Jurnal SPORTIF: Jurnal Penelitian Pembelajaran
Vol. 9 No. 3, December 2023, pp. 437 – 446
https://doi.org/10.29407/js_unpgri.v9i3.21062

Balance assessment in students with hearing impairment

Febriani Fajar Ekawati[1abef], Tri Winarti Rahayu[2cde], Ismaryati[1cde], Budhi Satyawan[2cd], Abrean Meli Andani[1cd].

[1]Department of Sport Coaching Education, Faculty of Sports, Universitas Sebelas Maret, Indonesia.

[2]Department of Physical Education, Health, and Recreation, Faculty of Sports, Universitas Sebelas Maret, Indonesia.

Received: 28 August 2023; Revised: 19 November 2023; Accepted: 7 December 2023; Available online: 26 December 2023.

Abstract

Balance is the ability to maintain body position when moving or standing still. Therefore, children must have this ability to move correctly. Children with hearing loss have problems in their vestibular system, consequently disturbing their daily activity concerning balance condition. This study aimed to evaluate the balance of students with hearing impairment in Karanganyar, Central Java. The present survey study used the Balance Test to measure 59 (male = 31, female = 28) hearing-impaired students' balance. Descriptive statistics analysis was used to calculate the mean of all participants and every gender group. The result revealed that the average balance score of all students was 1,136, the highest score was 4, and the lowest was 1. Concerning gender, females performed slightly better than males on the balance test, with scores of 1,143 and 1,129, respectively. Of the 59 students, more than 90% of females and males were categorized as poor, and more than 3% were classified as moderate and very good. The study suggests that the balance score of hearing-impaired students was low.

Keywords: hearing-impaired student, hearing impairment, balance, assessment.

How to Cite: Ekawati, F. F., Rahayu, T. W., Ismaryati, I., Satyawan, B., & Meli Andani, A. (2023). Balance assessment in students with hearing impairment. Jurnal SPORTIF : Jurnal Penelitian Pembelajaran, 9(3), 437-446. https://doi.org/10.29407/js_unpgri.v9i3.21062

Authors contribution: a – Preparing concepts; b – Formulating methods; c – Conducting research; d – Processing results; e – Interpretation and conclusions; f - Editing the final version

INTRODUCTION

Hearing impairment is a term used to describe the inability to hear sounds as well as someone who has normal hearing (WHO, 2023). The most common type of hearing loss is caused by the sensorineural system, where the cochlea or the nerve pathways of the hearing are damaged (Ravina J et al., 2023). Sensorineural deafness leads to balance problems and developmental and motor development delays (Winnick & Porretta, 2017). A study reported that sensorineural hearing loss and abnormal vestibular responses in children indicated a developmental delay in gross

Correspondence author: Febriani Fajar Ekawati, Universitas Sebelas maret Surakarta, Indonesia.
Email: febriani@staff.uns.ac.id

motor skills (Maes et al., 2014; Stepanchenko et al., 2020). Consequently, children will experience difficulties in normal childhood activities, such as standing, running, walking, and jumping, that need balance performance.

Balance is a person's ability to keep the body from falling. Visual, proprioceptive, and vestibular signal systems are all involved in maintaining balance (Odabaşi & Orhan, 2023). Balance problems can arise if any of these systems are damaged or the central nervous system (CNS) is abnormal (Ravina J et al., 2023).

Studies reporting balance deficits in hearing-impaired children have been examined meticulously. Ebrahimi et al. (2016) reported that motor performance and balance were significantly associated with sensorineural hearing loss in children. Additionally, children with cochlear implants experienced balance deficits and low motor movement. Another study reported that both unilateral and bilateral hearing-impaired children had a balance problem (Wong et al., 2013). Furthermore, children with severe to profound hearing loss had balance problems during the test, which worsened when visual input was absent (Wong et al., 2013). A study in Indonesia of 58 students with hearing loss reported that these children had low levels of static balance (Raharjo et al., 2020).

Balance disorder in children with hearing impairment influences their motor performance and subsequently indicates low physical fitness (Winnick & Porretta, 2017). Furthermore, lower levels of physical fitness are related to some chronic diseases (Alotaibi, 2021; Knapik et al., 2019). Therefore, conducting balance tests during childhood is necessary for preventive measures to reduce the impact of balance disorders (Wong et al., 2013).

Studies investigating balance deficits and motor development in hearing impairment are well documented. One study reported that both unilateral and bilateral hearing-impaired children had a balance problem (Wong et al., 2013). Ebrahimi et al., (2016) concluded that motor performance and balance had a significant association with sensorineural hearing loss in children. Another study examined static balance in a group

of 58 students using the Stork Balance Stand Test and reported low levels in students‘ balance (Raharjo et al., 2020). Evaluating balance with a single test like static or dynamic balance is less appropriate since the concept of balance is multidimensional. A study in Hong Kong examined balance using the Pediatric Version of the Clinical Test for Sensory Interaction of Balance (P-CTSIB) as a modification of the Sensory Organisation Test (SOT) (Wong et al., 2013).

Furthermore, Barton et al. (2016) developed a balance test combining biomechanical and neurophysiological concepts to prevent imbalance issues in individuals. Both tests measure the standing balance of children through different sensory systems. Although a single test is less precise than a multidimensional test to measure balance, some researchers are still using this test for practical reasons.

In the clinical setting, single tests like static and dynamic balance tests are more practical when the test takes place in a field area with more participants (Sibley et al., 2013). Balance assessment in students with hearing impairment is necessary to evaluate balance disorder as early as possible so that the parents, teacher, and the school have information to prepare additional activities to maintain the children’s physical condition. Therefore, this study aimed to investigate the balance of hearing-impaired students in Karanganyar.

METHOD

This study examined 59 hearing-impaired students consisting of 31 males and 28 females. Participants were recruited from SLB or School for Special Education Negeri Karanganyar, especially the hearing-impaired class, and School for Special Education in class B Pawestri, the school for children with hearing impairment. The range of participants' age was 8 – 20 years, with the general inclusion criteria being the lack of disorders in muscles and bones. A day before the balance assessment, parents of students provided a consent form for their children's participation in this study. A consent letter was obtained from the parents the day before the measurement was conducted. The present survey study investigated the

balance of students with hearing impairment. A balance test (Pasaribu, 2020) was used to measure static standing position with both arms outstretched and eyes closed.

Research Procedures

The participants were instructed to stand on one leg and maintain this position as long as possible. The duration of the standing position was timed using a stopwatch. The time would stop when participants opened their eyes, moved their arms, and placed their feet down. Each participant was given the opportunity to do the test three times, and the best time of the test was taken to proceed to data analysis. Additionally, the best time of the test converted to score balance, as shown in Table 1. Statistical analysis of this study used SPSS version 25. Descriptive analysis was used to calculate the mean of all participants' balance and every group of gender.

Table 1. Normative data for balance test.

Score	Male	Criteria	Female
5	>50″	Excellent	>30″
4	50 - 41″	Very Good	30 - 23″
3	40 - 31″	Good	22 - 16″
2	30 - 20″	Moderate	15 - 10″
1	<20″	Poor	<10″

(Pasaribu, 2020)

RESULT

A total of 59 hearing-impaired students have carried out a balance test. The result revealed that the average balance score of students with hearing impairment was 1,136.

Table 2. Descriptive statistics of balance test.

Variable	Balance Time (Second)		Balance Skor	
	Males	Females	Males	Females
N	31	28	31	28
Maximum	43.75	26.11	4	4
Minimum	1.10	1.26	1	1
Average	5.83	5.29	1.129	1.143

Table 2 shows the descriptive statistics of balance tests in students with hearing impairment. Males maximum time balance was 43.75 seconds, while the minimum time was 1.10 seconds. Females' maximum

time balance was 26.11, while the minimum was 1.26. The balance score of males was slightly lower than that of females, with scores of 1,129 and 1,143, respectively.

Table 3. Balance categories of male and female students with hearing impairment

No.	Category	Result			
		Male	Percentage	Female	Percentage
1	Excellent	0	0%	0	0%
2	Very Good	1	3.2%	1	3.6%
3	Good	0	0%	0	0%
4	Moderate	1	3.2%	1	3.6%
5	Poor	29	93.6%	26	92.8%

Table 3 contains the balance categories of students with hearing impairment. The data shows that more than 90% of both male and female students are categorized as poor in balance assessment. There were only two students who had very good and moderate categories.

DISCUSSION

This study aimed to evaluate the balance of students with hearing impairment. The result of this study showed that the criteria of the balance score of the hearing-impaired students is poor. This finding is in line with the vestibular deficit theory, which is one of the most widely accepted theories about motor and balance deficits in children with hearing impairment. Communication and language deficits are the main problems when interacting with hearing-impaired children. Not only communication, hearing-impaired children experience a lack of physical performance, especially body balance (Maes et al., 2014; Odabaşi & Orhan, 2023; Stepanchenko et al., 2020; Winnick & Porretta, 2017). Balance is a physical condition that supports people's daily activities, such as walking, running, and cycling. Hence, individuals with balance disorders would have problems with their movement. Hearing-impaired children generally experience this condition. A previous study has reported that hearing-impaired children performed less balance than healthy children (Walicka-Cupryś et al., 2014). Balance deficit in children might affect their motor development. Maes et al., (2014) reported that hearing-impaired children perform weak motor performance in the movement test. Therefore,

balance assessment should be included in the routine physical assessment of children with hearing impairment to avoid unfavorable effects caused by balance problems.

In regard to gender differences, balance tests using static and dynamic have similar results (Ayanniyi et al., 2014). A previous study reported that gender has a small significant effect on the total balance score (Li et al., 2022; Melo et al., 2015; Mnejja et al., 2022). This study measured static balance in male and female students using the field-based method. Similar to previous research, the present study's result shows a different balance condition between the two groups. Female students performed balance slightly better than male students. This result is consistent with previous studies that reported girls have better balance performance than their counterparts (Banerjee & Ghosh, 2021; Kolic et al., 2020; Li et al., 2022). Using a dynamic balance test, Ghosh et al., (2022) suggested that girls have better balance compared to boys with various degrees of deafness. This condition may be attributed to several factors, such as girls' ability to use vestibular information and integrate their senses better than boys (Parhoon et al., 2014). Furthermore, there is a linear decrease in balance in hearing-impaired children with an increasing degree of deafness (Banerjee & Ghosh, 2021; Ghosh et al., 2022).

Although gender differences had a slight impact on the balance of children with hearing impairment, other demographics, such as age, did not have any significant relation to it (Atar et al., 2016; Murat et al., 2013). Comparing three different groups of the same age, Field Murat et al. (2013) analyzed the balance of hearing-impaired active people with a group of sedentary deaf and healthy football players. The result concluded that hearing-impaired people with an active lifestyle like football have better performance regarding balance skills than those who are sedentary. This result aligns with another study that reported that hearing-impaired and healthy badminton players have similar balance skills (Halil et al., 2015). Many publications reported that sports habits improve physical performance and also the structure of vestibular coordination ability.

Consequently, parents and the special education school should encourage their children to be physically active. Some activities, such as exercise, games, and a combination of music and vibration, can improve the balance of hearing-impaired children (Zhou & Qi, 2022). Therefore, students should do some sports activities in their daily lives, such as going swimming and playing ball games like football, volleyball, and basketball, to improve their physical performance and further their balance. As a result, parents should support their children to be physically active by encouraging them to take some sports classes. Finally, physical education teachers should provide classes with interesting various physical activities that are able to motivate students to do sports activities.

This study is preliminary research that measured a static balance of students with hearing impairment in Karanganyar. Although many benefits were derived from this study, some limitations should be considered. Firstly, participants were selected without any information regarding the cause of hearing impairment. Secondly, there needs to be a standardized assessment of students with hearing impairment static balance. The consideration of using field-based methods instead of laboratory tests was a practical reason.

CONCLUSION

This study aimed to investigate the balance of hearing-impaired students. A balance test was used to assess static balance with eyes closed during the test. From the findings of this study, the balance performance of students with hearing impairment is categorized as poor. In addition, female students exhibited slightly better balance performance than male students. As a result, this finding can provide basic guidelines for parents and the school on using appropriate activity programs for their hearing-impaired children. Although many benefits were derived from this study, some limitations should be considered. Firstly, participants were selected without any information regarding the cause of hearing impairment. Secondly, there needs to be a standardized assessment of students with hearing impairment static balance. Further investigations of

balance tests using a better methodology and more samples are needed to get higher-quality results.

ACKNOWLEDGMENT

The Universitas Sebelas Maret supported this study with contract number 254/UN27.22/PT.01.03/2022. We thank you the schools and children who participated in the study.

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