

To Evaluate the Effectiveness of Weight Shifting Activities to Improve Trunk Control and Balance Among Children with Cerebral Palsy

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ABSTRACT

The purpose of this study was to evaluate the effect of weight-shifting activities for improving trunk control and balance among children with cerebral palsy. **Background:** Impaired trunk control and balance are common challenges faced by children with cerebral palsy (CP), significantly affecting their functional abilities and participation in daily activities. Weight-shifting activities, which involve controlled movement of the centre of gravity, have been identified as a potential intervention to improve trunk control and postural stability in this population. **Methods:** A quasi-experimental design was chosen for the study. Based on inclusion and exclusion criteria 12 children with CP aged 5 to 15 years were selected. Participants received weight-shifting intervention for 5 sessions a week for 6 weeks. Intervention focused on static and dynamic weight-shifting activities. Trunk control and balance were used to assess trunk control and balance using standardized tools, Trunk Control Measurement Scale (TCMS) and Paediatric Balance Scale (PBS). Pre-test and post-test were compared. **Results:** Data analysis was done using SPSS Software. Wilcoxon signed-rank –test shows that the result was found to be significant. The p -value was 0.002 for TCMS and PBS which is statistically significant as the value is less than 0.05. **Conclusion:** Weight-shifting activities demonstrate significance in improving trunk control and balance among children with Cerebral Palsy, highlighting their importance as therapeutic activities in occupational therapy settings.

Keywords: Cerebral Palsy, Weight Shifting, Trunk Control, Balance, Motor Control

INTRODUCTION

Cerebral Palsy:

According to ICD-10. Cerebral palsy is a group of disorders that affect a person's ability to move, maintain balance, and control posture. ⁽¹⁾ Cerebral palsy (CP) is a group of non-progressive brain disorders affecting motor function, typically caused by brain damage before, during, or shortly after birth. Although the brain lesion doesn't worsen, the condition can impact movement and posture over time. Children with CP often have poor trunk control, delayed reaction time, and difficulty with movement planning and balance. These motor impairments limit their mobility, self-care, and social participation.

Trunk Control and Cerebral Palsy:

Trunk control refers to the ability to stabilise and manage the upper body, which is essential for

maintaining balance and sitting upright. It plays a vital role in child development and typically begins to develop by around four months of age. ⁽³⁾ Trunk control issues are common in children with cerebral palsy due to neurological and motor impairments affecting core muscles. Poor trunk stability leads to motor dysfunction, impacting posture, balance, and functional activities. Trunk control is essential for coordinated limb movements and functional tasks like reaching and walking. It helps maintain posture, manage weight shifts, and keep balance through proper sensorimotor function. In children with cerebral palsy, impaired trunk control hinders gross motor development, but research shows it can be improved with targeted exercises. A study showed that 10 hours of additional trunk exercises improved the ability to control the trunk in subacute stroke patients. ⁽⁴⁾ A study showed that Children with cerebral palsy (CP) frequently show impaired trunk control. ⁽⁷⁾

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



Balance and Cerebral Palsy:

Balance is a vital skill that enables us to maintain our posture and move safely through our environment. ⁽⁸⁾

⁽⁹⁾ Balance relies on visual, vestibular, and somatosensory systems to keep the body upright during rest and movement. In cerebral palsy, brain damage affects motor control, making balance crucial in rehabilitation. Static balance helps maintain posture, while dynamic balance prevents falls during movement. Developing both is essential for independence and daily activities.

Trunk Control and Balance:

Trunk control and balance are impaired to varying degrees in children with cerebral palsy, influenced by gender, topography, and severity of motor impairment. The study found a strong positive correlation between trunk control and balance in children with spastic CP. ⁽¹³⁾ Trunk stabilization can also have an immediate therapeutic effect on balance. It has been proven through many studies that trunk stabilization exercises immediately improve static and dynamic balance. [14] Activities that help to increase trunk control also affect balance and help to improve balance in children with cerebral palsy.

Weight Shifting in Cerebral Palsy:

Weight shift refers to the principle whereby the weight of the body is shifted from one supporting part of the body to another, such as from one leg to another. Weight shifting is an important skill for individuals with cerebral palsy as it can help in balance, stability, trunk control, posture, as well as mobility. In cerebral palsy due to muscle imbalance, spasticity, or weakness, weight shifting is often challenging. Improving weight shifting can help to improve trunk control and balance. Once the trunk control and balance are improved, the individual with cerebral palsy can enhance their mobility, independence, and quality of life. Various studies say that different weight-shifting activities can be used to improve trunk control and balance. ⁽⁴⁾ ⁽¹⁵⁾

AIM AND OBJECTIVES:

AIM:

To evaluate the effectiveness of weight-shifting activities to improve Trunk control and Balance among children with cerebral palsy.

OBJECTIVES:

- To evaluate Trunk control and balance using Trunk Control Measurement Scale (TCMS) and Paediatric Balance Scale (PBS)[Pre-test].
- To provide intervention using weight-shifting activities.
- To re-evaluate Trunk control and Balance using TCMS and PBS [post-test].
- To compare the pre-test and post-test scores to establish the effectiveness of weight shifting activities.

Need of The Study

Cerebral palsy (CP) is one of the most common motor disabilities in children, significantly affecting trunk control and balance, which are crucial for daily activities and independence. Weight shifting has shown potential in improving trunk control and balance. This study aims to evaluate the effectiveness of weight-shifting activities to improve trunk control and balance in children with CP.

REVIEW OF LITERATURE

kyoungsim Jung et al. (2014) conducted a study to check “The effectiveness of weight shifting abilities in stroke patients to improve trunk, proprioception and balance abilities”. The study evaluated the effects of weight-shift training on an unstable surface in 18 chronic hemiparetic stroke patients, divided into a weight-shifting group and a control group. The weight-shifting group trained on a Balance Pad and Dynamic Ball Cushion for 30 minutes, five times a week for four weeks, while the control group followed conventional exercises. Assessments using trunk reposition error (TRE), Trunk Impairment Scale (TIS), and Timed Up and Go (TUG) test showed that weight shift training effectively improved balance, proprioception, and trunk control in stroke patients. ⁽⁴⁾ A study was conducted on “Impaired visually guided weight-shifting ability in children with cerebral palsy” by Laurent Ballaz et al. (2015). The results show that an active video game can be used as an engaging and

effective method for evaluating visually guided weight-shifting abilities in children with motor impairments. ⁽²²⁾ **Lieve Heyrman et al. (2013)** conducted a study on "Clinical characteristics of impaired trunk control in children with spastic cerebral palsy". The study concluded that trunk control impairment varies by CP type and severity, highlighting the importance of targeted trunk-focused interventions to improve functional abilities. ⁽⁷⁾ **Sivatejaa Panibatla et al. (2017)** conducted a study on the "Relationship Between Trunk Control and Balance in Children with Spastic Cerebral Palsy". It is a cross-sectional study. The study found a significant relationship between trunk control and balance in children with CP. ⁽¹³⁾ A study was conducted by **Heba M Youssr El-Basatiny et al. (2015)** on "Effect of Trunk Exercises on Trunk Control, Balance and Mobility Function in Children with Hemiparetic Cerebral Palsy". The study found that trunk exercises improve trunk control, balance, and mobility in children with spastic hemiparetic cerebral palsy. ⁽²⁶⁾

METHODOLOGY

Research Design:

Quasi-experimental single-group (pre-test and post-test) study.

Study Setting:

The study was conducted in occupational therapy, Department of Therapeutics, National Institute for the Empowerment of Persons with Multiple Disabilities

(DIVYANGJAN), Muttukadu, Chennai.

Sampling Technique:

Convenient Sampling was used for the study.

Sampling Population:

Children diagnosed with cerebral palsy

Age Group:

5 to 15 years

Sampling Size:

This study included 12 children diagnosed with Cerebral Palsy.

Selection Criteria

Inclusion criteria:

- Both Genders
- Children with cerebral palsy between the age group of 5-15 years of age.
- Children with Cerebral Palsy with trunk control and balance impairment with TCMS scoring of static sitting balance more than 5 out of overall score 20.
- Able to do Upper Extremity Movements.

Exclusion criteria:

- Severe and profound Intellectual disability
- Seizures
- Other Spinal Deformities

Duration of the study:

The duration of the study was for 6 months. Intervention was given for 6 weeks. The length of each session was 30 minutes, conducted for five days a week. (30 sessions). ⁽⁴⁾

Variables:

- Independent variable: Weight-shifting activities
- Dependent variable: Trunk control and Balance

Tools Used

- Paediatric Balance scale. (PBS)
- Trunk control measurement scale. (TCMS)

Pediatric Balance Scale

The Pediatric Balance Scale (PBS), a modified Berg Balance Scale, assesses functional balance in children using 14 items scored 0–4 (max 56 points).

Psychometric properties:

- **Reliability:**

Test-retest (ICC=0.998)

Interrater reliability (ICC=0.997).

• Validity:

PEDI self-care ($r=0.73$, $p<0.001$) and mobility ($r=0.82$, $p<0.001$)
 Selective Control Assessment of Lower Extremity ($r=0.797$, $p<0.05$)

Trunk Control Measurement Scale:

The Trunk Control Measurement Scale (TCMS) assesses static and dynamic trunk control in children with spastic CP. It includes 15 items (max 58 points)

Psychometric properties:

- Reliability: The TCMS demonstrates high reliability (ICCs > 0.90) across all subscales.
- Validity: The TCMS exhibits strong validity in assessing trunk control and motor functions, with high correlations confirming its construct and concurrent validity.

Intervention Protocol

A total of 9 weight-shifting activities were used as an intervention. The therapist gave needed support to the child while doing activities. An adequate break was given between each activity.

Name of The Activities:

1. Weight shifting on the balance cushion. ⁽⁴⁾
2. Weight shifting in long leg. ⁽¹⁵⁾
3. Sequential weight shifting. ⁽¹⁶⁾
4. Activation of the trunk in all planes. ⁽¹⁷⁾
5. Swiss ball activity. ⁽¹⁸⁾
6. Bird dog. ⁽¹⁹⁾
7. Multidirectional step. ⁽²⁰⁾
8. Walking, holding the wall. ⁽²⁰⁾
9. Reaching tasks on the table and chair. ⁽²¹⁾

WEEK 1	<input type="checkbox"/>	Weight shifting on balance cushion
	<input type="checkbox"/>	Weight shifting in long leg sitting
	<input type="checkbox"/>	Bird dog
WEEK 2	<input type="checkbox"/>	Activation of the trunk in all planes.
	<input type="checkbox"/>	Sequential weight shifting.
	<input type="checkbox"/>	Reaching task on table and chair
WEEK 3	<input type="checkbox"/>	Activation of trunk in all planes.
	<input type="checkbox"/>	Swiss ball activity
	<input type="checkbox"/>	Bird dog
WEEK 4	<input type="checkbox"/>	Weight shifting on balance cushion
	<input type="checkbox"/>	Reaching task on table and chair
	<input type="checkbox"/>	Multidirectional step
WEEK 5	<input type="checkbox"/>	Swiss ball activity
	<input type="checkbox"/>	Multidirectional step
	<input type="checkbox"/>	Walking with holding wall.
WEEK 6	<input type="checkbox"/>	Swiss ball activity
	<input type="checkbox"/>	Multidirectional step
	<input type="checkbox"/>	Walking with holding wall.

PROCEDURE:

Data collection procedure: After parental concern, children with Cerebral palsy of the age group 5 – 15 years were selected to participate in this study based on inclusion and exclusion criteria. The parents of the participant gave written consent for the participant's willingness to participate. The trunk control measurement scale (TCMS) was used to assess trunk control. The Paediatric Balance Scale (PBS) was used to assess the balance. A total of 12 children were selected for the study based on the diagnosis. Intervention was given for 30 minutes per session, five days a week for 6 weeks. The post-test measure was administered at the end of the 6th-week intervention period. Data analysis was done.

RESULTS:

Statistical analysis:

The data was analysed using descriptive and inferential statistics. Descriptive statistics provided the mean and standard deviation, while inferential statistics were performed using the Wilcoxon Signed Rank Test. The SPSS 27 software package was used for all analyses.

• Descriptive Statistics:

Age and gender distribution are shown in the table below.

• Inferential Statistics:

Wilcoxon Signed Rank Test was used for both TCMS and PBS Pre vs. Post Test Scores

The gender distribution of participants, provide the demographic composition of the study sample. Total number of participants taken for the study were 12, male 8 (66.7%), female 4 (33.3%). The distribution shows a higher proportion of male participants compared to female participants. The age distribution of participants, highlighting the frequency, percentage, mean \pm standard deviation, and the range of ages within the study. With 33.3% of participants under 6 years and 66.7% over 6 years. This distribution helps in understanding the age-related factors that may influence the outcomes of the study, ensuring that the findings are relevant across different age ranges.

Wilcoxon Signed Rank - Test compared the Pre and Post-test scoring regarding TCMS Group in cerebral palsy children at a 5% level of significance was observed.

Table 1: statistical analysis of pre and post-tests of the Trunk control measurement scale (TCMS).

TCMS	Mean	N	Std. Deviation	Z - Value (P - Value)
Pre-Test	25.08	12	6.317	-3.064 (0.002) *
Post Test	33.75	12	6.107	

* Indicates Statistically Significant

Table 1 shows the interpretation of trunk control measurement scale (TCMS) there is **Significance difference** between the Pre and Post-test scoring

regarding TCMS group in cerebral palsy children's. The pre-test mean score was 25.08 ± 6.317 , and the post-test mean score was 33.75 ± 6.107 , showing a statistically significant decline ($p < 0.05$).

Table 2: shows the statistical analysis of pre and post-tests of the paediatric balance scale (PBS)

PBS	Mean	N	Std. Deviation	Z - Value (P - Value)
Pre-Test	23.75	12	11.639	-3.088 (0.002) *
Post Test	31.67	12	11.492	

* Indicates Statistically Significant

Wilcoxon Signed Rank - Test compared the Pre and Post-test scoring regarding PBS Group in cerebral palsy children at 5% level of significance was observed. There is **Significance difference** between the Pre and Post-test scoring regarding Paediatric Balance Scale group in cerebral palsy children's. The pre-test mean score was 23.75 ± 11.639 , and the post-test mean score was 31.67 ± 11.492 , showing a statistically significant decline ($p < 0.05$).

DISCUSSION:

The study was done to evaluate the effectiveness of weight shifting activities to improve trunk control and balance among children with cerebral palsy. Data was analysed and pre- and post-test were compared using SPSS software. Out of 12 children, 8 were male and 4 were female. The ages of children are, 4 children were in the age group of more than 6 years and 8 children of age less than 6 years. Table 1 shows the comparison of pre and post-test of Trunk control measurement scale (TCMS). The mean score increased from 25.08 in the pre-test to 33.75 in the post-test, this suggests that after giving intervention using weight-shifting activities, significant improvement is observed in trunk control. Table 2 shows a significant improvement in the Paediatric Balance Scale (PBS) scores among children with cerebral palsy (CP) post-intervention. The pre-test mean score of 23.75 increased to 31.67, with a statistically significance. This improvement highlights the effectiveness of the weight-shifting in enhancing balance. These results indicate that weight shifting activities can improve balance in children with CP. All the weight-shifting activities given for the intervention used static or dynamic balance. Continuous repetitions of the activities led to improvement in balance. During the intervention, it was observed that children who initially scored higher in various components of trunk control measurement scale and paediatric balance scale demonstrated relatively quicker progress and responded well to the intervention. Their existing functional abilities helped them to perform the intervention and to achieve further improvement easily. On the other hand, children who began with lower scores faces greater challenges in advancing to next level. Wilcoxon signed-rank test was used to compare pre-test and post-test scores of TCMS and

PBS. Thus, we can say that Weight-shifting activities has a significance in improving trunk control and balance. A similar study was done by Kyoungsim Jung in 2014 to evaluate the effect of weight-shifting training to improve trunk control and balance in stroke patients. The study also showed improvement in trunk control and balance after giving weight-shifting activities. ⁽⁴⁾ Based on the study results, the alternate hypothesis of the study "There is a significant effect of weight-shifting activities to improve trunk control and balance among children with Cerebral Palsy" is accepted and the null hypothesis is rejected.

CONCLUSION:

This study's results concluded that weight-shifting activities improve trunk control and balance among children with cerebral palsy. Enhanced balance and trunk control, as reflected in higher PBS and TCMS scores, may contribute to greater functional independence and improved quality of life. So, weight shifting may be considered as one of the interventions for addressing the trunk control and balance of children with cerebral palsy

LIMITATION & RECOMMENDATION:

LIMITATIONS:

- The study population had unequal gender distribution.
- The study was conducted only at one place – NIEPMD.

RECOMMENDATION:

- The research may be done to ensure that the weight shifting is beneficial for any other dependent variable.
- This study mainly focused on the paediatric population, but it could also be evaluated for adult conditions.
- More number of children can be made to participate to generalize the study.

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