International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 17s, 2025
https://www.theaspd.com/ijes.php

A Comparative Analysis Of Peabody Developmental Motor Scales-2 (Pdms-2) And Trunk Impairment Scale (Tis) In Cerebral Palsy Children- A Correlational Study

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ABSTRACT

Aims: *The aim is to study is to find the correlation between trunk- impairment scale (TIS) and PDMS-2 scale subcomponents stationary and locomotion.*

Methods: *This observational study included a sample of 70 children diagnosed with cerebral palsy, aged between 60 and 64 months. Participants of both genders were assessed and enrolled in the study following the acquisition of informed consent from their parents. The Trunk Impairment Scale and PDMS-2 (Stationary and Locomotion subtests) were administered following standard manual guidelines for evaluation.*

Results: *A descriptive analysis of the baseline characteristics was performed using the mean and standard deviation. To investigate the association between the PDMS-2 subtests stationary and locomotion raw scores and the Trunk Impairment Scale (TIS), Karl Pearson's correlation coefficient was used. We assessed GMFCS level and TIS Scores which showed level I as (19.47#2.03) where level V as (2.14+2.73) between TIS and PDMS-2 (stationary and locomotion). It showed a positive correlation in Stationary (r=0.8155) and locomotion (r=0.8386). The study revealed a positive association between the Trunk Impairment Scale (TIS) scores and the PDMS-2 subtests for stationary and locomotion skills. Data were analyzed using SPSS (Statistical Package for the Social Sciences), version 21.0.*

Conclusion: *The correlation between PDMS-2 and TIS in children with cerebral palsy demonstrated a positive relationship. Further the study can be explored in other Neurodevelopmental conditions at different ages various conditions and stages.*

Keywords: *Cerebral Palsy, TIS, PDMS-2*

INTRODUCTION

Cerebral palsy refers to a group of non-progressive neurodevelopmental conditions that impact movement and posture. It is frequently associated with additional challenges such as sensory impairments, cognitive difficulties, behavioral issues, and seizures[1]. Cerebral palsy (CP) is the leading cause of significant physical disability in the childhood, with an approximated prevalence ranging from 1.5 to 2.5 per 1,000 live births[2]. Motor impairments, such as spasticity, poor coordination, and abnormal muscle tone, considerably affect gross and fine motor function[3]. Trunk control is essential for the development of key motor functions, including the ability to sit, stand, and walk[4,5]. Children with cerebral palsy frequently experience difficulties with trunk control as a result of hypotonia or hypertonia, which can result in reduced postural stability, the use of compensatory movement strategies, and the development of musculoskeletal abnormalities[6,7]. Thus, assessing trunk function is vital in planning appropriate interventions. Among the different assessment tools for evaluating trunk function in children with cerebral palsy, the Trunk Impairment Scale (TIS) is recognized as a reliable and valid clinical measure, commonly used for children aged 5 to 12 years[8,9]. It evaluates trunk control in a seated position, focusing on both static and dynamic aspects[9]. The Peabody Developmental Motor Scales-2 (PDMS-2) is a standardized assessment commonly utilized to evaluate both gross and fine motor skills in children up to the age of five[10,11]. The PDMS-2 evaluates various motor abilities, comprising reflexes, stationary posture, locomotion, grasping, object manipulation, and visual-motor integration. Several items related to trunk control are included

within the stationary and locomotion subtests[10,11,12]. Although both TIS and PDMS-2 assess aspects of trunk control, literature correlating their findings is limited. Establishing a relationship between these scales can help clinicians predict developmental motor skills based on trunk performance and vice versa. Hence, the objective of the study is to explore the association between the Trunk Impairment Scale and the Peabody Developmental Motor Scales-2 in children with cerebral palsy, with the goal of contributing to improved clinical evaluation and intervention strategies.

MATERIALS AND METHODS:

Source of data collection: Data collection was done in the Bethel Medical Mission Hospital and Physiotherapy department of Hosmat Hospital Educational Institute Bangalore, Karnataka. The patient who visited the outpatient department of physiotherapy, referred from pediatric outpatient department after the initial evaluation done by pediatrician.

Research Design: Correlation study

Study Duration and Sample Size: The study was conducted over a period of one year and included a sample of 70 children.

Sampling Technique: Children diagnosed as Cerebral palsy from the age group of 60 to 64 months, 27 were enlisted for the study. Reason for the study was explained to the parent/caretaker, prior to assessment, consent of the parent was taken. Subsequently, every alternate child visiting the pediatric physiotherapy department who met the inclusion criteria was enrolled in the study. PDMS-2 and TIS was administered in the interval of 2- 3 days. A pilot study was carried out involving 5 children with cerebral palsy, during which TIS and PDMS-2 assessments were administered and their results analyzed for correlation. A positive correlation was observed, with a correlation coefficient of 0.7874. The population correlation is 0.6147. Based on this sample size was calculated and it was 68~70 children under 80% of power and 5% of error.

Inclusion criteria

1) Children of age 60 to 64 months
2) Diagnosed case of Cerebral Palsy by pediatrician
3) Medically stable to assess
4) Parent/Guardian Consent

Exclusion Criteria

1) Incomplete evaluations using the Trunk Impairment Scale and the Peabody Developmental Motor Scales-2 following inclusion in the study.
2) Parents who declined or chose to withdraw from the assessment process.
3) Visual and hearing impairment hindering evaluation
4) Children suffering from acute illnes

Procedure

Approval was obtained prior to conducting the study from the Institutional Ethics Committee, Bethel Medical Mission Hospital, Bangalore (BMMG/REV/398/2024). Written consent for participation was obtained from the child's parent following confirmation of the inclusion criteria. Demographic information was gathered from the parents, and both the PDMS-2 and TIS assessments were administered according to the procedures described in their respective manuals, after which the scores were recorded. After the preliminary evaluation by the pediatrician for medical diagnosis of cerebral palsy. These children were evaluated further. Chronological age was calculated according to their date of birth. History was taken from the parents; primary care givers and hospital records an initial evaluation was conducted, followed by the administration of the PDMS-2 and the TIS to children who met the inclusion and exclusion criteria. PDMS-2 and TIS was administered with in the gap of 2-3 days.

PDMS-2 Administration:

The Peabody Developmental Motor Scales – 2nd Edition (PDMS-2) was conducted following the standardized manual, which includes comprehensive item descriptions, visual illustrations, and specific scoring guidelines. Instructions were repeated up to three times. If a child lost interest before completing an item, it was re-administered later. Each item was attempted until the child scored a 2 or completed three trials.

Scoring:

2. = Mastery of the item as per criteria; 1 = Partial performance resembling the criteria; 0 = Unable/unwilling to attempt or no skill shown

Testing Procedure: Entry Point: According to the child's age as recorded in the booklet, the Basal Level was determined when the child scored a 2 on three consecutive items; if this criterion was not met, testing proceeded in reverse until it was achieved. The Ceiling Level was established when the child scored 0 on three consecutive items. For this study, only Stationary (30 items) and Locomotion (89 items) subtests were assessed.

Trunk Impairment Scale (TIS):

The Trunk Impairment Scale (TIS) was administered using both verbal and non-verbal instructions, beginning from defined starting positions. Each task was performed 3 times, with the best performance recorded for scoring. No practice trials were allowed. Feedback was given between subtests, which assessed static sitting balance, dynamic sitting balance, and coordination. Items were rated on an ordinal scale ranging from 2 to 4 points. The maximum possible scores were: 7 for static balance, 10 for dynamic balance, and 6 for coordination, with a total score range of 0 to 23, indicating optimal performance. A descriptive analysis of the baseline characteristics was performed using the mean and standard deviation. To examine the correlation between the PDMS-2 subtests stationary and locomotion raw scores and the Trunk Impairment Scale (TIS), Karl Pearson's correlation coefficient was applied.

RESULT

A significant positive correlation was observed between PDMS-2 raw scores (Stationary and Locomotion) and TIS scores across the total sample. Specifically, stationary scores showed a strong correlation with TIS ($r = 0.8115$, $p < 0.0001$), and locomotion scores demonstrated an even stronger relationship ($r = 0.8386$, $p < 0.0001$), suggesting that improvements in motor functions measured by PDMS-2 are closely associated with trunk control as assessed by TIS. When assessed at each level of the Gross Motor Function Classification System (GMFCS), differences in the strength of correlation were observed. In children classified under GMFCS Level 1 and Level 2, both stationary and locomotion scores showed moderate to strong correlations with TIS scores, all of which were statistically significant ($p < 0.05$). However, in Level 3, only locomotion scores were significantly correlated ($r = 0.8566$, $p = 0.0001$), whereas stationary scores did not reach statistical significance ($r = 0.1974$, $p = 0.4806$). Strong and significant correlations were observed for both variables in Levels 4 and 5, with the highest correlations seen in Level 5 (stationary: $r = 0.9727$, locomotion: $r = 0.9573$), This indicates that children with more severe functional limitations exhibit a higher dependence on trunk control for their motor abilities.

Further analysis by types of Cerebral Palsy (CP) revealed consistently strong and statistically significant relationships. In hemiplegic CP, both stationary ($r = 0.6121$) and locomotion scores ($r = 0.6008$) showed moderate correlations with TIS. In spastic diplegia, stationary scores correlated strongly ($r = 0.6869$), while locomotion scores had an exceptionally high correlation ($r = 0.9605$, $p < 0.0001$). Among children with spastic quadriplegia, both domains showed very strong correlations stationary scores with $r = 0.9050$ and locomotion scores with $r = 0.7094$.

DISCUSSION

The objective of the study was to evaluate the association between trunk control, evaluated using the TIS, and motor skills measured by the PDMS-2 in children with cerebral palsy (CP). Findings revealed a significant positive correlation between TIS scores and the stationary and locomotion subtests of the PDMS-2, signifying the essential role of trunk control in overall motor development. Trunk control serves as a key foundation for developing gross motor skills like sitting, standing, and walking. In children with cerebral palsy, challenges such as spasticity, low muscle tone, and poor coordination can hinder trunk stability, often leading to postural imbalances and the use of compensatory movement patterns.[12,13]. As supported by Panibatla et al.[4], and Abdel-aziem A et al[15] there is a strong correlation between TIS scores and functional mobility levels in children with CP, emphasizing that improved trunk stability contributes directly to higher functional motor outcomes[6,16].

The results of our study mirror these findings, where children with better TIS scores also demonstrated significantly higher PDMS-2 scores. This supports the view that trunk control is not an isolated component but rather intertwines with gross motor functions like balance, gait initiation, and core stabilization, which are essential for tasks assessed in the PDMS-2 locomotion domain. Further validation comes from a study by Saavedra et al.[16] which found that trunk and head stability in seated positions were essential for upper limb use and reaching tasks in children with CP. This suggests that even fine motor outcomes though not the main focus of the present study can be indirectly affected by trunk impairments. Hence, tools like PDMS-2, although focused on both gross and fine motor development, reflect elements of postural control embedded in their stationary and locomotor evaluations. Interestingly, a recent review by Zhu et al.[10] applying COSMIN methodology has

validated the PDMS-2 as a highly reliable and construct-valid tool for evaluating motor development in children up to six years old. When paired with TIS, which has also been validated for children of age 5–12 years by Saether et al.[18] This combination offers a thorough assessment of both segmental trunk control and overall motor function. The strong correlation identified in this study is consistent with the results of Sato et al.[19], who reported a significant relationship between TIS scores and gross motor function, especially in sitting and standing positions. Their work reinforced the clinical utility of TIS in both diagnosis and outcome monitoring in pediatric rehabilitation. Given the evidence, the implication is clear: enhancing trunk control should be a central focus in therapeutic interventions for children with CP[20,21]. Structured trunk-targeted physiotherapy programs can potentially enhance not just static postures but dynamic mobility and balance, leading to improvements in overall motor function as captured by tools like PDMS-2[22,23,24].

CONCLUSION

The study of correlation between PDMS-2 and TIS in children with CP showed a positive correlation. Further the study can be explored in other Neurodevelopmental conditions at different ages various conditions and stages.

Limitation

This study included only two components that is stationary and locomotion, no item wise correlation was studied and was limited to a small age group 60 to 64 months.

Future scope of the study

Future studies can explore item-wise correlations between PDMS-2 and TIS, include broader age groups, and extend the research to other neurodevelopmental conditions. Longitudinal and interventional designs may offer deeper insights into how trunk control influences overall motor development and functional independence across different stages and diagnoses.

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