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# Assessment and Comparison of Static and Dynamic Balance in Children with Partial Visual Impairment – A Case Control Study

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**Abstract**

**Aim**: Vision provides essential spatial cues for maintaining balance and posture. This study compares static and dynamic balance in children with partial visual impairment and those with normal vision using the Pediatric Berg Balance Scale (PBS) and Functional Reach Test (FRT). The results help identify balance deficits and guide interventions to enhance stability. **Materials and Methods**: A total of seventy-two children aged 5–15 years were selected through purposive sampling and divided into two groups. The study group included children with partial visual impairment, while the control group consisted of children with normal vision. Their static and dynamic balance were evaluated using the Pediatric Balance Scale and the Functional Reach Test. **Results**: The mean PBS score was significantly lower ($p < 0.001$) in the visually impaired group, indicating reduced static balance associated with vision loss. The mean FRT score was also lower in this group, reflecting decreased dynamic balance; however, this difference was not statistically significant ($p = 0.051$). These findings suggest a trend toward impaired dynamic stability among children with visual impairment. **Conclusion**: The study revealed that children with partial visual impairment demonstrated significantly reduced static balance compared to those with normal vision. Although dynamic balance also showed a decreasing trend, the difference was not statistically significant. Overall, visual impairment was found to have an adverse effect on postural stability.

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**Key words: Partial Visual Impairment, Static Balance, Dynamic Balance, Pediatric Balance Scale, Functional Reach Test**

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## Introduction

Vision is a complex sensory process in which the eyes and brain work together to interpret light reflected from objects, allowing individuals to perceive, understand, and interact with their surroundings. Light enters the eye through the cornea and lens, which focus it onto the retina—a light-sensitive tissue located at the back of the eye. The retina contains rods, which allow vision in dim light, and cones, which provide colour perception and visual clarity in bright light. These photoreceptors convert light into electrical impulses that are transmitted to the visual cortex for interpretation (Lamb, 2022). Visual acuity, or the sharpness of vision, is an important measure of functional visual performance. Reduced acuity can interfere with daily activities and independence, and commonly results from conditions such as cataracts, glaucoma, diabetes mellitus, or neurological disorders (Lee et al., 2022).

Visual impairment refers to a reduced ability to see clearly, even with the use of corrective lenses. According to the World Health Organization (WHO), visual impairment is classified as low vision or blindness. *Low vision* is defined as visual acuity less than 6/18 but equal to or better than 3/60 in the better eye with the best possible correction, whereas *blindness* is defined as visual acuity less than 3/60 or a visual field of less than ten degrees (Dandona and Dandona, 2004). Partial visual impairment describes individuals who retain some degree of functional vision but experience difficulty performing routine activities such as reading, mobility, and recognizing faces or objects. This condition may arise from congenital disorders such as congenital cataract or glaucoma, or from acquired conditions including diabetic retinopathy, trauma, or neurological diseases (Brown et al., 2000).

Balance is a fundamental motor skill essential for maintaining stability during both stationary and dynamic activities. It depends on the coordinated input from three key sensory systems: the visual system, which offers spatial orientation cues; the vestibular system, located in the inner ear, which detects head movement and equilibrium; and the somatosensory system, which provides proprioceptive information about body position. These inputs are integrated by the central nervous system to maintain posture and stability (Horak et al., 2024). When vision is compromised, postural control becomes less effective because the remaining sensory systems cannot fully compensate for the loss of visual input, leading to reduced stability, increased sway, and impaired balance performance (Li et al., 2025).

Previous studies consistently highlight the essential role of vision in maintaining postural stability and spatial orientation. Visual feedback plays a particularly important role during standing and locomotion, while visual impairment is associated with increased postural sway and instability (Rizzato et al., 2021). Postural balance is typically described in terms of static balance, which refers to maintaining a stable position without movement, and dynamic balance, which involves maintaining stability during movement or changes in body position (Taneda et al., 2021). Given the importance of visual input in maintaining equilibrium, the present study aims to assess and compare static and dynamic balance in children with partial visual impairment using the Pediatric Balance Scale (PBS) and the Functional Reach Test (FRT) (West et al., 2002). Understanding these balance deficits may contribute to the development of early intervention strategies and targeted rehabilitation programs to improve postural stability in visually impaired children (Wood et al., 2022).

## Materials & Methods

The present study was designed as a case–control study and was conducted over a period of six months across various schools and residential societies in the Pune region. A purposive sampling

method was used to select participants, resulting in a total sample size of seventy-two children. The sample size was determined using Cohen's formula for detecting correlation, which considers the Z-value for the desired level of significance, the Zβ-value for the desired statistical power, and the expected correlation coefficient (r).
The study included children with partial visual impairment as well as children with normal vision, all between five and fifteen years of age and representing both genders. Children were excluded if they had musculoskeletal disorders affecting balance (such as scoliosis or clubfoot), neurological conditions (such as Down syndrome, cerebral palsy, or autism), hearing loss, or altered sensations such as impaired proprioception. For the control group, age- and gender-matched children with normal vision were included, provided they had no history of neurological, musculoskeletal, developmental, or systemic conditions affecting balance or posture, and no uncorrected refractive errors or visual deficits.
The equipment used for assessment included the Pediatric Balance Scale (PBS), an adjustable-height bench, a chair with back support and armrests, a stopwatch, a six-inch step stool, a measuring tape, and a ruler. The primary outcome measures were the Pediatric Balance Scale (PBS) and the Functional Reach Test (FRT).
Prior to data collection, Institutional Ethical Committee approval was obtained. Participants were recruited according to the inclusion and exclusion criteria for both the study and control groups. Assent was obtained from the children, and informed consent was collected from their parents, guardians, or caregivers. The purpose and procedures of the study were explained in detail to all participants and their guardians, and demographic information for each child was recorded.
All children were assessed using the Pediatric Balance Scale (PBS) and the Functional Reach Test (FRT). The same assessment procedures were followed for both children with partial visual impairment and those with normal vision to allow for accurate comparison between groups. The collected data were systematically entered into an Excel spread sheet for organization and statistical analysis, and the results were interpreted accordingly.
**Results**
The present case–control study was conducted to assess and compare static and dynamic balance in children with partial visual impairment. A total of seventy-two children aged between five and fifteen years participated in the study, with thirty-six children in the partial visual impairment group (study group) and thirty-six children in the normal vision group (control group). The study was carried out across various schools and residential societies in the Pune region over a period of six months.
The age distribution of participants was similar in both groups, with the majority belonging to the 9–11 years age range, followed by those aged 6–8 years and 12–15 years, ensuring age comparability between groups. Both groups also demonstrated a similar gender ratio, with males comprising approximately seventy percent of each group, thereby minimizing gender-related confounding. Among the visually impaired children, eighty-six percent had bilateral visual impairment and fourteen percent had unilateral impairment. Most children in the study group exhibited a high degree of visual disability, with half of them demonstrating 80–90% disability, indicating severe visual loss.
Static balance was assessed using the Pediatric Balance Scale (PBS), while dynamic balance was measured using the Functional Reach Test (FRT). The mean PBS score for the visually impaired group was 49.17 ± 0.71, compared to 54.86 ± 0.18 in the control group. Statistical analysis using the Mann–Whitney U test revealed a significant difference ($p < 0.001$), indicating that children with partial visual impairment had markedly reduced static balance compared to children with normal vision.

For dynamic balance, the mean FRT score in the visually impaired group was 8.97 ± 0.48, whereas the control group scored 10.58 ± 0.56. Although the control group demonstrated slightly better performance, the difference was not statistically significant ($p = 0.051$), indicating only a mild reduction in dynamic balance among children with partial visual impairment.
Overall, the results indicate that partial visual impairment has a significant negative impact on static balance, contributing to decreased postural stability. Although dynamic balance was also reduced in the study group, the difference did not reach statistical significance. These findings highlight the critical role of vision in maintaining postural control and support the need for early balance training and sensory integration interventions to improve stability, safety, and confidence in children with partial visual impairment.

**Table 1. Age Distribution**

| Age | Study Group | Control Group |
|---|---|---|
| **6-8 years** | 22.22% | 25% |
| **9-11 years** | 52.78% | 47.22% |
| **12-15 years** | 25% | 27.78% |

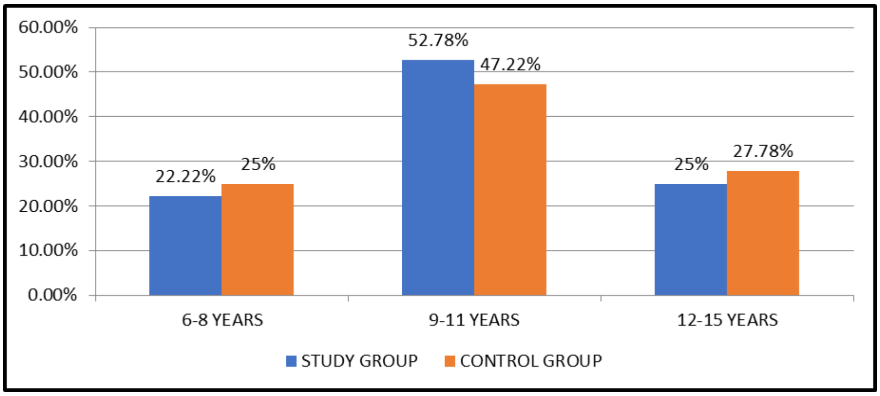


**Figure 1. Age Distribution**

**Table 2. Gender Distribution**

| Gender | Study Group | Control Group |
|---|---|---|
| **Male** | 72% | 69% |
| **Female** | 28% | 31% |

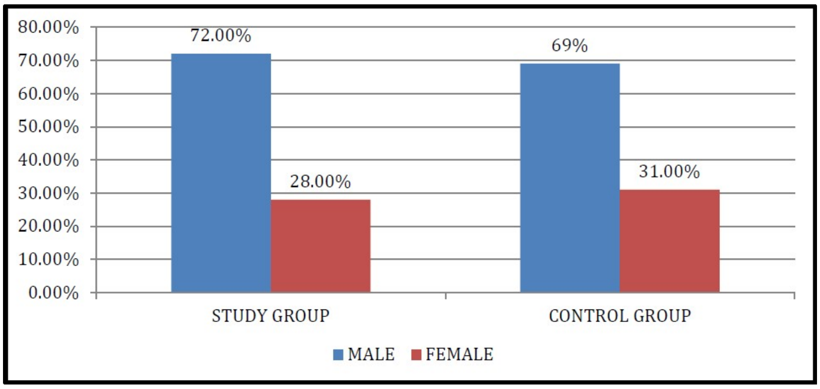


**Figure 2. Gender Distribution**

**Table 3. Type of Blindness**

| Blindness | Count | Percentage |
|---|---|---|
| **Unilateral** | 5 | 13.89% |
| **Bilateral** | 31 | 86.11% |

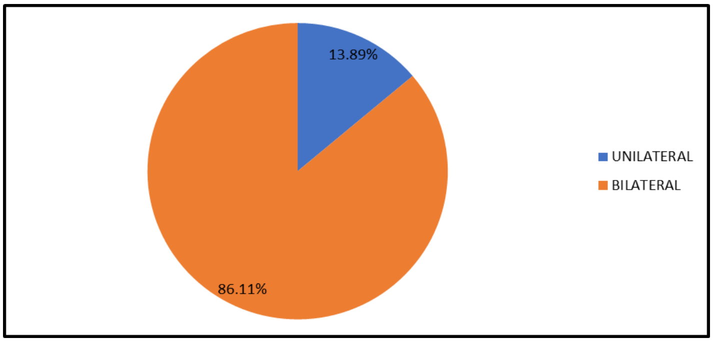


**Figure 3. Type of Blindness**

**Table 4. Percentage of Disability**

| Disability | Count | Percentage |
|---|---|---|
| 40-49 | 2 | 5% |
| 50-59 | 1 | 3% |
| 60-69 | 9 | 25% |
| 70-79 | 6 | 17% |
| 80-90 | 18 | 50% |

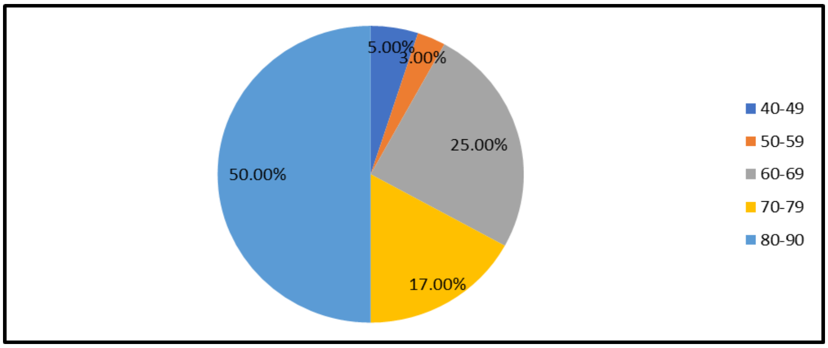


**Figure 4. Percentage of Disability**

**Table 5. Comparative Analysis of Pediatric Balance Scale (PBS)**

| Group | Mean | Standard Deviation |
|---|---|---|
| **Study** | 49.17 | 0.713 |
| **Control** | 54.86 | 0.183 |

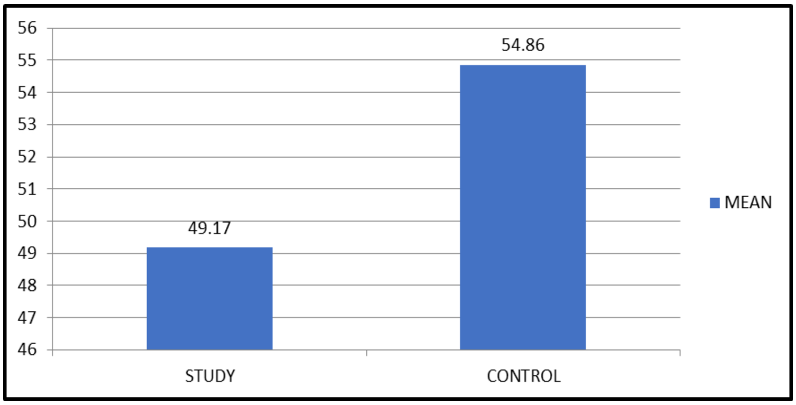


**Figure 5. Comparative Analysis of Pediatric Balance Scale (PBS)**

**Table 6. Comparative Analysis of Functional Reach Test (FRT)**

| Group | Mean | Standard Deviation |
|---|---|---|
| **Study** | 8.97 | 0.487 |
| **Control** | 10.58 | 0.56 |

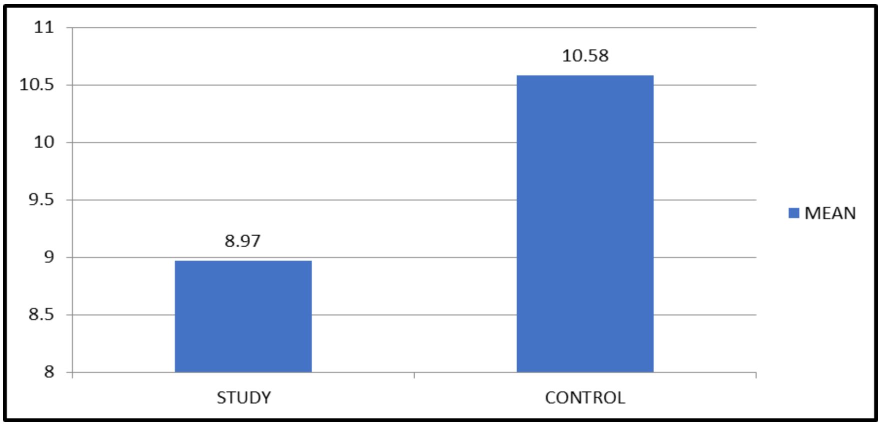


**Figure 6. Comparative Analysis of Functional Reach Test (FRT)**

## Discussion

The present comparative study aimed to assess and compare static and dynamic balance in children with partial visual impairment and those with normal vision. A total of seventy-two children participated in the study, with equal representation in both groups. Static balance was evaluated using the Pediatric Balance Scale (PBS), while dynamic balance was assessed through the Functional Reach Test (FRT).

Both groups were comparable in terms of age and gender, ensuring a balanced analysis. Most participants were between nine and eleven years of age, and in both groups, the majority were boys. Among the children with visual impairment, most had bilateral involvement, and many of them presented with severe levels of visual disability. This indicates that a large proportion of the visually impaired group experienced substantial visual loss that could influence their postural control and movement efficiency.

The findings revealed that the mean PBS score of children with partial visual impairment was significantly lower than that of children with normal vision. This clearly demonstrates that static balance is more compromised in the visually impaired group. Vision plays a crucial role in maintaining postural stability by providing continuous information regarding body orientation, movement, and environmental cues. When visual input is reduced, the body is required to rely more heavily on the vestibular and proprioceptive systems. However, these systems alone cannot fully compensate for the absence of visual feedback, resulting in increased postural sway and reduced stability.

Children with partial visual impairment may also show delays in motor and sensory development, as vision supports coordinated movement and spatial awareness. Since vestibular and proprioceptive systems are still maturing during childhood, these children face greater difficulty in adapting and compensating for visual deficits. To maintain balance, they often adopt compensatory strategies such as stiffening their posture or widening their base of support. Although these strategies provide a sense of safety, they tend to limit natural balance responses and reduce overall postural control, which contributes to their lower PBS scores.

In the Functional Reach Test, the visually impaired children demonstrated lower reach distances than the control group; however, the difference did not reach statistical significance. This suggests that their dynamic balance is affected to some extent but not severely impaired. Dynamic balance tasks depend on depth perception and accurate judgment of distance. Children with partial visual impairment may find it difficult to estimate how far they can reach safely and thus restrict their movement to avoid losing balance. This cautious approach results in shorter reach distances during the FRT.

Overall, the study indicates that static balance is more adversely affected than dynamic balance in children with partial visual impairment. Vision provides essential spatial and motion cues that help maintain an upright posture. When visual information is limited, the brain receives less precise feedback, leading to instability and increased reliance on other sensory systems. Although these systems offer partial compensation, they do not fully substitute the stabilizing role of vision.

In conclusion, children with partial visual impairment exhibit significantly reduced static balance and mildly reduced dynamic balance compared to children with normal vision. These findings emphasize the importance of vision in postural stability and highlight the need for early balance training and multisensory interventions. Exercises aimed at enhancing proprioceptive and vestibular input may help improve balance performance and confidence among visually impaired children.

## Conclusion

Children with partial visual impairment showed significantly reduced static balance compared to children with normal vision, while dynamic balance was only mildly affected and not statistically significant. These findings highlight the essential role of vision in maintaining postural stability, particularly during static tasks. Reduced visual input limits spatial orientation and optical flow cues, leading to greater postural sway. Although compensatory reliance on proprioceptive and vestibular systems provides some support, it cannot fully replace visual feedback. Overall, visual impairment substantially influences balance control. The results emphasize the need for early, targeted balance training and multisensory integration approaches in rehabilitation programs for visually impaired children.

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Conflict of Interest: None declared