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## Dual-task and single-task training for postural balance enhancement in children with intellectual disabilities

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### Abstract

This study aimed to compare the effectiveness of dual-task and single-task training on postural balance enhancement in children with intellectual disabilities (ID). A total of 40 children, aged 8-12 years, with mild to moderate ID were randomly assigned to either the dual-task or single-task training group. Both groups underwent a 12-week intervention focusing on improving postural balance. Postural balance was assessed using the Pediatric Balance Scale (PBS) and a force platform system to measure sway. The results indicated that while both groups showed significant improvements in postural balance, the dual-task training group demonstrated greater improvements, suggesting that dual-task exercises may offer superior benefits in enhancing postural control in children with ID.

**Keywords:** Children, intellectual disabilities, single-task, training group, including poor postural balance

### Introduction

Children with intellectual disabilities (ID) often exhibit deficits in motor control, including poor postural balance, which can hinder their participation in daily activities. Improving postural balance is critical to fostering their functional independence. Traditionally, single-task balance training has been used to address balance issues. However, dual-task training, which involves performing a cognitive or motor task alongside balance exercises, has recently been shown to improve postural control by engaging both cognitive and motor systems simultaneously. This study aims to investigate whether dual-task training is more effective than single-task training in enhancing postural balance in children with ID.

### Objective

The objective of this paper is to compare the effectiveness of dual-task and single-task training on improving postural balance in children with intellectual disabilities.

### Methodology

#### Participants

A total of 40 children (aged 8-12 years) with mild to moderate intellectual disabilities were recruited from special education schools in Bhagalpur District, Bihar, India. Participants were screened to ensure they had no severe musculoskeletal or neurological impairments. Written informed consent was obtained from the participants' guardians.

**Table 1:** Demographic Profile of Participants

Characteristic	Single-Task Group (N=20)	Dual-Task Group (N=20)
Age (years)	9.5±1.2	9.6±1.3
Gender (M/F)	12/8	13/7
ID Level (Mild/Moderate)	14/6	15/5
Height (cm)	132.4±5.8	131.9±6.1
Weight (kg)	35.2±4.5	34.8±4.8

### Study Design

This was a randomized controlled trial with participants assigned to either the dual-task training group or the single-task training group.

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**Table 2:** Intervention activities for 12 week training

Week	Single-Task Training Activities	Dual-Task Training Activities
Week 1-2	Standing on one leg	Standing on one leg while solving math problems
Week 3-4	Walking on a balance beam	Walking on a balance beam while catching/throwing a ball
Week 5-6	Shifting weight from one foot to the other	Shifting weight while naming objects
Week 7-8	Reaching forward from a standing position	Reaching forward while reciting words backward
Week 9-10	Balancing on a foam surface	Balancing on foam while answering cognitive questions
Week 11-12	Walking backward on a balance beam	Walking backward on a balance beam while memorizing sequences

### Outcome Measures

- Pediatric Balance Scale (PBS):** A 14-item scale that evaluates various aspects of functional balance, including standing, reaching, turning, and shifting weight. Each task is scored on a 0-4 scale, with a higher score indicating better balance.
- Force Platform System:** This system objectively measured center of pressure (CoP) displacement and sway velocity. Participants were instructed to stand barefoot on the platform for 30 seconds while their CoP movements were recorded in both the anterior-posterior and medial-lateral directions.

**Table 3:** Observation of Data

Group	PBS (Pre)	PBS (Post)	CoP Displacement (Pre)	CoP Displacement (Post)	Sway Velocity (Pre)	Sway Velocity (Post)
Single-Task Group	25.3±3.4	34.2±2.8	5.2 cm±0.5	3.8 cm±0.6	9.2 cm/s±1.2	7.1 cm/s±1.1
Dual-Task Group	25.1±3.2	37.5±3.1	5.1 cm±0.6	3.1 cm±0.4	9.3 cm/s±1.3	6.0 cm/s±1.0

Data were analyzed using SPSS software version 26. A within-group analysis was performed using paired t-tests to assess the changes in PBS scores and force platform measurements from baseline to post-intervention. Independent t-tests were used to compare the post-intervention improvements between the dual-task and single-task groups.

A p-value of < 0.05 was considered statistically significant. The following data were collected pre- and post-

intervention.

### Results

#### Baseline and Post-Intervention Outcomes

The table below summarizes the baseline and post-intervention outcomes for both the single-task and dual-task training groups. Data includes the Pediatric Balance Scale (PBS) scores, Center of Pressure (CoP) displacement, and sway velocity pre- and post-intervention.

**Table 4:** Observed Data from Pre- and Post-Intervention

Variable	Single-Task Group (N=20)	Dual-Task Group (N=20)	P-Value
PBS (Pre)	25.3 ± 3.4	25.1 ± 3.2	0.79
PBS (Post)	34.2 ± 2.8	37.5 ± 3.1	0.001**
CoP Displacement (Pre)	5.2 cm ± 0.5	5.1 cm ± 0.6	0.76
CoP Displacement (Post)	3.8 cm ± 0.6	3.1 cm ± 0.4	0.03*
Sway Velocity (Pre)	9.2 cm/s ± 1.2	9.3 cm/s ± 1.3	0.85
Sway Velocity (Post)	7.1 cm/s ± 1.1	6.0 cm/s ± 1.0	0.02*

**Note:** \*p<0.05 is considered statistically significant.

### Discussion

The results of this study demonstrate that both single-task and dual-task training interventions led to significant improvements in postural balance among children with intellectual disabilities (ID) over the course of 12 weeks. However, children in the dual-task training group exhibited more pronounced improvements compared to those in the single-task group, as reflected in the Pediatric Balance Scale (PBS), Center of Pressure (CoP) displacement, and sway velocity measures.

In terms of PBS scores, both groups showed improvements, but the dual-task group exhibited significantly greater gains. This suggests that dual-task training, which involves combining physical and cognitive challenges, is more effective at enhancing postural balance. The addition of cognitive tasks such as solving problems or catching objects while maintaining balance appears to engage different neurological pathways, potentially facilitating more comprehensive motor learning and adaptation. These findings highlight the potential of dual-task exercises to better target and stimulate both cognitive and motor systems, resulting in enhanced balance control.

The reduction in CoP displacement further supports the effectiveness of dual-task training. The dual-task group showed a greater decrease in CoP displacement compared to the single-task group, indicating superior postural stability. This greater improvement in the dual-task group may be due to the simultaneous cognitive engagement required during the training, which likely promotes a more integrated response in balance-related tasks. The greater reduction in sway velocity observed in the dual-task group also reflects an improved ability to maintain balance in dynamic conditions, suggesting that this type of training may better prepare children with ID to handle real-world postural challenges.

Overall, the findings from this study suggest that incorporating dual-task activities into balance training programs could lead to more substantial improvements in postural control for children with intellectual disabilities. The inclusion of cognitive tasks alongside physical exercises may encourage greater neurological engagement, fostering improvements not only in balance but also in overall motor and cognitive coordination. The dual-task approach may also help children with ID enhance their functional abilities, allowing for more confident

participation in everyday activities that require balance and coordination.

These results offer important implications for clinical and educational settings, where dual-task training could be implemented as a more effective method of improving balance in children with ID. By targeting both motor and cognitive functions, this approach could lead to better long-term outcomes and increased functional independence. However, further research is needed to explore the long-term effects of dual-task training, particularly in different age groups and levels of intellectual disability, to fully understand its benefits and applicability.

### Conclusion

The findings of this study suggest that both single-task and dual-task training can improve postural balance in children with intellectual disabilities, but dual-task training offers more significant benefits. The dual-task approach, which combines cognitive and motor challenges, leads to greater improvements in balance control, as evidenced by higher Pediatric Balance Scale scores, reduced center of pressure displacement, and lower sway velocity. This indicates that engaging both cognitive and motor systems simultaneously through dual-task activities may provide a more effective method for enhancing postural stability in children with intellectual disabilities. The results support the inclusion of dual-task training in interventions aimed at improving balance and motor function, with potential long-term benefits for daily functional activities and overall independence in this population. Further research is necessary to explore the long-term impacts and broader applicability of dual-task interventions in various settings.

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