurosci. 2014, 8, 725.
12. Papavasiliou AS. Management of motor problems in cerebral palsy: a critical update for the clinician.
13. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy. *Dev Med Child NeurolSuppl*(2007) 109(April):8–14.
14. Rosenbloom L. Early diagnosis and therapy in cerebral palsy: A primer on infant developmental problems. Arch Dis Child. 1983, 58: 757.
15. Tsao, H.; Pannek, K.; Boyd, R.N.; Rose, S.E. Changes in the integrity of thalamocortical connections are associated with sensorimotor deficits in children with congenital hemiplegia. Brain Struct. Funct. 2015, 220, 307–318.
16. Vascakova T, Kudlacek M, Barrett U. Halliwick concept of swimming and its influence on motoric competencies of children with severe disabilities. European Journal of Adapted Physical Activity. 2015;8(2).
17. Wagner LV, Davids JR, Hardin JW. Selective Control of the Upper Extremity Scale:validation of a clinical assessment tool for children with hemiplegic cerebral palsy. Dev Med Child Neurol. 2016;58(6):612–617.
18. Yeo, S.S.; Jang, S.H.; Son, S.M. The different maturation of the corticospinal tract and corticoreticular pathway in normal brain development: Diffusion tensor imaging study. Front. Hum. Neurosci. 2013, 8, 573.