SP-37

EFFECTS OF EXERGAMES AND KANGOO JUMPS TRAINING ON STRENGTH IN 14-22 YEARS OLD HEARING IMPAIRED SEDENTARY WOMEN

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ABSTRACT

In this study, it was aimed to evaluate the effect of Nintendo-Wii and Kangoo Jumps training on strength variables of sedentary female aged between 14-22. 38 hearing impaired with close disability levels were divided into three groups as Nintendo-Wii, Kangoo jumps and the control group without any practice. Nintendo-Wii and Kangoo Jumps training methods were done for 1 hour twice a week for 8 weeks. In the research, a pre-test-post-test control group model was used. At the end of the 8-week training program, same measurements were applied again the development levels of the groups and the differences between the groups were analyzed. LaFayette brand digital hand dynamometer was used for strength measurement. Quadriceps and dorsal flexion strength measurements were made. In the research; the time consists of two different levels as pre-test and post-test, and the group consists of three levels: Nintendo-Wii, Kangoo Jumps and control. Two-way analysis of variance was used for repeated measurements in order to examine the common effect of measurements made at different times in different groups. A significant difference was found between pre-test and post-test scores of right, left dorsiflexion and left quadriceps strength measurements ($p < 0.05$). On the other hand, the change in right and left dorsiflexion scores obtained from the measurements taken over time in different groups, is significant ($P_{group * measurement} < 0.05$). As a result; Balance training on the stable and moving ground has been effective in strength development. The connection between strength and balance that are observed in different sports branches and non-hearing impaired individuals was also observed in hearing-impaired participants in our study.

Keywords: Hearing impaired, Exergame, Kangoo Jumps, Quadriceps Flexor, Dorsal Flexor, Strength

1. INTRODUCTION

Hearing impairment is defined as the inability to perceive speech and environmental sounds.[1] Since auditory stimuli direct visual behavior, hearing impaired children cannot adequately develop their ability to direct the eyes, head and body to environmental stimuli.[2] For these reasons, hearing-impaired children may have deficiencies in motor functions such as balance and walking.[3-6] Hearing-impaired individuals have a limited level of participation in physical activities, and that leads to a decrease in their physical activity level, muscle strength, cardiovascular endurance, balance and sportive performance.[7-9] However, sports activities enable these individuals to gain the dexterity of daily life, orientation and mobility by improving their physical fitness and psychomotor skills.[10] It has been observed that the damaged vestibular coordination structures of the hearing impaired people improve and their balance skills increase when such sports activities are made into a habit.[11-13] Exergames, based on today's developing technologies; offers a variety of activities related to strength, flexibility, balance and dance skills. They also provide individual feedback based on basic anthropometric measurements.[14] Nintendo-Wii fit is an exergame designed for everyone, combining fitness and entertainment.[15] Experts now say that there is a need for the development of new and high-quality physical education programs that contribute to the youth maintaining the optimal level of motor activity and increasing their motivation for regular exercise.[16] According to [17] ; Kangoo Jumps shoes are one of the innovative type of training that will help improve the quality of physical activities of students. On the other hand, due to its design, Kangoo Jumps shoes reduce mobility in the ankle joint and muscle activation amplitude so they affect the strength generation during shock absorption.[18] Kangoo Jumps shoes are one of the favorite type of equipment in dynamic balance training because they reduce the pressure on joints and contribute positively to postural control during exercises.[17] Problems that may occur in muscle control and balance due to the effect of the vestibular system in hearing-impaired people also negatively affect muscle strength and motor functions.[19] Balance performance and muscle strength in different branches vary according to the needs of the sports branch.[20] There are many studies in the literature examining the relationship between lower extremity muscle strength and balance performance. These studies revealed that lower extremity muscle group (ankle, hip, leg) strength are extremely important in demonstrating balance skill.[21,22] However, these studies are mostly conducted with healthy individuals and they are studies that examine the effect of muscle strength on balance ability. Since the effect of balance training on the development of muscle strength is examined in our study, as the content it differs from other studies. In addition, there isn't a similar study with these features in the literature because this study was carried out with the hearing impaired. It is also a matter of curiosity that to what extent the training on stable ground and playing ground will affect the strength values. About this subject, there are studies on the balance of children[23] , but there are no studies of that for the hearing-impaired. For these reasons, in this study, it was aimed to examine the effect of Nintendo-Wii balance board and Kangoo Jumps training on the muscle strength variable, which were carried out to increase the dynamic balance skills of the hearing impaired individuals and to maintain postural stability.

2. MATERIALS AND METHODS

In our study a pre-test / post-test model was used and Nintendo-Wii balance board was applied on stable ground and Kangoo Jumps balance training on a dynamic ground that allows anterior-posterior movement were applied.

2.1. Research Group

38 hearing-impaired female students, studying at İbn-i Sina Special Education Vocational High School in Toroslar district of Mersin province, voluntarily participated in the study by getting permission from their parents with the consent form according to the Helsinki Criteria after obtaining the necessary legal permissions from the Mersin Provincial Directorate of National Education. The ethical committee decision of the study was taken by the Mersin University Social and Humanities Ethics Committee with decision number 2018/004 and dated 16.01.2018. Hearing-impaired students between the ages of 14-22 who had not been involved in any sports before and who did not have neurological and orthopedic disorders in the last 6 months participated in the study.

2.2. Data Collection Tools

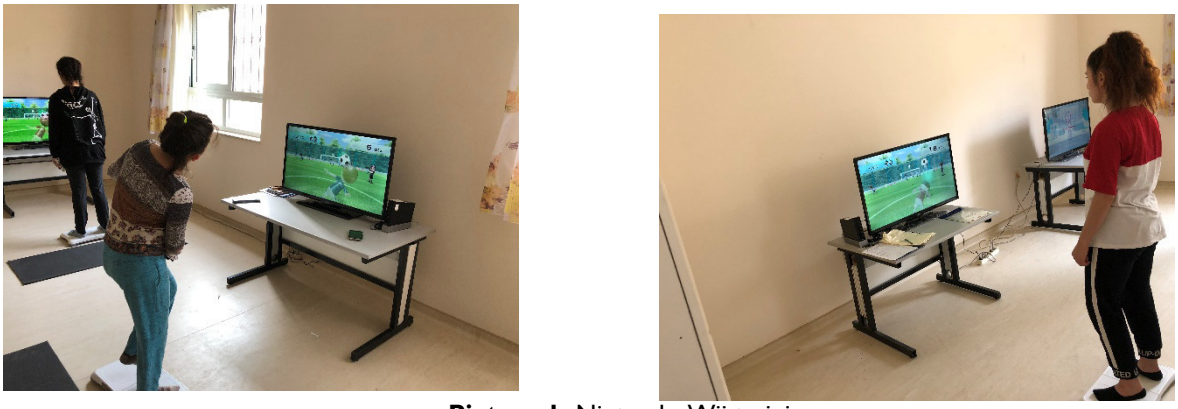
2.2.1. Nintendo-Wii Fit Balance Games

In the Nintendo-Wii Fit game console that helps improve the sense of balance; there are head ball, ski slalom, ski jumping, table tilt, walking on a stretched rope, balance bubble, penguin strap and snowboard slalom games.[24]

The participants played different Nintendo Wii games an hour per day twice a week for 8 weeks. The training program in Table 1 and photographic image in Picture 1 were given below.

Table 1. *8 weeks training program*

Week	Video Games
1.	Head Ball - Ski Slalom - Ski Jumping
2.	Table Tilt - Walking on the Rope - Balance Balloon
3.	Penguin Slide - Snowboard Slalom - Head Ball
4.	Ski Slalom - Ski Jumping - Table Tilt
5.	Walking on Rope - Balance Balloon - Penguin Slide
6.	Snowboard Slalom - Head Ball - Ski Slalom
7.	Ski Jumping ¬ Table Tilt - Walking on the Rope
8.	Balance Balloon - Penguin Slide - Snowboard Slalom

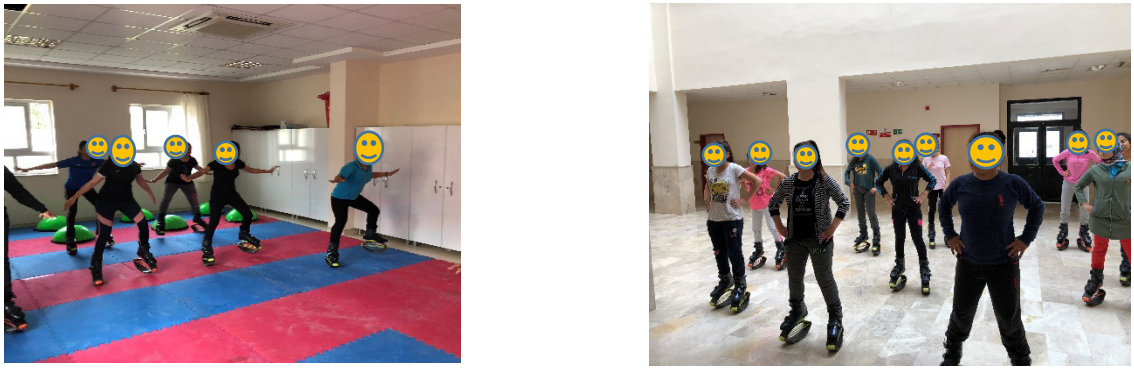


Picture 1. Nintendo-Wii trainings

2.2.2. Kangoo Jumps

An 8-week training program lasting 60 minutes twice a week (Tuesday-Thursday) was applied with Kangoo Jumps shoes that were invented to help reduce serious injuries in the joints by focusing on performance improving the performance of athletes**.**

Picture 2. Kangoo jumps training



2.2.3. Lafayette Hand-held Dynamometer Measurements

LaFayette brand digital hand dynamometer is a portable instrument sized 3.16 "x 5.11" x 1.6 "(8.03cm x 12.98cm x 4.1cm), with 3 easy-to-change heads, a rechargeable lithium-ion battery that can last for 6 hours and an LCD display with digital display. The device can give data such as peak power, time to peak power, total test time and average strength in kg, Newton and pounds and provides 150 data storage facilities. It also provides a selectable measurement time between 1-10 seconds.[25]

2.2.4. Quadriceps and dorsal flexion strength measurements

For strength measurements; The test was initiated with the participants sitting on a flat surface with their hips and knees flexed at 90°, feet free and without support. Participants were verbally informed about the test application technique before starting the test. The dynamometer for quadriceps flexor strength measurement is placed perpendicular to the tibia. For dorsal flexor strength measurement, the dynamometer was placed on the metatarsals. During the test, the "make test" technique, which requires isometric contraction, was applied. (Make test is the protocol of the maximum applied strength against the device by the tested participant while the person making the measurement keeps the dynamometer constant). All measurements were taken from both legs of the participants twice, by the same researcher, with the same hand.

Picture 3. Strength measurements

2.2.5. Data Analysis

The arithmetic mean and standard deviation values of the strength measurements of the participants were determined. 95% confidence interval was used in statistical analysis and α = .05 was accepted. Two-way analysis of variance was used for repeated measures to examine the common effect of measurements made in different groups and at different times.

3. RESULTS

The quadriceps and dorsal flexion strength descriptive statistics before and after training with different equipment are given in Table 2.

Table 2. Descriptive statics of the strength measurements

Groups	n	Right Dorsiflexion		Right Quadriceps		Left Dorsiflexion		Left Quadriceps	
		Pre Test	Post Test	Pre Test	Post Test	Pre Test	Post Test	Pre Test	Post Test
Nintendo-Wii	13	27,67	33,86	25,41	27,16	29,77	35,03	25,17	27,22
Kangoo Jumps	15	28,02	33,46	29,04	30,12	29,98	33,63	26,79	30,38
Control	10	28,16	28,35	28,17	28,95	28,11	29,53	26,51	26,17

3.1. Right Dorsiflexion

Table 3. Pre-test, Post-test Two Way Anova Results

Source of Variance	KT	Sd	KO	F	P	η^2
Between subjects	33081,095	1	33081,095	693,084	,000	
Group(individual –group)	46,070	2	23,035	,483	,621	,027
Error	1670,559	35	47,730			
In-subjects						

Measurement	286,194	1,000	286,194	30,408	,000	,465
Group*measurement	117,178	2	58,589	6,225	0,005	0,262
Error	329,410	35,000	9,412			
P<0,05						

No significant difference was found between the right dorsiflexion scores of the students in the groups participating in different training sessions (P_{group}> 0.05). However, there is a significant difference between pre-test and post-test scores. In addition, when the effect of group and time variables is examined together ($P_{group * measurement}$ <0.05), the change in the right dorsiflexion scores of the students in different groups obtained from the measurements taken over time is statistically significant. While eta square value of time-variable is 0.262, interaction (group * time) variable is 0.465. According to the criteria determined by Cohen, it can be said that the effect size level of the group variable is small, the effect size of the measurement variable and the interaction variable (group * measurement) are high.

3.2. Right Quadriceps

Table 4. Pre-test, Post-test Two Way Anova Results

Source of Variance	KT	Sd	KO	F	P	η^2
Between subjects	29265,304	1	29265,304	990,444	,000	,966
Group(individual –group)	77,495	2	38,748	1,311	,282	,070
Error	1034,168	35	29,548			
In-subjects						
Measurement	53,584	1	53,584	1,904	,176	,052
Group*measurement	5,796	2	2,898	,103	,902	,006
Error	985,086	35	28,145			
P<0,05						

There was no significant difference between the right quadriceps scores of the students in the groups participating in different training (P_{group}> 0.05). There is no significant difference between pre-test and post-test scores. When the effects of group and time variables are examined together ($P_{group * measurement}$> 0.05), there is no statistically significant difference in the right quadriceps values. The eta squared value of the time variable is 0.006 and the interaction (group * time) variable is 0.052. According to the criteria determined by Cohen, it can be said that the effect size level of the group is medium, measurement variable and interaction variable (group * measurement) is small.

3.3. Left Dorsiflexion

Table 5. Pre-test, Post-test Two Way Anova Results

Source of Variance	KT	Sd	KO	F	P	η^2
Between subjects	35532,662	1	35532,662	650,172	,000	,949
Group(individual –group)	81,099	2	40,550	,742	,484	,041
Error	1912,790	35	54,651			
In-subjects						
Measurement	438,481	1	438,481	26,699	,000	,433
Group*measurement	83,446	2	41,723	2,541	,093	,127
Error	574,804	35	16,423			
P<0,05						

No significant difference was found between the left dorsiflexion scores of the students in the groups participating in different training sessions (P_{group} > 0.05). There is a significant difference between pre-test and post-test scores. In addition, when the effects of group and time variables were examined together ($P_{group * measurement}$ > 0.05), a statistically significant difference was found. While the eta square value of the time variable is 0.127, the interaction (group * time) variable is 0.433. According to the criteria determined by Cohen, it can be said that the effect size level of the group variable is small, the effect size of the measurement variable and the interaction variable (group * measurement) are high.

3.4. Left Quadriceps

Table 6. Pre-test, Post-test Two Way Anova Results

Source of Variance	KT	Sd	KO	F	P	η^2
Between subjects	27018,937	1	27018,937	826,208	,000	,959
Group(individual – group)	49,222	2	24,611	,753	,479	,041
Error	1144,581	35	32,702			
In-subjects						
Measurement	115,005	1	115,005	5,244	,028	,130
Group*measurement	92,520	2	46,260	2,109	,136	,108
Error	767,534	35	21,930			
P<0,05						

There was no significant difference between the left quadriceps scores of the students in the groups participating in different training sessions (P_{group}> 0.05). There is a significant difference between pre-test and post-test scores. Also, when the effects of group and time variables are examined together ($P_{Group * measurement}$> 0.05), no significant difference was found. According to the criteria determined by Cohen, it can be said that the effect size level of the group variable is small, the effect size of the measurement variable and the interaction variable (group * measurement) are medium.

4. DISCUSSION

In this study, in which we researched whether or not the modern dynamic balance training that applied on 14-22 age group hearing-impaired female sedentary exercises affects on strength variables, the difference between the pre-test post-test mean scores for three different groups was analyzed. A statistically significant difference was found between the pre-test and post-test scores of right, left dorsiflexion and left quadriceps strength measurements (p <0.05). There was no significant difference in terms of time but a statistically significant difference in terms of the group. However, it is seen that the common effect of measurements made in different groups and at different times is significant.There are studies in the literature examining the relationship between balance skills and lower extremity muscle strength. In a study examining the effects of quadriceps and hamstring muscle strength on static and dynamic balance, it was found that quadriceps muscle strength had a positive relationship with balance performance[26]. In their study with elite wrestlers[27]; stated that balance performance has a significant relationship with knee muscle strength [28]; described the positive relationship between strength and balance and they explained that the increase in muscle strength improves intramuscular and inter-muscular coordination by increasing the synergist and antagonist working capacity of the extensor and flexor muscles.Osteoarthritis in the knee joint is one of the most common complaints in the lower extremities. In patients with knee osteoarthritis; knee joint proprioception, dynamic balance and maximal quadriceps strength may be impaired. In a study with those with osteoarthritis, they concluded that in women with knee OA, knee proprioception and balance responses decreased due to weakness of quadriceps muscle strength.[29]Similar results were encountered as a result of studies conducted with disabled individuals. During these studies, modern dynamic balance training equipment was used. Exergames have been used as a rehabilitation tool to improve balance and functional movement in various populations.[30,31] Another study stated that balance exercises with exergames are an effective method for improving the daily movements and dynamic balance skills of hearing-impaired individuals.[32] They concluded that the 8-week Nintendo-Wii balance board training applied to the hearing impaired individuals between the ages of 9-14 improved the dynamic balance values.[33] According to teacher reports and MABC (Movement Assessment Battery for Children) test results, it was understood that the motor skills of hearing-impaired children were weaker than non-deaf children.[34] In a study conducted with individuals with and without hearing impairment, they measured the effects of antigravity muscle strength on balance by measuring strength and static balance measurement for different muscle groups. As a result, they concluded that adequate mobility, proper posture, flexibility and muscle strength are important variables in improving the balance reactions of the hearing impaired.[35]In their study, Karakoç et al. stated that regular balance and coordination training increases the performance of hearing-impaired athletes and that static and dynamic balance training affects their performance.[36]

5. CONCLUSION

Specific sporty branch-trainings contribute to strength development and bring neuromuscular harmony with it. This situation is thought to contribute to the development of dynamic balance.[37] Our study, which we believe to improve the mobility skills of the hearing impaired in their daily lives, is similar to these studies when we look at the results. Studies in the literature show that training provides improvement. It is concluded that muscle strength is important in maintaining balance. As a result; balance training on the stable and moving ground has been effective in strength development. The connection between strength and balance that are observed in different sports branches and non-hearing impaired individuals was also observed in hearing-impaired participants in our study. We can say that balance training has been effective in the development of muscle strength. Better results can be achieved at the end of longer working periods.

6. CONFLICT OF INTEREST

Conflict of interest declared none

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