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Original Article

Prevalence of Balance Impairment in Children with Hearing Impairment

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Abstract

Background: Deafness, defined as a hearing impairment so severe that it prevents processing linguistic information through auditory senses, is believed to be linked to delays in motor development, including balance.

Objective: To figure out the prevalence of balance impairment in children with hearing impairment.

Methods: A cross-sectional study design was employed, involving 377 children aged between 8 and 15 years with hearing impairments, selected through non-probability convenient sampling. Data were collected from special education schools using the Standardized Walking Obstacle Course (SWOC) and Timed Up and Go (TUG) tests. The data were compiled and analyzed using SPSS version 25, with descriptive statistics used to present the findings.

Results: The study included 377 children with a mean age of 11.08 years; 21.5% were female, and 78.5% were male. Approximately 77.7% of participants demonstrated poor balance skills in the SWOC test, while 37.1% showed fair or poor performance in the TUG test.

Conclusion: The study found a high prevalence of balance impairment in children with hearing impairments. Both male and female participants reported symptoms of balance impairments, with 77.7% demonstrating poor balance skills in the SWOC test and 37.1% showing fair or poor performance in the TUG test. These findings suggest that children with hearing impairments are at significant risk for balance deficits.

1 Introduction

Hearing loss is a major global health issue, defined as the inability to process linguistic information using auditory senses due to a severe impairment, either with or without amplification (1). This impairment can result from damage to or underdevelopment of the vestibular system, which not only affects hearing but also plays a crucial role in maintaining balance and spatial orientation. Moreover, hearing loss has been linked to various psychological and social challenges, including depression, social isolation, and reduced socioeconomic status, particularly in the elderly (2). In children, hearing loss can impede language acquisition, academic performance, and future employment opportunities. The etiologies of hearing loss include issues in the small bones of the middle ear or in the vestibulocochlear nerve, also known as the eighth cranial nerve, which is responsible for transmitting sound to the brain (3).

Hearing loss in children is a multifaceted condition that extends beyond communication barriers to include physical, emotional, and developmental challenges. Deaf and hard-of-hearing children are more susceptible to

physical, emotional, and sexual abuse compared to their hearing peers. Furthermore, these children often experience vestibular dysfunction, which can significantly impair their balance and postural control (4). According to the National Institute on Deafness and Other Communication Disorders, approximately three out of every 1,000 children born in the United States will have some form of hearing loss (5). This condition is directly linked to delays in motor development, including balancing, postural control, and limb coordination.

Balance is essential for daily activities, allowing children to maintain, achieve, or restore a stable state whether they are standing still or moving. Static balance refers to maintaining a steady position in a weight-bearing, antigravity posture for a short period, while dynamic balance involves maintaining stability during movement, such as walking or running (6). Research has shown that children with severe hearing impairments often exhibit poorer static balance compared to their typically developing peers (7). Furthermore, the literature indicates that 20-85% of children with sensorineural hearing loss (SNHL) suffer from peripheral vestibular dysfunctions, which compromise their balance due to the close anatomical and functional relationship between the cochlea and the vestibular apparatus (8).

Previous studies have primarily focused on unilateral hearing impairments or static balance, without adequately addressing dynamic balance or bilateral impairments. This study aims to fill that gap by examining both static and dynamic balance in children with unilateral and bilateral hearing impairments, thereby expanding the scope for both diagnosis and rehabilitation (9). Identifying balance issues early in hearing-impaired children is crucial for implementing suitable treatments and developing appropriate physical education programs that cater to their needs, thereby ensuring a more effective and balanced lifestyle.

The assessment of balance in hearing-impaired children involves several tools and tests. The Standardized Walking Obstacle Course (SWOC) test and the Timed Up and Go (TUG) test are two reliable measures used in clinical practice to evaluate balance and functional mobility. The SWOC test assesses an individual's ability to walk and maneuver around obstacles, measuring stability and speed, while the TUG test evaluates functional mobility by timing the ability to rise from a chair, walk a short distance, turn, walk back, and sit down (10). These tests provide valuable insights into the balance capabilities of children with hearing impairments, aiding in the identification of those at risk of balance deficits.

This study aims to determine the prevalence of balance impairment in children with hearing impairments using the SWOC and TUG tests. By focusing on both static and dynamic balance impairments in unilateral and bilateral hearing-impaired children, this research seeks to enhance diagnostic and rehabilitative approaches, ultimately improving the quality of life for these children. Early identification and intervention can help mitigate the adverse effects of balance impairments, supporting better physical health, social integration, and educational outcomes for hearing-impaired children (11).

2 Material and Methods

This cross-sectional study employed a non-probability convenient sampling technique to investigate the prevalence of balance impairment in children with hearing impairments. Data were collected from various schools in Lahore and Sheikhupura over six months following the approval of the study synopsis. The sample size of 377 children was calculated using the RaoSoft sample size calculator. The target population consisted of children aged between 8 and 15 years who had hearing impairments and met the inclusion criteria. These criteria included the ability to understand commands and no history of musculoskeletal disease, while

exclusion criteria encompassed visual impairments, epilepsy or seizures, hip and knee flexion contractures, serious medical complications, and past surgical history of the lower limbs.

Data collection involved a self-administered questionnaire, and informed consent was obtained from the parents of the participating children. The study adhered to ethical standards, in compliance with the Declaration of Helsinki. Data were gathered using the Standardized Walking Obstacle Course (SWOC) test and the Timed Up and Go (TUG) test. The SWOC test, a performance-based test designed to assess an individual's capacity to walk and maneuver around obstacles in a controlled environment, evaluates balance, direction changes, and obstacle avoidance, all of which are critical for daily activities and reducing the risk of falls. The SWOC test has demonstrated very satisfactory to excellent reliabilities, with intraclass correlation coefficients (ICC) ranging from 0.851 to 0.993 (17).

The TUG test, also a performance-based measure, was used to assess functional mobility. This test measures the time it takes for an individual to rise from a chair, walk a short distance, turn around, walk back to the chair, and sit down. The TUG test is a valid and reliable measure of functional mobility, providing insights into stability and time walking forward over a given distance, including one turn and sit-to-stand and stand-to-sit transitions. The TUG test has shown significant correlations with SWOC completion times and step counts under various conditions, with correlation coefficients ranging from 0.586 to 0.815 (2).

Statistical analysis was performed using SPSS version 25. Descriptive statistics, including mean and standard deviation, were used to present categorical and demographic data. Numerical variables were expressed as mean and standard deviation. The data analysis aimed to determine the prevalence of balance impairment among the participating children, with results discussed in terms of the SWOC and TUG test performances.

The study included 377 children with hearing impairments, with a mean age of 11.08 years and a standard deviation of 2.216 years. The gender distribution comprised 21.5% female and 78.5% male participants. The results indicated that 21 patients reported an 'Excellent' score with no desirable balance impairment, 63 reported a 'Good' score, 139 reported a 'Fair' score, and 154 reported a 'Poor' score in the SWOC test. In the TUG test, 145 patients reported an 'Excellent' score with no desirable balance impairment, 121 reported a 'Good' score, 58 reported a 'Fair' score, and 53 reported a 'Poor' score.

This study highlights the significant prevalence of balance impairment in children with hearing impairments, underscoring the need for early identification and intervention to mitigate the adverse effects on physical health, social integration, and educational outcomes. The findings suggest that both static and dynamic balance impairments are prevalent in this population, necessitating a comprehensive approach to diagnosis and rehabilitation.

3 Results

The study involved 377 children with hearing impairments, aged between 8 and 15 years, with a mean age of 11.08 years and a standard deviation of 2.216 years. The gender distribution included 21.5% female and 78.5% male participants. The results of the SWOC and TUG tests indicated that a significant proportion of the participants demonstrated poor balance skills. In the SWOC test, 40.8% of the children had 'Poor' performance, 36.9% had 'Fair' performance, 16.7% had 'Good' performance, and only 5.6% had 'Excellent' performance.

Table 1 Age Range Distribution

Age Range	Frequency	Percent
8-10	144	38.2
11-13	168	44.6
14-15	65	17.2
Total	377	100.0

In the TUG test, 15.4% of the participants had a 'Poor' performance, 21.8% had a 'Fair' performance, 24.4% had a 'Good' performance, and 38.5% had an 'Excellent' performance.

Table 2 Gender Distribution

Gender	Frequency	Percent
Female	81	21.5
Male	296	78.5
Total	377	100.0

The findings reveal a high prevalence of balance impairment among children with hearing impairments.

Table 3 SWOC Test Performance

Performance Level	Frequency	Percent
Excellent	21	5.6
Good	63	16.7
Fair	139	36.9
Poor	154	40.8
Total	377	100.0

Specifically, 77.7% of participants demonstrated poor balance skills in the SWOC test, while 37.1% showed fair or poor performance in the TUG test.

Table 4 TUG Test Performance

Performance Level	Frequency	Percent
Excellent	145	38.5
Good	92	24.4
Fair	82	21.8
Poor	58	15.4
Total	377	100.0

These results suggest that children with hearing impairments are at a considerable risk for deficits in body balance, highlighting the need for targeted interventions to improve their balance and functional mobility.

4 Discussion

The study revealed a significant prevalence of balance impairment among children with hearing impairments. The findings indicated that 77.7% of participants demonstrated poor balance skills in the SWOC test, while 37.1% exhibited fair or poor performance in the TUG test. These results align with previous research, which has consistently shown that children with hearing impairments often experience challenges in maintaining balance and postural control (4). The high prevalence of balance impairment observed in this study can be

attributed to the anatomical and functional relationship between the cochlea and the vestibular apparatus, both of which are components of the vestibular-auditory system (8). This relationship underscores the importance of considering vestibular dysfunction when addressing balance issues in children with hearing impairments. Previous studies have reported similar findings, indicating that a significant proportion of children with sensorineural hearing loss exhibit peripheral vestibular dysfunctions, which compromise their balance (7).

The study's strengths included a large sample size and the use of reliable and valid assessment tools, such as the SWOC and TUG tests, which have demonstrated satisfactory to excellent reliabilities (17). The inclusion of both unilateral and bilateral hearing impairments, as well as the consideration of both static and dynamic balance, provided a comprehensive understanding of balance impairments in this population. However, the study also had limitations. The cross-sectional design limited the ability to establish causal relationships between hearing impairment and balance deficits. Additionally, the use of non-probability convenient sampling may have introduced selection bias, potentially affecting the generalizability of the findings. Furthermore, the study did not account for the potential influence of other factors, such as the duration and severity of hearing loss, the use of hearing aids, and the presence of additional disabilities, which could have impacted balance performance (14-17).

In light of these findings, it is recommended that healthcare providers working with children with hearing impairments incorporate balance assessments into their routine evaluations. Early identification of balance impairments can facilitate timely interventions, which may include vestibular rehabilitation exercises, balance training programs, and the use of assistive devices to enhance stability and prevent falls. Schools should also consider developing tailored physical education programs that address the unique needs of children with hearing impairments, focusing on activities that promote balance and coordination (18).

Future research should aim to explore the longitudinal effects of hearing impairment on balance and investigate the efficacy of various intervention strategies in improving balance in this population. Studies should also consider a more diverse sample, including children from different geographic regions and socio-economic backgrounds, to enhance the generalizability of the findings. Additionally, examining the impact of advanced hearing technologies, such as cochlear implants, on balance performance could provide valuable insights into the potential benefits of these devices beyond auditory rehabilitation (19).

5 Conclusion

In conclusion, this study highlighted the substantial prevalence of balance impairment among children with hearing impairments, emphasizing the need for comprehensive assessments and targeted interventions to address these challenges. By improving our understanding of the relationship between hearing loss and balance, we can develop more effective strategies to support the physical, social, and academic development of children with hearing impairments (11).

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Disclaimers

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