Spor ve Performans Araştırmaları Dergisi / Journal of Sports and Performance Researches, 2021;12(1):91-104

Spor ve Performans Araştırmaları Dergisi
Journal of Sports and Performance Researches
https://dergipark.org.tr/tr/pub/omuspd

Araştırma Makalesi
Geliş Tarihi/Received: 17.02.2021 Kabul Tarihi/Accepted: 23.03.2021 DOI: 10.17155/omuspd.882085

# THE EFFECT OF BOSU, KANGOO JUMP, NINTENDO-Wii BALANCE BOARD TRAININGS ON AGILITY IN HEARING IMPAIRED SEDENTARY*

**Cihat KORKMAZ[1**]** **Manolya AKIN[1]**

[1]Mersin Üniversitesi, Spor Bilimleri Fakültesi, Mersin Türkiye

## ABSTRACT

In this study, it was aimed to determine the effect of different balance training on the agility variables of hearing impaired female sedentaries. 51 hearing impaired female students between the ages of 14 and 22 were included. Training groups with close hearing impairment levels were created. Nintendo-wii, (n=13), Bosu (n=13), Kangoo Jumps (n=15) and control group (n=10). The training groups received 60 minutes of training for 2 days a week for 8 weeks. The control group, on the other hand, continued its daily education programs by not participating in any activities. Hexagonal Obstacle Test was used to measure agility score. Arithmetic mean and standard deviation values were determined in order to define the age, height, weight and hearing impairment levels of the participants. Kruskal-Wallis test was used to examine whether there was a significant difference between the pre-test measurements of the groups, and Wilcoxon signed rank test was used to observe the change between pre-test and post-test measurements. The dynamic balance pre-test and post-test values of all groups were compared by means of two-way analysis of variance for repeated measures. At the end of the 8-week training programs, the agility scores of the Nintendo-Wii, Kangoo Jumps and Bosu groups were found to be significantly different in favor of the post-test between the pre-test and post-test mean scores. To conclude effect size we used Eta square test. As a result of this, training with the Bosu ball was found to improve agility values, but not with as much effect size as Nintendo and Kangoo Jump shoes. We recommend the use of these equipment that improve agility skills in individuals with hearing impairment, but it is thought that better results will be obtained if longer training programs are implemented.

**Keywords**: Agility, bosu ball, hearing impaired, kangoo jumps shoes, Nintendo-wii

# BOSU, KANGOO JUMP, NINTENDO-Wii BALANCE BOARD ANTRENMANLARININ İŞİTME ENGELLİ SEDANTERLERDE ÇEVİKLİK ÜZERİNE ETKİSİ

## ÖZET

Bu çalışmada, farklı denge eğitimlerinin işitme engelli kadın sedanterlerin çeviklik değişkenleri üzerindeki etkisinin belirlenmesi amaçlanmıştır. 14-22 yaş arası 51 işitme engelli kız öğrenci dahil edildi. İşitme engel düzeyleri birbirine yakın antrenman grupları oluşturuldu. Nintendo-wii, (n = 13), Bosu (n = 13), Kangoo Jumps (n = 15) ve kontrol grubu (n = 10). Antrenman grupları 8 hafta boyunca haftada 2 gün 60 dakika eğitim aldı. Kontrol grubu ise herhangi bir faaliyete katılmayarak günlük eğitim programlarına devam etti. Çeviklik puanını ölçmek için Altıgen Çeviklik Testi kullanıldı. Katılımcıların yaş, boy, kilo ve işitme bozukluğu düzeylerini belirlemek için aritmetik ortalama ve standart sapma değerleri belirlendi. Grupların ön test ölçümleri arasında anlamlı bir fark olup olmadığını incelemek için Kruskal-Wallis testi, ön test ve son test ölçümleri arasındaki değişimi gözlemlemek için Wilcoxon işaretli sıra testi kullanıldı. Tüm grupların dinamik denge ön test ve son test değerleri, tekrarlanan ölçümler için iki yönlü varyans analizi ile karşılaştırıldı. 8 haftalık eğitim programlarının sonunda Nintendo-wii, Kangoo Jumps ve Bosu gruplarının çeviklik puanlarının ön test ve son test puan ortalamaları arasında son test lehine anlamlı derecede farklı olduğu görülmüştür. Etki büyüklüğüne bakmak için Eta kare testi kullandık. Bunun bir sonucu olarak, Bosu topuyla yapılan antrenmanın çeviklik değerlerini artırdığı, ancak Nintendo-wii ve Kangoo Jumps ayakkabılarının etkisi kadar büyük olmadığı bulundu. İşitme engelli bireylerde çeviklik becerilerini geliştiren bu ekipmanların kullanılması önerilmektedir ancak daha uzun eğitim programları uygulanırsa daha iyi sonuçlar alınacağı düşünülmektedir.

**Anahtar Kelimeler**: Bosu topu, çeviklik, işitme engelliler, kangoo jumps ayakkabıları, Nintendo-wii

*This study was produced from Cihat KORKMAZ's doctorate thesis.

**Yazışmadan sorumlu yazar: Cihat KORKMAZ korkmaz.cihat68@gmail.com

## INTRODUCTION

Congenital hearing loss or hearing loss due to some reasons after birth leaves negative effects on the individual's education and puts the individuals in a difficult situation in terms of socialization (Ertürk, 2003). Hearing impairment is a serious type of disability that affects an individual's life both psychologically and physically (Polat, 2008).

Our sense of hearing has many important functions such as discrimination, localization, identification of the sounds coming from the environment and frequency adjustment of acoustic signals. People who have a partial or total loss of hearing or congenital hearing loss may have problems with these functions. However, in various environments, the vestibular system in the inner ear plays an important role in maintaining the vertical position of the body and balance related to gravity while walking. The vestibular system works with information from many systems such as hearing, vision, and muscular structures. Disability of the vestibular system temporarily or permanently for any reason causes physiological and psychological problems such as disorientation in movements, disruption during walking, changes in tinnitus, heart rate and pressure, fear, anxiety and panic (Gabell and Simons, 1982; Topuz and Bostancı, 1997).

It is confirmed that physical activities have a positive effect on the improvement of performance and balance skills of hearing-impaired individuals. Besides, it is observed that if such activities are habituated, damaged vestibular coordination structures improve and balance skills increase (Butterfield, 1991; Azevedo and Samelli, 2008; Gheysen et al., 2008). Agility skill (Cobb, 1999), which requires the ability to change direction without loss of speed, is also affected by the development of balance (Brown et al., 2000). At this point, balance and agility emerge as the most important factors on hearing-impaired individuals' daily movements performance and high performance in sportive environments (Erkmen et al., 2007). Therefore, it is important to improve the low dynamic balance skills and agility values of hearing impaired sedentary individuals.

Agility is the ability to change a body's direction quickly, simply and in the most controlled way while moving from one point to another (Huxham et al., 2001). It is also expressed as the ability to change direction in a balanced way without loss of speed (Cobb, 1999) or the ability to control the body composition while changing direction during the sequence of movements (Spaniol et al., 2010). The abilities, such as rhythm, dynamic balance and visual tracking, of an athlete with improved agility feature are also developed (Mizuno et al., 2001). Agility is generally influenced by understanding and decision-making factors and speed of change of direction. As a result of the studies, it is considered that there is a general relationship between the speed of changing direction and speed. There is a significant relationship between agility and speed (Spaniol et al., 2010). In developing agility, multiple training programs should be organized and personal training programs should be created (Sheppard and Young, 2006).

In recent years, with the increasing interest in alternative balance and agility training methods, activities such as active video games on fixed ground (Nintendo-Wii) (Demir and Akın, 2018) and activities done with equipment such as bosu ball, trampoline, kangoo jump shoes (Akın and Durmuş, 2014; Sınar and Akın, 2015; Kesilmiş et al., 2018) on moving ground (Lubetzky-Vilnai et al., 2015) provide high motivation in addition to its being fun (Korkmaz and Akın, 2019). It is stated that the trainings based on video games are more effective, motivating and highly involved than traditional balance trainings. Because there is a fact that video games can be adjusted according to individual needs, interests and exercise protocols can also be arranged (De Bruin et al., 2010; Kliem and Wiemeyer, 2010; Gioftsidou et al., 2013; George et al., 2016). In addition, Wii fit games require balance, coordination, anaerobic endurance, strength and lower extremity control. These components of Wii Fit games appear to have a beneficial effect on both muscular endurance and neuromuscular components (control of dynamic balance and agility) (Smits-Engelsman et al., 2017). It is observed that dynamic balance skill develops as a result of studies with Nintendo-wii in hearing-impaired individuals (Korkmaz and Akın, 2019).

Kangoo Jump is a sport involving jumping that is performed with specially designed rebound shoes. Kangoo Jump is becoming increasingly popular and it can be used for jogging, athletic training, sports strengthening, and conditioning. The benefits of this sport include reduced body fat, tightening and strengthening muscles, increased agility and it provides aerobic exercise for the heart (Vance and Mercer, 2001). Every jump with these shoes involves maintaining balance and it is also quite challenging even for the fittest. In addition, the use of Kangoo jump shoes also prevents joint lesions, since direct impact on the floor is avoided (Baltaretu, 2015).

Training on a soft, semi-circular 'bosu' ball filled with air improves the core area and your muscles that you do not use in daily life (Demir and Akın, 2018). Bosu ball is an effective equipment for balance and agility skills as it can be shaped according to movements.

It is believed that such modern equipment, which improve agility and balance skills, can help individuals with hearing disabilities to develop their ability to perform activities that are difficult in everyday life. The findings in the study results will contribute to the literature on agility acquisition in hearing impaired individuals.

## MATERIALS AND METHODS

### Participants

51 hearing-impaired female students (60 ± 11.5% hearing impaired) aged between 14 and 22 years of age who study at Ibn-i Sina Special Education Vocational High School and who are sedentary individuals, were informed according to the Helsinki Criteria and they voluntarily participated in the study by getting permission from their parents with the consent form. The ethical committee decision of the study was taken by the Mersin University Social and Humanities Ethics Committee with decision number 2018/004 dated 16.01.2018. In the study, Nintendo-wii game group (n = 13), bosu group (n = 13), kangoo jump group (n = 15) were trained and training was applied twice a week for 8 weeks. On the other hand, the control group (n = 10) did not receive any training and they were allowed to participate in normal daily activities at the school.

### Research Design

The control and the other groups' ability skills were measured with the hexagonal agility test before and after the trainings. The training programs applied are given below in detail.

### Agility Measurements

This test requires the athlete to perform a series of two-footed back and forth jumps over the sides of a hexagon. The athlete warms up for 10 minutes the assistant marks out a hexagon with 66 cm sides. The athlete stands in the middle of the hexagon, facing line A throughout the test. The assistant gives the command "GO" and starts the stopwatch. The athlete jumps with both feet over line B and back to the middle, then over line C and back to the middle, then line D and so on. When the athlete jumps over line A, and back to the middle this counts as one circuit. The athlete is to complete three circuits. When the athlete completes three circuits, the assistant stops the stopwatch and records the time. The athlete has a 5-minute rest and then repeats the test. On completion of the second test, the assistant determines the average of the two recorded times. If the athlete jumps the wrong line, or lands on a line, then the test is to be restarted (Mackenzie, 2002).

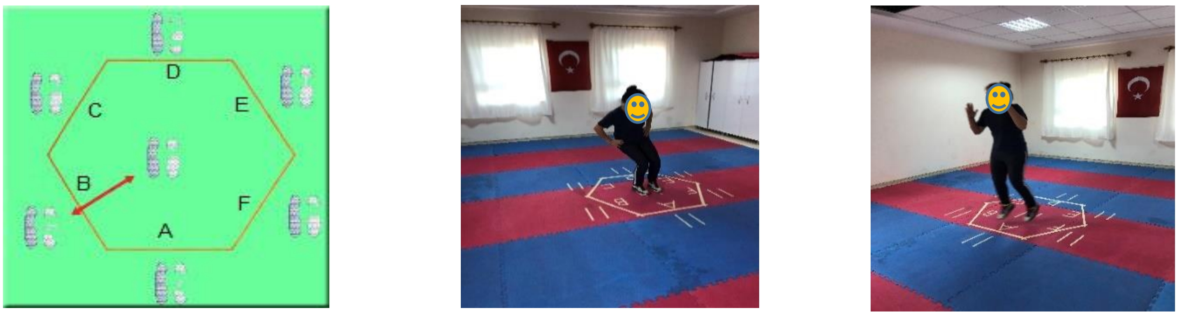


Figure 1. Hexagonal Obstacle Test

## Trainings

### 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 stretched rope, balance bubble, penguin strap and snowboard slalom games (https://www.nintendo.com).

The participants played different Nintendo Wii games an hour per day twice a week for 8 weeks. Training program is given below in Table 1.

**Table 1.** 8-week 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 |


Figure 2: Ski Jumping game

### *Bosu Ball Training*

Exercises with the bosu ball were performed flipping the bosu ball to stand on its rubbery side 6 times and using bouncy side 4 times. The visual illustrative information of the 10 movements performed below are given below. In addition to this, the weekly exercises for 8 week training sessions are given in Table 2 with repetition numbers.

**1st Movemen**t: Turn the Bosu ball’s flat side up, stand on the bosu ball, control your balance then move it to the right, left, forward and back by using double feet. A completed round is counted as 1 repetition.

**2nd Movement:** Turn the Bosu ball’s flat side up, stand on it, separate your legs according to your balance then try to make a circle with the bosu ball using your feet. A completed round is counted as 1 repetition.

**3rd Movement:** Turn the flat side up, extend your arms forward, control your balance, do squats.

**4th Movement:** Turn the flat side up, stand on the bosu ball with one leg and strech the other leg to the front and do squat with one leg.

**5th Movement:** Turn the flat side up, stand on it and first open your right leg to the right side until its 90 degree angles for 5 times then do the same movement with your left leg.

**6th Movement:** Turn the flat side up, stand on it bent forward while one leg is lifted back until it's 90 degrees.

**7th Movement:** Turn the Bosu ball's bouncy side up, place your hands on the edges of the flat surface shoulder with apart do the push up movement.

**8th Movement:** Turn the Bosu ball's bouncy side up, lay your back on the ball and do crunch movement.

**9th Movement:** Turn the Bosu ball's bouncy side up, stand beside the bosu ball with your right foot on top of the ball, lower your body into a lunge bending your front and back knees until they are 90 degrees.

**10th Movement:** Turn the Bosu ball's bouncy side up, stand on it, control your balance then pull your knees to your core area in turn.

**Table 2**. 8-week bosu ball training program

| | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 |
|---|---|---|---|---|---|---|---|---|
| **Movements** | 1, 3, 5, 7, 8. movements | 2, 4, 6, 9, 10. movements | 1, 3, 5, 7, 8. movements | 2, 4, 6, 9, 10. movements | 1, 3, 5, 7, 8. movements | 2, 4, 6, 9, 10. movements | 1, 3, 5, 7, 8. movements | 2, 4, 6, 9, 10. movements |
| **Number of Repetitions** | 8 repetitions | 8 repetitions | 2*8 repetitions | 2*8 repetitions | 3*8 repetitions | 3*8 repetitions | 3*8 repetitions | 3*8 repetitions |
| **Rest** | 30 sec break between repetitions, 1 min break between sets | | | | | | | |

Figure 3: Bosu ball training

### *Kangoo Jumps Training*

An 8-week training program with an average of 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.

**Table 3**. 8-week kangoo jumps training program

| | |
|---|---|
| **WEEK 1** | *Walks with different step range (shoe adaptation process) |
| **WEEK 2** | *Jogging (around the school) *Stretching |
| **WEEK 3** | *Warm-up and stretching, *Static jumping exercises, *3 × 15 right foot<br>*3 × 15 left foot, *3 × 15 pairs of feet, *Cooling exercises without shoes |
| **WEEK 4** | *Warm-up and stretching, *Short distance running, *Cooling exercises without shoes |
| **WEEK 5** | *Warm-up and stretching, *Cardio training (3 sets 15 minutes, 5 minutes rest between sets), *Cooling exercises without shoes |
| **WEEK 6** | *Warm-up and stretching, *Dynamic jumping exercises<br>*Right foot and left foot; 3 steps, 5 steps, 10 steps (3 sets of each of the moves)<br>*Kangaroo jumps (10 steps × 3 sets), *Cooling exercises without shoes |
| **WEEK 7** | * Continuous warm-up movements (Performing a 20-meter run after 10 repetitions of the specified movement and doing another movement determined by coming to the starting point again) *Cooling exercises without shoes |
| **WEEK 8** | *Warm-up and stretching, *Station work (3 × 5 minutes, 2 minutes rest between sets)<br>*Static jump exercises, *Dynamic jump exercises |

Figure 4: Kangoo Jumps training

### Statistical Analysis

Shapiro Wilk test was used for the distribution of normality since the number of students in the groups ranged between 10 and 15. The effect of the training programs applied on the agility values was measured with the Wilcoxon signed rank test. Two-way analysis of variance was also used for repeated measures in order to understand whether there was a difference between the averages of the scores received by the agility pretest and posttest measurements of all training groups. If there was a difference, Scheffe post hoc test was applied to find out between which groups this difference was (Scheffe, 1959). Eta square effect size statistics were used to compare the average scores of the groups before and after the training program and to interpret the results (Tabachnick et al., 2007).

## RESULTS

**Table 4.** Descriptive statistics of the age, height, weight and defect rates

| | AGE (Years) | HEIGHT (cm) | WEIGHT (kg) | DEFECT RATE |
|---|---|---|---|---|
| | **Mean±Sd** | **Mean ±Sd** | **Mean±Sd** | **Mean%±Sd%** |
| **Nintendo (n=13)** | 17.92 + 2.22 | 159.38 + 6.09 | 56.54 + 7.26 | 63 + 11 |
| **Kangoo Jump (n=15)** | 15.93 + 1.28 | 155.73 + 5.64 | 52.20 + 6.5±8 | 55 + 13 |
| **Bosu (n=13)** | 18.46 + 1.45 | 158.69 + 8.56 | 59.54 + 14.98 | 62 + 11 |
| **Control (n=10)** | 17.80 + 1.32 | 157.90 + 3.67 | 54.60 + 5.38 | 60 + 11 |

The Hexagonal agility test descriptive statistics before and after training with different equipment are given in Table 5.

**Table 5.** Hexagonal agility pre-test and post-test descriptive statistics

| Training groups | | Agility pre-test | | Agility post-test | |
|---|---|---|---|---|---|
| | **n** | **Mean** | **Sd** | **Mean** | **Sd** |
| **Nintendo-Wii** | 13 | 39.59 | 8.45 | 29.16 | 8.30 |
| **Kangoo Jump** | 15 | 36.94 | 5.54 | 25.61 | 5.99 |
| **Bosu** | 13 | 29.73 | 9.32 | 25.08 | 8.12 |
| **Control** | 10 | 30.16 | 4.93 | 29.21 | 4.69 |

The differences in the agility values of Nintendo wii, kangoo-jump and bosu exercises and intra-group effect values are given in Table-6. Two-way analysis of variance analysis for the repeated measures of agility pre-test and post-test results of the groups are given in Table-7.

**Table 6.** Wilcoxon signed rank test results regarding agility pre-test and post-test results

| Groups | Test | Mean | Sd | z | p | $\eta^2$ |
|---|---|---|---|---|---|---|
| **Nintendo (n=13)** | Pre-test | 39.60 | 8.45 | -3.18 | 0.001 | 0.38 |
| | Post-Test | 29.16 | 8.31 | | | |
| **Kangoo Jump (n=15)** | Pre-Test | 36.94 | 5.54 | -3.40 | 0.001 | 0.38 |
| | Post-Test | 25.61 | 6.00 | | | |
| **Bosu (n=13)** | Pre-Test | 29.73 | 9.33 | -2.13 | 0.033 | 0.17 |
| | Post-Test | 25.09 | 8.12 | | | |
| **Control (n=10)** | Pre-Test | 30.17 | 4.93 | -2.70 | 0.007 | 0.36 |
| | Post-Test | 26.49 | 5.85 | | | |

There is significant difference between the average of pre-test and post-test of agility of the Nintendo-wii, kangoo jump and bosu training groups. (Znintendo = -3,18, p <0.05, Zkangoo = -3,40 p <0.05, Zbosu = -2,13 p <0.05). It is seen that this difference is in favor of the post-test when the rank average and total of the scores are examined. Considering the effect sizes, it was found that the increase in the agility values of the group training with Nintendo-wii and Kangoo Jump shoes was high. It has been found that training with the Bosu ball improves agility but is not as effective as Nintendo-wii and Kangoo Jump shoes. In the control group, a development was observed due to the low number of participants and considering the growth effect.

**Table 7.** Pre-test, post-test two way anova result

| Source of Variance | KT | sd | KO | F | P | $\eta^2$ | Difference |
|---|---|---|---|---|---|---|---|
| **Between subjects** | 94038.59 | 1 | 94038.59 | 1105.60 | <0.001 | | |
| **Group(individual – group)** | 663.42 | 3 | 221.14 | 2.60 | 0.063 | 0.14 | |
| **Error** | 3997.66 | 47 | 85.05 | | | | 1-3; 1-4 |
| **In-subjects** | | | | | | | |
| **Measurement** | 1168.48 | 1 | 1168.48 | 62.73 | 0 | 0.57 | |
| **Group*measurement** | 433.12 | 3 | 144.37 | 7.75 | 0.005 | 0.33 | |
| **Error** | 875.38 | 47 | 18.62 | | | | |

P<0,05 Training groups (1:Nintendo-Wii, 2:Kangoo jump, 3:Bosu Ball, 4:Control)

As a result of the two-way analysis of variance for the repeated measurements made on the averages of the scores of the participants in the Nintendo-wii, Kangoo Jump, Bosu and Control groups, the group effect was not significant (F(3-47) = 2.6; p> 0.05). According to these results, you can see that there is no significant difference between the agility average scores of Nintendo-wii, Kangoo jumps, Bosu ball and Control groups. Therefore, it can be said that the F value of the common effect found as a result of variance analysis does not reflect significant differences.

The difference between the average scores obtained from the pre-test and post-test measurements of the individuals of all groups was found to be significant (F (1-47) = 62.73; p <0.05). This finding shows that when there is no group distinction, the level of agility of individuals varies depending on the training program. In addition, it was found that the value obtained as a result of the examination of the common effect (group * measurement effect), which is important for this research, was significant (F (3-47) = 7.75; p <0.05). This finding shows that the agility scores of individuals in the Nintendo-wii, Kangoo, Bosu and Control groups changed significantly in the pretest and posttest measurements.

## DISCUSSION

It is proved with many studies that hearing-impaired individuals have insufficient balance. Improved balance causes personal increase of agility. It is useful to apply improving trainings. There is an increasing interest of people in suitable and safe exercise programs. Therefore, we have to be more attentive to the studies to improve their agility skills. There are many studies in the literature with different training methods to improve the balance and agility skills of hearing impaired individuals, such as a study investigating whether table tennis training improved static balance showed that hearing impaired children had significantly improved static balance performance (Chang et al., 2016). Kaya and Sarıtaş (2019) stated that balance studies with active video games are effective methods of improving daily movements and dynamic balance skills of hearing impaired individuals. Another study shows that Tai Chi and traditional exercise programs have positive effects on balance and functional mobility in children with sensory hearing loss (Çetin et al., 2020). At the end of the 8-week plyometric exercise program, they concluded that it had a positive effect on the static balance of deaf volleyball players (Nacaroglu and Karakoç, 2018). On the other hand, in a study Eliöz et al. (2016) investigated the effect of motion sensor computer games on gun shooting ability, they concluded that motion-based computer games contribute to skill development.

In studies comparing the change in balance skills of hearing impaired children of different age groups and children who heard normally after a certain period of time, improvements in the balance skills of deaf children were determined (Eleni et al., 2002; Rine et al., 2004; de Sousa et al., 2012; Majlesi et al., 2014; Melo et al., 2015).

Under these circumstances, Nintendo-wii, kangoo jumps and bosu ball were selected as safe and improving training equipments for our study. Trainings with active video games mainly focused on supporting rehabilitation and physical activity. They have been used as a tool to improve balance and functional movement among different populations (Taylor et al., 2012; Mhatre et al., 2013; Demir and Akın, 2018; Korkmaz and Akın, 2019). The other equipments such as Kangoo Jumps (KJ) shoes provide doing exercises that put less pressure on joints but affect postural control. It has been stated that these kinds of equipments affect and regenerate postural control variables and improve some physical-physiological parameters (strength, flexibility, endurance, muscle strength) and as a result of this, there is an increase about the levels of well-being and life satisfaction of the participants (Baltaretu, 2015). Regarding trainings with KJ shoes, there are studies with significant difference in the literature (Akın and Durmuş, 2014; deOliveira et al., 2014; Germina et al., 2015; Mokrova et al., 2018). In studies conducted to learn how they react to the trainings done on soft and hard ground to improve the balance skills of the hearing-impaired individuals, it was reported that posture exercises on the surface of the bosu ball are effective for developing balance skills along with visual stimuli (Yaggie and Campbell, 2006; Lubetzky-Vilnai et al., 2015).

Our research includes a soft and movement-shaped equipment such as BOSU ball. Our study, which is also aimed for the rehabilitation of the hearing impaired, shows similarities with these studies. In our study, a significant increase in agility skill was found as a result of the 8 week kangoo jump Nintendo-wii and bosu ball training for the hearing impaired. The training methods used in this study to improve the agility skill has never been used before in the literature.

There are studies on agility in people with no hearing impairment. For example, it was found that taekwon-do (Singh et al., 2015) and karate (Davaran et al., 2014) of pliometric workouts increased the agility performance of athletes. On the other hand, core training does not improve agility because it's stated that there can be many factors affecting agility (Kır, 2017). Organizing multiple training programs and creating personal training programs in the development of agility can reduce the impact of these factors (Sheppard and Young, 2006).

## CONCLUSION AND SUGGESTIONS

As a conclusion, it was seen that the 8-week training program applied with new technological equipments increased the agility skill of hearing impaired individuals. We think that we have made a contribution to the literature by starting from this and these kind of studies. However, it is suggested that trainings will be more efficient if training programs are applied in longer periods of time.

## FUNDING

The authors received financial support for the research by Mersin University Scientific Research Projects Unit as project BAP-EBE BESYO (AD) 2018-1-TP3-2833 PhD.

## REFERENCES

Akın, M., Durmuş, A. (2014). The effect of training kangoo jump shoes on the balance next strength and shots ratıo in women basketball players. 7-9 November 2014. 13. Sports Science Congress, Konya.

Azevedo, M.G. & Samelli, A.G. (2009). Comparative study of balance on deaf and hearing children. Rev CEFAC, 11(1), 85-91.

Baltaretu, I. (2015). Physical activity and emotional life adjustments a study of kangoo jumps training effects. Romanian Journal of Experimental Applied Psychology, 6(1). 74-87.

Brown, L.E., Ferrigno, V., & Santana, J. C. (2000). Speed, agility, and quickness training. Human Kinetics.

Butterfield, S.A. (1991). Influence of age, sex, hearing loss, and balance on development of running by deaf children. Perceptual and Motor Skills, 73(2), 624-626. doi:10.2466/pms.1991.73.2.624

Cetin, S.Y., Erel, S., & Bas Aslan, U. (2020). The effect of Tai Chi on balance and functional mobility in children with congenital sensorineural hearing loss. Disability and Rehabilitation, 42(12), 1736-1743. doi: 10.1080/09638288.2018.1535629

Chang, Y.C., Hsu, C.T., Ho, W.H., & Kuo, Y.T. (2016). The effect of static balance enhance by table tennis training intervening on deaf children. International Journal of Medical and Health Sciences, 10(6), 356-359**.** doi.org/10.5281/zenodo.1125573

Cobb, S.V.G. (1999). Measurement of postural stability before and after immersion in a virtual environment. Applied Ergonomics, 30(1), 47-57. doi: 10.1016/S0003-6870(98)00038-6

Davaran, M., Elmıeh, A., Arazı, H., (2014) The Effect of a Combined (plyometric-sprint) Training Program on Strength, Speed, Power and Agility of Karate-ka male athletes. Research Journal of Sport Sciences, 2(2), 38-44.

De Bruin, E.D., Schoene, D., Pichierri, G., Smith, S.T. (2010). Use of virtual reality technique for the training of motor control in the elderly-Some theoretical considerations, Zeitschriftfür Gerontologie und Geriatrie,43, 229-234. doi:10.1007/s00391-010-0124-7

de Sousa, A.M.M., de França Barros, J. ve de Sousa Neto, B. M. (2012). Postural control in children with typical development and children with profound hearing loss. International Journal of General Medicine, 5, 433. doi: 10.2147/IJGM.S28693

Demir, A., & Akın, M., (2018). Aktif Video Oyunları ve Wobble Board Denge Antrenmanının 6 Yaş Çocuklarda Dinamik Dengeye Etkisinin Karşılaştırılması. Gaziantep Üniversitesi Spor Bilimleri Dergisi, 3(4),109-121. doi: 10.31680/gaunjss.461858

deOliveira, R.F., deOliveira, P.D., Szezerbaty, S.K.F., deOliveira, L.C., DeAlmeida, J.S., Gil, A.W.D., ... & DeOliveira, R.G. (2014). Effect of running exercise with and without the use of equipment Kangoo Jumps, in postural control: a case study. Manual Therapy, Posturology & Rehabilitation Journal= Revista Manual Therapy, 12. doi: 10.17784/mtprehabjournal.2014.12.179

Eleni, F., Paraskevı, G., Dımıtrıos, K., Nıckoletta, A., Vassilios, T. ve Charalampos, T. (2002). Effect of rhythmic gymnastic on the balance of children with deafness, EUR. J. of Special Needs Education, Vol. 17, No. 3. 301-309. doi: 10.1080/08856250210162211

Elioz, M., Erim, V., Küçük, H. Karakaş, F. (2016). Hareket algılayıcı bilgisayar oyunlarının beceri öğretimine etkisi. Beden Eğitimi ve Spor Bilimleri Dergisi, 10(1), 13-18.

Erkmen, N., Suveren, S., Göktepe, A. S., & Yazıcıoğlu, K. (2007). Farklı Branşlardaki Sporcuların Denge Performanslarının Karşılaştırılması. Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi, 5(3), 115-122. doi: 10.1501/Sporm_0000000080

Ertürk, B. (2003). İşitme engelli çocukların ailelerine öneriler. Ankara, Başbakanlık Özürlüler İdaresi Başkanlığı.

Gabell, A., & Simons, M. A. (1982). Balance coding. Physiotherapy, 68(9), 286.

George, A., Rohr, L., & Byrne, J. (2016). Impact of Nintendo Wii games on physical literacy in children: Motor skills, physical fitness, activity behaviors, and knowledge. Sports, 4(1), 3. doi: 10.3390/sports4010003

Germina, C., Roxana, D., Eliana, L., Alina, A., & Alexandru, C. (2015). Aerobic gymnastics on kangoo-jumps boots and its impact on students'fitness. Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health, 15(2 S1), 294-300.

Gheysen, F., Loots G., & van Waelvelde, H. (2008). Motor development of deaf children with and without cochlear implants. Journal of Deaf Studies and Deaf Education, 13(2), 215-224. doi: 10.1093/deafed/enm053

Gioftsidou, A., Vernadakis, N., Malliou, P., Batzios, S., Sofokleous, P., Antoniou, P., ... & Godolias, G. (2013). Typical balance exercises or exergames for balance improvement?, Journal of Back and Musculoskeletal Rehabilitation, 26(3), 299-305. doi: 10.3233/BMR-130384

https://www.nintendo.com/

Huxham, F.E., Goldie, P.A., & Patla, A.E. (2001). Theoretical considerations in balance assessment. Australian Journal of Physiotherapy, 47(2), 89-100. doi: 10.1016/S0004-9514(14)60300-7

Kaya, M. ve Sarıtaş, N. (2019). A comparison of the effects of balance training and technological games on balance in hearing-ımpaired individuals. Journal of Education and Training Studies, 7(3S), 48-53. doi: 10.11114/jets.v7i3S.4055

Kesilmiş, İ., Akın, M., & Kesilmiş, M. M. (2018). The Effect of Kangoo Jumps On Dynamic Balance Ability and Strength in Badminton Players. ERPA 2018, 536.

Kır, R. (2017). 11-15 yaş arası tenis sporcularında kor antrenman programının kuvvet, sürat, çeviklik ve denge üzerindeki etkisinin incelenmesi. Doktora Tezi. Gazi Üniversitesi. Beden Eğitimi ve Spor Anabilim Dalı. Ankara.

Kliem, A., & Wiemeyer, J. (2010). Comparison of a traditional and a video game based balance training program. International Journal of Computer Science in Sport, 9(2), 80-91.

Korkmaz, C., Akın, M. (2019). 9-14 Yaş Grubu İşitme Engelli Sedanterlerde Nintendo-Wii Balance Board Antrenmanlarının Dinamik Denge Üzerine Etkisi [Effect of Nintendo-Wii Balance Board Training on Dynamic Balance in Between 9-14 Age Hearing Impaired Sedentaries], Spor Eğitim Dergisi, 3 (3), 01-10.

Lubetzky-Vilnai, A., McCoy, S. W., Price, R., & Ciol, M. A. (2015). Young adults largely depend on vision for postural control when standing on a BOSU ball but not on foam. The Journal of Strength & Conditioning Research, 29(10), 2907-2918. doi: 10.1519/JSC.0000000000000935

Mackenzie, B. (2002). Hexagonal Obstacle Test. Retrieved from http://www.brianmac.co.uk/hexagonal.htm

Majlesi, M., Farahpour, N., Azadian, E. ve Amini, M. (2014). The effect of interventional proprioceptive training on static balance and gait in deaf children. Research in Developmental Disabilities, 35, 3562-3567. doi: 10.1016/j.ridd.2014.09.001

Melo, R.D.S., Lemos, A., Macky, C.F.D.S.T., Raposo, M.C.F. ve Ferraz, K. M. (2015). Postural control assessment in students with normal hearing and sensorineural hearing loss. Brazilian Journal of Otorhinolaryngology, 81(4), 431-438. doi: 10.1016/j.bjorl.2014.08.014

Mhatre, P.V., Vilares, I., Stibb, S.M., Albert, M.V., Pickering, L., Marciniak, C.M., et al. (2013). Wii Fit balance board playing improves balance and gait in Parkinson disease. PM&R, 5, 769-777. doi: 10.1016/j.pmrj.2013.05.019

Mizuno, Y., Shindo, M., Kuno, S., Kawakita, T., & Watanabe, S. (2001). Postural control responses sitting on unstable board during visual stimulation. Acta Astronautica, 49(3-10), 131-136. doi: 10.1016/S0094-5765(01)00089-3

Mokrova, T, Bryukhanova, N., Osıpov, A., Zhavner, T., Lobıneva, E., Nıkolaeva, A., Vapaeva, A., Fedorova, P. (2018) Possible effective use of Kangoo Jump complexes during the physical education of young students. Journal of Physical Education and Sport, (46), 342 – 348. doi:10.7752/jpes.2018.s146

Nacaroglu, E., & Karakoc, O. (2018). Effects of Eight Week Plyometric Study on the Balance Performance of Hearing Impaired Athletes. International Education Studies, 11(6), 1-7. doi: 10.5539/ies.v11n6p1

Polat, E. (2008). İşitme Engelli Güreşçilerle Sağlıklı Güreşçilerin Dinamik Dengelerinin Karşılaştırılması Yayınlanmamış Yüksek Lisans Tezi, Dumlupınar Üniversitesi, Kütahya.

Rine, R.M., Braswell, J., Fisher, D., Joyce, K., Kalar, K. ve Shaffer, M. (2004). Improvement of motor development and postural control following intervention in children with sensorineural hearing loss and vestibular impairment. International Journal of Pediatric Otorhinolaryngology, 68(9), 1141-1148. doi: 10.1016/j.ijporl.2004.04.007

Scheffe, H. (1959). The analysis of variance. New York: John Wiley press.

Sheppard, J.M. and Young, W.B. (2006). Agility literature review: Classifications, training and testing. Journal of sports sciences, 24(9), 919-932. doi: 10.1080/02640410500457109

Sınar, D.S., Akın, M. (2015). Kangoo Jump ile Yapılan Antrenmanın Kız Atletlerde Sprint ve Durarak Uzun Atlama Üzerine Olan Etkisinin İncelenmesi. 10-13 Eylül 2015, Uluslararası Spor Bilimleri Araştırma Kongresi, Çanakkale.

Singh, A., Boyat, A.V., & Sandhu, J.S. (2015). Effect of a 6 week plyometric training pro-gram on agility, vertical jump height and peak torque ratio of Indian Tae-kwondo players. Sport Exerc Med Open J, 1(2), 42-46. doi: 10.17140/SEMOJ-1-107

Smits-Engelsman, B.C., Jelsma, L.D., & Ferguson, G.D. (2017). The effect of exergames on functional strength, anaerobic fitness, balance and agility in children with and without motor coordination difficulties living in low-income communities. Human Movement Science, 55, 327-337. doi: 10.1016/j.humov.2016.07.006

Spaniol F., Flores J., Bonnette R, Melrose D. ve Ocker L. (2010). The relationship between speed and agility of professional arena league football players Journal of Strength and Conditioning Research, 24(1). doi: 10.1097/01.JSC.0000367217.41032.6c

Tabachnick, B.G., Fidell, L.S., & Ullman, J.B. (2007).Using multivariate statistics (Vol. 5). Boston, MA: Pearson., 210-211

Taylor, M.J.D., Shawis, T., Impson, R., Ewins, K., McCormick, D., & Griffin, M. (2012). Nintendo Wii As a Training Tool in Falls Prevention Rehabilitation: Case Studies. Journal of the American Geriatrics Society, 60, 1781-1783. doi: 10.1111/j.1532-5415.2012.04122.x

Topuz, B., & Bostancı, İ. (1997). Kulak-burun-boğaz hastalıkları teşhis ve tedavi. Basım Ajans.

Vance, J., & Mercer, J.A. (2001). Impact forces during running in a novel spring boot. In Proceedings of the 25th Annual Meeting of the American Society of Biomechanics, San Diego (Vol. 109).

Yaggie, J.A., & Campbell, B.M. (2006). Effects of balance training on selected skills. The Journal of Strength & Conditioning Research, 20(2), 422-428.