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### RESEARCH ARTICLE

# Effects of Sprint and Plyometric Training on Speed, Jumping and Anaerobic Strength of Hearing Impaired Male Sportsmen

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### Abstract

The study aims to determine the effect of a 8 week sprint and plyometric training out regularly on speed, jump and anaerobic power parameters among hearing impaired male athletes at the age of 18-21. The measurement and tests of the study was carried out in 2018 and the article was written in 2019 in Samsun. 45 male volunteers with hearing impairment participated in this study. 15 of whom are sprint training (experimental) group aged 19.6±1,18; 15 of whom are plyometric training (experimental) group aged 19.33±1,12 and 15 of whom are control group aged 19.87±1,19. The experiment groups was made to take sprint and plyometric training practices for 8 weeks, the content of which had been determined before hand while the participants attended their trainings in their local teams. Two assessments were carried out in specified parameters for three groups at the beginning and end of the study. In statistical analysis, the significance level was taken as  $\alpha=0,05$ . One way analysis of variance was used to determine the differences between the groups. When the differences were found, Tukey test was used. Paired sample t-test for within group analysis. There are not any statistically difference in parameters of age, weight and training age of the participants ( $p>0.05$ ). There is statistically significant difference in height parameter ( $p<0.05$ ). 8 weeks of training, at the end of the results of participants data, there are significant differences among body weight, vertical and horizontal jumping, 20 meters and 30 meters sprint ( $p<0,01$ ); anaerobic power, sprint group ( $p<0.05$ ), plyometric group ( $p<0,01$ ) positive increase. There is significant difference found in anaerobic strength in control group ( $p<0,05$ ). In conclusion, the results of the present study showed that both sprint and plyometric training for 8 weeks improve the sprint, jump and anaerobic power performance.

### Keywords

Hearing Impaired, Sprint, Plyometric, Training, Sportsman

### INTRODUCTION

In recent years, the use of scientific principles has gained great importance in increasing athlete performance. Increased knowledge about the effects of various types of training, muscle fiber types, muscle biochemistry, and nerve muscle response have enabled coaches to train a modern athlete better (Brown et al.,1986). Important developments have been made

in. Studies in the field of training science have been directed towards increasing performance and increasing success (Kurudirek, 1998). In general, the efficiency of the performance athlete includes multiple (physical, physiological, biomotoric, psychological, mental, sociological, technical, tactical, etc.) components. In training, many training methods have been developed in our time and combined training systems have started to be

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used (Kraemer, 2001). Sportive activities, especially regular activities, are important for individuals' physical development and basic skills. It is known that training increases the maximal working capacity (Fox, 1988). Physical training is useful only as long as it forces the body to adapt with high levels of loading. If the load is not enough to make a change in the body, there is no harmony in any way. These structural and physiological changes on the body are the result of the loads required by a special activity depending on the scope, intensity and frequency of training. Therefore, adaptation to training is the sum of the changes that occur with the systematic repetition of exercises (Bompa, 2003).

### **Plyometric training**

Plyometric training provides rapid muscle activation, known as a stretching-shortening cycle. The muscles undergo an eccentric contraction before a concentric contraction. For example, an athlete jumping over the box to the floor first has an eccentric contraction in the lower limb muscles (an involuntary springing occurs depending on the falling speed when the athlete touches the ground). Then the athlete prepares to jump up again and the springing turns into a concentric contraction this time. This concentric contraction throws the athlete up and the athlete leaps over the box. To this situation; It is called the stress-shortening cycle in which eccentric and concentric contractions occur one after another. Plyometric training stands out as an effective training method with rapid results, since there are many strain-shortening cycles in the human movement (Turner & Jeffreys, 2010). As stated in the literature, there is a need for training to develop vertical and horizontal jump and leg strength training to jump faster and higher for a successful performance, especially in the sports branches based on jump. Plyometric training is recommended to improve the jumping force. Since splashes are made as explosives in a very short time unit, they develop both explosive power and explosive feature (Bosco, 1985; Chu, 1992).

### **Plyometric trainings and sport performance**

The whole secret of plyometric training is that the muscles work the stretching-shortening cycle perfectly. At this point, we encounter scenarios related to the neurophysiological change and development of the muscles. Studies have shown that in the energy storage and flexibility of muscles (Finni et al., 2001), active working rate

(Bobbert & Casius, 2005), in the nervous system (Bosco et al., 1981) show that there is an increase in pre-activity pre-preparation (McBride et al., 2008) and motor coordination skills (Bobbert & Casius, 2005). As a result of these adaptations, an increase in sportive performance is provided.

### **Sprint and speed training**

While Gundlach defines speed as "*the ability to advance at full speed*" (Muratlı & Sevim, 1977), Zaciorskij, "*The ability to complete a motoric action in a short time in an existing environment*" (Bağırgan, 1982), Grosser et al. (1981), "*The ability to react as a result of a stimulus as soon as possible*" (Blair, 1991; Armstrong & Simons-Morton, 1994). It is defined as "*the ability to move or move very quickly*" (Bompa (2007); "The ability of man to move himself from one place to another at the highest speed" (Sevim, 1997). Speed is the basis for performance in many sports. It is an explosive form of movement (Murphy & Wilson, 1997). Speed is the determining factor in many sports related to sprints, skips and athletics (Blair, 1991; Sevim, 1997). It is stated that "*speed can only be trained by being fast*" (Candan & Dündar, 1988), and training to be done for speed development should be 75-100% (Sevim, 1993). It is carried out by entering a certain submaximal and maximal loadings and oxygen borrowing.

This study was conducted on hearing impaired male athletes. Although there are no studies where two different training methods are used in hearing-impaired athletes, there are studies in which different training methods are applied (Kurt et al., 2017; Kurt et al., 2018). Studies have shown that the hearing impaired is the group with the highest participation in sports among individuals with disabilities (Longmuir & Bar-Or, 2000). Sports appeals to the strong perceptions of the hearing impaired (visual, kinesthetic, etc.) and offers more understandable and feasible opportunities compared to many other areas where they struggle with difficulties because teaching methods adapted to their disabilities are not used (Mitchel, 2005).

Özsoy (1987) calls the hearing-impaired "hearing impaired" to the situation that arises because the hearing sensitivity cannot fulfill their duties in development, adaptation, especially communication, and "hearing-impaired" to those who require special education because of this self-disability. Hallahan & Kaufman (1989) defines the hearing impaired as "*a person with mild to severe*

hearing defects". Wiley (1971) states, "For the Hearing people who have hearing sensation but who can function with or without hearing aid but who have malfunction."

among hearing impaired male athletes at the age of 18-21.

## MATERIALS AND METHODS

### Participants

The measurement and tests of the study was carried out in 2018 and the article was written in 2019 in Samsun. 45 male volunteers with hearing impairment participated in this study, at the age of 18-21.

### Research design in the study

Participated in the study, 15 of whom are sprint training (experimental) group aged  $19.6 \pm 1,18$ ; 15 of whom are pliometrik training (experimental) group aged  $19.33 \pm 1,12$  and 15 of whom are control group aged  $19.87 \pm 1,19$ . The experiment groups was made to take sprint and pliometric training practices for 8 weeks, the content of which had been determined before hand while the participants attended their trainings in their local teams. Two assessments were carried out

**Chart: 1.** (A) Sprint, (B) pliometric and (C) control groups at 8-week stage, weekly trainin programs

Groups	Training Type	Loading Methods	Number of Units	Time
(A) SPRINT GROUP	Club Workouts	Technical and other works	3	90 min.
	SPRINT Workouts	With the intensive interval method and the reloading method, SPRINT TRAINING	3	60-75 min.
(B) PLYOMETRIC GROUP	Club Workouts	Technical and other works	3	90 min.
	PLYOMETRIC Workouts	Intensive interval method and With the reloading method, PLYOMETRIC TRAINING	3	60-75 min.
(C) CONTROL GROUP	Club Workouts	Technical and other works	3	60-75 min.

### Warm-up

According to the characteristics of the test or training to be carried out, the participants were warmed with the same procedure for 10-15 minutes before the test and training, accompanied by the trainer. In practice, warming is completed with opening-stretching movements, each lasting 5-6 seconds, so that the physical and physiological characteristics of the athletes will affect the least

### Restings

Rests, sets or series, 15 sec heart rate taken between maximal pulse between sets 90 beats / min. (full rest); 120-130 at / min in sets.

basic needs of life, deaf people do not function. **The study aims**, to determine the effect of a 8 week sprint and pliometric training out regularly on speed, jump and anaerobic power parameters in specified parameters for three groups at the beginning and end of the study.

### Data collection tools

The majority of participants are basketball players, football players and volleyball players; It was determined that they attended trainings in their clubs on average three days a week. The sprint and pliometric training groups that participated in our study performed the training specified in chart-1 for an average of 60-75 minutes 3 (three) days a week (Monday, Wednesday and Friday) with an interval of one day. At the end of the study, an educational game was played for 20-25 minutes. The work in one unit was completed in about two hours. In training, intensive interval and repetition method was applied. The intensity of his training was 75-90% (submaximal) in the intensive interval, and maximal in the repetition method (90-100%).It was applied in short intervals and different (increasing-decreasing-constant) accelerations.

(productive rest) was taken as basis. ccording to the individual loading principles, the workout continued, taking into account the athlete's own statement. Kurt et al. (2008) states that the training should be athlete-centered and the athlete should feel ready for new loads.

### Weekly workouts applied to working groups in the eight-week intermediate phase:

#### A-Sprint Workouts

The training forms applied in this section are grouped under four (4) main headings from easy to difficult depending on whether they are with or without tools and power status:

<b>1. Preparation and strengthening exercises (1st and 2nd week)</b>	a) Stair studies (single-double speed running) b) Hollow sprints c) Acceleration sprints d) Acceleration sprints (positive, negative and constant acceleration: 10-20-30-40-50) m. distances e) Slalom studies f) Skipping rope
<b>2. Speed drills (3rd and 4th week)</b>	a) Jumping-exaggerated running b) Stipping the knees to the abdomen - on-site and running forward c) Slalom operation (3-4x 10) among towers (10 pieces) d) Slalom study (3-4-5x15) between funnels (15) e) Landing works (for speed barrier) (incline not more than 15 degrees)
<b>3. Drawing drills and acceleration sprints (5th and 6th week)</b>	a) Hill climbing (on different slopes) 30-40 meters b) Hill climbing (on different slopes) 50-60 meters c) Fartlek works (500-750-1000 meters; Vd.), d) Changing direction, running at different speeds.
<b>4. Submaximal and maximal sprint training (7th and 8th weeks)</b>	a) Pramidal Sprint (incremental) load training, (10-20-30-40-50 m. (4-6 again) Submaximal (75-90) intensity, b) Pramidal Sprint (incremental) Loading Workouts, (10-20-30-40-50 m. (4-6 repeat) at maximal (90-100) severity, etc. c) Interval sprints: (20-30-40-50-60-70) m. (4-6 reps). Submaximal (75-90%). d) Interval sprints: (20-30-40-50-60-70) m. (4-6 reps). Maximal (90-100%).

## B-Pliometric Workouts

The training forms applied in this section are grouped under four (4) main headings from easy to difficult depending on whether they are with or without tools and power status:

Weineck (1988) suggests that depth jumps should be done last, after other studies have been done, and the following steps for jumping studies:

1	Depth Jump Exercises
2	Additional Weight Jumping Exercises
3	Leg Force Exercises With Barbell Or / Dumb-Bell
4	Additional Weightless Jump-Force Exercises

Stages of the bounce force level (Weineck, cited from 1988:Dundar, 1994; adaptation: Kurt, 2011)

<b>1. Preparation and strengthening studies (1st and 2nd week)</b>	a) Skipping rope (in various ranges and numbers) b) High knee drills c) Stair work d) Jumping tense knees to abdomen e) Leap-overrun running f) Stipping the knees on the abdomen (on-site and forward) g) Hoping run h) Double foot jumping (using arms-arms encede-arms with hips)
<b>2. Jumping and power movements depending on the movement performed (3rd and 4th week)</b>	a) Leaping out of potty posture b) squatting stretched splash c) Jumping from the taking-push-up state to the potty state d) Jumping from flat tumble to potty state e) Frog splashes f) Double foot jump using arms. Hexagonal work g) Commando movement (dance)
<b>3-Jumps on the 2nd Tool (driller) (5th and 6th week)</b>	a) Jumping exercises between lines drawn on the ground b) Jumping exercises on the rope ladder on the ground (single foot and double feet), etc. c) Gymnastic order or jumping from low obstacle (single-double foot) d) Jumps to the side (Hands, free; waist; neck) e) Kangaroo leaps (odd-even); frog leaps f) Change lateral-direction, jump over low-middle obstacle (Hands, in different position) g) Jumping exercises over a single medicine ball (10-15-20 repetitions) h) On intermittent health balls (10 pieces: 3-5-7 rebound exercises)



#### 4. Barrier and vault drills (7 and 8 weeks)

- a) Jumps over barriers (by changing forward and direction)
- b) Changing direction through the funnel and jumping
- c) 180 degree rotation funnel jumps
- f) Gymnastic Box Serial jumps over the body part
- g) Jumps over different (long-short) barriers
- h) Depth leap through Gymnastic Boxes the crates (double feet); Increasing-decreasing heights in crates.
- i) Depth leap through Gymnastic Boxes increasing and decreasing heights (double feet).

#### Measurements and tests

Participants' age, training age, body weight, height length, vertical jump height, horizontal jump length, 20 meters basic speed, 30 meters sprint speed tests and anaerobic power calculations were made. Measurements, tests and training, accompanied by a sign language translator and three researcher trainers, one of whom is recording, on the synthetic track and artificial turf field, outdoors, at a temperature of 18-20 C<sup>0</sup>, with an altitude of 759 mm-Hg at 10 altitudes, in the same environment and applied under conditions.

#### Age and training age determination

Identity cards are taken as the basis for determining the chronological age of the athletes. For the training age, the number of years active licensed sports is based.

#### Body weight and height length measurement

Body weight was measured in kilograms with a pressure sensitive to 100 grams. In practice, athletes with bare feet, shorts and t-shirts on the soles of the feet were flat on the scales and measurements were taken. The height measurements were also measured with the same arrangement, such as the body height of the subject from the heels to the top of the head. The subjects' feet are closed, the head is upright, the knees are stretched, the heels are adjacent, the body is in an upright position, it is provided to reach high point by taking a deep breath. The distance between the miter and the floor from the vertex point is recorded in centimeters.

#### Vertical and horizontal jump test

Leap is a capability that contains an index of complex movements. Bounce depends on the strength of the leg muscles, the explosive force, the flexibility of the muscles involved in the jump and the technique of jumping (Mülhfriedal,

1987;Sevim,1997).From this point of view, increasing the jump force provides high efficiency especially in sports such as football, volleyball and basketball (Ziyagil,1989; Chu,1992). *Jumping force*, is defined as the jump of the athlete vertically high and horizontally away (Günay et al., 1994). The development of horizontal and vertical jump forces show atypical similarity (Muratlı & Sevim, 1977).

#### Vertical jump (VJ) test

Several studies in recent years show that anaerobic exercises have a positive effect on vertical jump. In practice, with the help of the jumpmeter connected to the waist of the athlete, the distance shown on the electronic meter is recorded, provided that the two feet are actively jumping upwards and falling to the same place. Of the two (2) valid leaps, the best was evaluated.

#### Horizontal jump (HJ) test

The subject tries to jump long distance from behind the marked line by using maximal effort with double feet. The distance between the starting line and the nearest trail left by the athlete to the line is measured in meters (Fetz & Konoxl, 1978). In practice, the athlete stands behind a straight line drawn on the ground on the synthetic track, with the toes behind the line double feet. Feet are in the normal range. The subjects were informed that by using all their forces forward with the help of the arms with the knees bent, they had to make a hard move to leap forward and away horizontally and they should be placed on the ground as they were without losing their balance. As a result of the two pairs of feet horizontally jumped from the standing position, the distance between the line at the jump point and the last trace of the subject was measured in meters of steel tape, and the best of the two valid jumps was evaluated.

### 20-meter and 30-meter acceleration test

Significant improvement in acceleration can be procured by practical technique, proper training, and coordination development despite having innate specialties (Günay & Yüce, 1996). Bağırğan (1982) states that a certain level of velocity is necessary, even this level can vary, for each branch of the sport to succeed. To detect the basic velocity level, a 20-meter acceleration test has been applied as the indicator of the particular velocity and a 30-meter acceleration test has been applied to detect sprint velocity. A new test brand photocell was used in the application. The athlete takes the high starting behind two meters of the start line and waits as the sign language translator gave the ready command ( rising and waving white flag). He runs at his finest whenever he starts the parkour. Timing starts as the athlete entered the start point and it stops itself after the end of the 20-meter and 30-meter measured separately. The distance between the start and endpoints on the synthetic track was measured with an accuracy of 0.01. The best of the two measurements taken at 10 minutes intervals at both distances were taken.

### Calculation of anaerobic power

Anaerobic power is work power that can be generated in one minute anaerobic way, using the ATP-CP energy source. Anaerobic power will be high in excess of the ability to use the ATP-CP energy source. Anaerobic energy sources; Adenosine Triphosphate (ATP) is Creatine Phosphate (CP) and Glycogen. In an oxygen-free environment, the energy necessary for muscle contraction is released by their metabolic breakdown. ATP and CP are called energy-rich phosphagen. These are emergency energy sources. Although they are limited in our muscles, their energy potential is high, that is, they can create high energy in a short time. These energy sources are used in short-term, high-intensity efforts (Akgün, 1992).

Although there is no satisfactory method that can measure anaerobic power with the desired accuracy (Manning et al.,1988) , there are tests and indirect methods that partially reflect anaerobic power (Foss et al.,1998). Anaerobic strength tests are routinely used in exercise physiology laboratories. Most of these tests are standing vertical jumping, standing horizontal jumping, Margaria-Kalamen, and Wingate test (Mayhew et

al.,1986). In our study, anaerobic power was calculated with the following formula by taking the bodyweight with the vertical jump height determined as a result of the vertical jump test (Garbetta, 1989; Tamer, 1995).

$$P (\text{Anaerobic Power}) = \sqrt{4.9 \times (W) \times \sqrt{D}}$$

calculated with the formula. These values:  
**P=Anaerobic Power (kg.m/sec.)**  
**W=Body weight (kilogram),**  
**4.9 =Standard time (seconds),**  
**D=Distance jumped vertically (meter).**

### Statistical analysis

In statistical analysis, the significance level was taken as  $\alpha=0,05$ . One way analysis of variance (One-Way ANOVA) was used to determine the differences between the groups. When the differences were found, Tukey's HSD (Tukey's Honestly Significant Difference) test was used. Paired sample t-test for within group analysis.

## RESULTS

A difference has been found on the height parameter by comparing the parameters of subjects' ages, height, boy mass, and training ages with one way variance analysis ( $p<0.05$ ) (Table 1). In the comparison done by Turkey's HSD test, the height of the sprint group was found out different(shorter) than other plyometric groups and control group, ( $p<0.05$ ) (Table 2). After the two measurements gauged both before and after the eight-week-long sprint and plyometric training program applied to the hearing impaired 18-21-year-old boy athletes. Positive effects have occurred in the factors of body mass, vertical jump, horizontal jump, twenty and thirty meters acceleration, and anaerobic power of both groups ( $p<0.01$ ). No difference was found in other parameters except for increasing in anaerobic power ( $p<0,05$ ) depending on the meaningful gain on the body mass of the control group, ( $p>0,05$ ). (Table 3-a,b,c).

**Table 1.** Comparison of participants' age, height, body weight, and training age parameters and one-way analysis of variance (One Way ANOVA) test results

Parameters	(A) Sprint Training Group (n=15)			(B)Pliometric Training Group (n=15)			(C) Control Group (n=15)			F	P
	Mean-Sd.	Min	Max	Mean- Sd.	Min	Max	Mean – Sd.	Min	Max		
Age (years)	19.6±1,18	18	21	19.33 ±1,12	18	21	19.87 ±1,19	18	21	0.847	p>0.05
Height (cm)	178.13±4,85	166	184	179.93±7,26	173	188	179.53±5,88	165	187	7.464	P<0.05*
Weight (kg)	68.95±5,60	60.1	76.2	71.42±10,1	55.4	92.2	70.40±13,12	42.1	94,1	0.227	p>0.05
Training age (years)	4.27± 1,53	2	7	4,4 ± 1,82	2	7	4.47 ± 1,98	2	7	0.049	P>0.05

As a result of one-way analysis of variance (One Way ANOVA) test of the participating groups; Age: (F=19.47=0.847;p>0.05); body weight: (F=19.47=0.227; p>0.05); training age: (F=19.47=0.049; p>0.05), there is no significant difference between parameters. height: (F=3.23=7.464; p<0.05) and height parameters were found different (Table 1).

**Table 2.**Comparison of the participants' height parameters Tukey HSD test table

Groups	$ \bar{X}_1 - \bar{X}_2 $	T	Decision (p)
Sprint - Pliometric	178,13 - 179.93	=1.8 > 1.19	p<0.05*
Sprint - Control	178,13 - 179.53	=1.4 > 1.19	p<0.05*
Pliometric - Control	179.93 - 179.53	=0.4 < 1.19	p>0.05

As a result of the Tukey method; While there was no significant difference between the height of the plyometric training group and the control group, (p>0.05); the lengths of these two groups were found to be significantly longer than those of the sprint training group. (p<0.05), (Table 2).

Results of (A) Sprint Training, (B) Pliometric Training and (C) Control Groups's pre test / post test Data Paired (Dependent) "T" Test in Various Parametr:

**Table 3-a)** (A) Pre / post test data of the Sprint training group in various parameters paired (dependent) "t" test table

Parameters	Tests	(A) Sprint Training Group (n=15)			
		Mean- Sd.	Mean-D .	t	P
1 Body weight (kg)	Pre-test	68.95±5.6			
	Post-test	67.15±5.31	-1.8	14.02	p<0.01*
2 Verticalle jumping (cm)	Pre-test	51.8±9.34			
	Post-test	54.2±24.13	2.4	5,67	p<0.01*
3 Horizontal jumping (cm)	Pre-test	219.53±25.31			
	Post-test	225.33±21.5	5.8	12,61	p<0,01*
4 20 Meters sprint (sec.)	Pre-test	3.18±0.25			
	Post-test	3.07±0.19	-0.11	5,9	p<0.01*
5 30 Meters sprint (sec.)	Pre-test	4.578±0.34			
	Post-test	4.417±0.19	1.161	8,19	p<0,01*
6 Anaerobic power (kg.m/sec.)	Pre-test	109.588±15.85			
	Post-test	110.589±15.82	0.999	2,96	p<0,01*

(\*) (A) In the sprint training group, in the measurements made after 8 weeks; subjects' body weight (t=14.02;p<0.01), vertical jump (t=5.67;<0.01), horizontal jump (t=12.61;p<0.01), 20 meters accerelation (t=5.9;p<0.01), 30 meters accerelation(t=8.19;p<0.01), anaerobic power, (t=2.96;p<0.05), statistically significant difference (development) was found in all parameters (Table 3-a).

**Table 3-b)** (B) Pre / post test data of the pliometric training group in various parameters paired (dependent) “t” test table

Parameters	Tests	(B) Pliometric Training Group (n=15)			
		Mean- Sd.	Mean-D	t	P
1 Body weight (kg)	Pre-test	71.42±10.09			
	Post-test	70.16±9.91	-1.26	5,78	p<0.01*
2 Verticalle jumping (cm)	Pre-test	52.6±9.39			
	Post-test	56.4±9.09	3.8	12,83	p<0.01*
3 Horizontal jumping (cm)	Pre-test	214.6±19.77			
	Post-test	221.93±18.86	7.33	16.14	p<0.01*
4 20 Meters sprint (sec.)	Pre-test	3.226±30			
	Post-test	3.156±0.26	-0.07	8,28	p<0.01*
5 30 Meters sprint (sec.)	Pre-test	4.49±0.27			
	Post-test	4.396±0.24	-0.094	7,16	p<0.01*
6 Anaerobic power (kg.m/sec.)	Pre-test	114.432±20.47			
	Post-test	116.408±19.38	1.976	3,11	p<0.01*

(\*)

(B) In the Pliometric training group, in the measurements made after 8 weeks; subjects' body weight ( $t=5.78$ ;  $p<0.01$ ), vertical jump ( $t=12.83$ ;  $p<0.01$ ), horizontal jump ( $t=16.14$ ;  $p<0.01$ ), 20 meters speed ( $t=8.28$ ;  $p<0.01$ ), 30 meters sprint speed ( $t=7.16$ ;  $p<0.01$ ), anaerobic power ( $t=3.11$ ;  $p<0.01$ ), statistically significant difference (development) was found in all parameters (Table 3-b).

Let us examine the control group's data to understand whether the developments in the two training groups are the result of the training practices or the routine training in the clubs:

**Table 3-c)** (C) Pre / post test data of the control group in various parameters paired (dependent) “t” test table

Parameters	Tests	(C) Control Group (n=15)			
		Mean- Sd.	Mean-D	t	P
1 Body weight (kg)	Pre-test	70.39±13.12			
	Post-test	70.67±12.47	0.28	2.33	p<0.05*
2 Verticalle jumping (cm)	Pre-test	53.07±10.28			
	Post-test	53.0±9.55	-0.07	0,34	p> 0.05
3 Horizontal jumping (cm)	Pre-test	220.2±21.54			
	Post-test	220.66±19.58	0.46	1.48	p> 0.05
4 20 Meters sprint (sec.)	Pre-test	3.113±0.16			
	Post-test	3.123±0.15	0.01	1,83	p> 0.05
5 30 Meters sprint (sec.)	Pre-test	4.48±0.2			
	Post-test	4.469±0.19	0.01	1,58	p> 0.05
6 Anaerobic power (kg.m/sec)	Pre-test	113.194±23.57			
	Post-test	113.928±16.45	0.734	2,64	p<0.05*

(\*) (C) In the control group, in the measurements made after 8 weeks; subjects' body mass ( $t=2.33$ ;  $p<0.05$  \*), vertical jump height ( $t=0.34$ ;  $p>0.05$ ), horizontal jump length ( $t=1.48$ ;  $p>0.05$ ), 20 meters basic acceration ( $t=1.83$ ;  $p>0.05$ ), 30 meters sprint acceration ( $t=1.58$ ;  $p> 0.05$ ), Anaerobic power, ( $t=2.64$ ;  $p<0.05$ \*). Statistically, there is a significant difference in body weight and anaerobic power parameters. No significant difference was found in other parameters. The increase in body weight of the control group may be due to seasonal training reduction. We can say that the increase in anaerobic power is due to the increase in body weight because it produces more anaerobic power (Table: 3-c).



It can be seen in these data that the exercises applied to the sprint and plyometric group caused a decrease in body weight of the subjects, development in vertical jump and horizontal jump, development in 20-meter speed and 30 m sprint speeds, and increase in their anaerobic power (**Table 3-a-b**).

## DISCUSSION

Some researches seek out the effect of certain types of training on certain parameters. Plyometric exercises are quite common among them: (Günay et al., 1994; Cicioğlu et al., 1997; Kutlu et al., 2001; Luebbers et al., 2003; Kurt, 2011; Kurt et al., 2013; Pamuk & Özkaya, 2017). On the other hand, there are different kinds of plyometric exercise to compare with a different method: Quick power and plyometric exercises (Öztin et al., 2003). Sprint and plyometric exercises (Markovic et al., 2007) et al. There are some researches too that seek out the effect of different kinds training on several parameters: Quick power (Sevim & Erol, 1993; Sevim et al., 1996; Polat et al., 2002; Kurt et al., 2010b), strength (Eler & Sevim, 2002), quick power and sprint (Diallo et al., 2001; Polat et al., 2002), intensive interval exercise (Son et al., 2007), enduring and interval exercises (Revan et al., 2008), aerobic and interval exercise (Kurt et al., 2017) et al.

### Body mass rate of subjects

The arithmetic mean of the pre-measurement rate of the sprint exercising group is 68.95 kg. The lowest rate was calculated as 60.1 kg while the highest rate was calculated as 76.7 kg. The arithmetic mean of the last measurement is 67.15 kg. The lowest rate was calculated as 59.04 kg while the highest rate was calculated as 74.5 kg. The difference between the first and the last measurement is 1,8 kg which equals to  $\cong 2.61\%$ . The arithmetic mean of the pre-measurement rate of the plyometric exercising group is 71.42 kg. The lowest rate was calculated as 55.04 kg while the highest rate was calculated as 92.2 kg. The arithmetic mean of the last measurement is 70.16 kg. The lowest rate was calculated as 54.01 kg while the highest rate was calculated as 89.8 kg. The difference between the first and the last measurement is 1,26 kg which equals to  $\cong 1.76\%$ . The arithmetic mean of the pre-measurement rate of the control group is 70.393 kg. The lowest rate

was calculated as 42.1 kg while the highest rate was calculated as 94.1 kg. The arithmetic mean of the last measurement is 70.67 kg. The lowest rate was calculated as 43.3 kg while the highest rate was calculated as 92.4 kg. The difference between the first and the last measurement is 0.28 kg which equals to  $\cong 0.32\%$ .

In this experiment, in the term of body mass 1.8 kg of wane has occurred in sprint exercising group and it sounds meaningful ( $p < 0.01$ ); 1.26 kg of wane has occurred in the plyometric exercising group and it sounds meaningful ( $p < 0.01$ ). 0.28 kg of rising has occurred in the control group and it sounds meaningful ( $p < 0.05$ ). It is thought that the meaningful decrease in body mass is due to the effect of applied sprint and plyometric exercises on the decrease in body weight. The results obtained in our study show parallelism with the previous study results in body weight.

### Some literature studies about body mass

Kurt et al. (2017) meaningful wane in body mass and other parameters as a result of the 8 week-long research which search the effect of aerobic and interval training on anaerobic power, velocity and jumping performance of hearing-impaired basketball players ( $p < 0,01$ ). Thirty-two subjects from the age of 15 between 19 were subdivided in to experiment group ( $n=16$ ) and control group ( $n=16$ ). Kurt et al. (2015), meaningful wane in body mass of experiment group as a result of the 8 week-long research aimed to find out the effect of training done by stretch and shortening cycle muscle exercising on some physical and physiological parameters of the soccer player, sixteen of who were subdivided as the control group while the other sixteen were subdivided as experiment group ( $p < 0,01$ ). Kurt (2011) meaningful wane in body mass in the experiment group as a result of the 8 week-long research which is held by thirty-two soccer players from the age of 15 and 16 ( $p < 0.01$ ). Ateş et al. (2007), meaningful wane in body mass of the experiment group as a result of ten-week plyometric training applied to football players aged 16-18 ( $p < 0.05$ ). Koç (2010), As a result of the combined training program applied to handball players, they found a decrease in the body mass of the subjects. Berger et al. (2006), Compared to the control group which is applied continuous and high-intensity interval training performed 3-4 days a week for six weeks, it was stated that no significant change was observed in any of the

groups and the changes in both training groups were similar in the term of body mass.

#### **Vertical jump rate of the subjects**

The arithmetic mean of the pre-measurement rate of the sprint exercising group is, 51.8 cm. The lowest rate was calculated as 33 cm. while the highest rate was calculated as 69 cm. The arithmetic mean of the last measurement is 54.2 cm. The lowest rate was calculated as 38 cm, while the highest rate was calculated as 70 cm. The difference between the first and the last measurement is 2.4 cm. which equals to 4.63%. The arithmetic mean of the pre-measurement rate of the plyometric exercising group is 52.6 cm. The lowest rate was calculated as 38 cm. while the highest rate was calculated as 73 cm. The arithmetic mean of the last measurement is 56.4 cm. The lowest rate was calculated as 41 cm, while the highest rate was calculated as 76 cm. The difference between the first and the last measurement is 3.8 cm. which equals to 7.22%. The arithmetic mean of the pre-measurement rate of the control group is, 53.07 cm. The lowest rate was calculated as 36 cm. while the highest rate was calculated as 72 cm. The arithmetic mean of the last measurement is 53.0 cm. The lowest rate was calculated as 35 cm. while the highest rate was calculated as 70 cm. The difference between the first and the last measurement is 0.07 cm. which equals to 0.13%.

Accordingly, in the vertical jump test, in the sprint training group, 2.4 cm. improvement and significant ( $p < 0.01$ ); in plyometric training group 3.8 cm. improvement was found and significant ( $p < 0.01$ ). In the control group, there was an improvement of 0.07 cm and it was not found significant ( $p > 0.05$ ). In the vertical jump, more improvement occurred in the plyometric training group compared to the sprint training group. At vertical jump, significant improvement is thought to be due to the training effect of sprint and plyometric exercises applied to the vertical jump. The results obtained in our study were in line with the previous study results on vertical jump.

#### **Some literature studies about vertical jump**

Adıgüzel & Günay (2015), In the study, in which 30 male basketball players participated in the study which they were investigated the effect of eight-week plyometric training on the jump and isokinetic force parameters in 15-18 age group basketball players, in addition to the training

program, free jump in vertical jump with some other parameters as a result of plyometric training three days a week for eight weeks (cm), 120° squat jump (cm) and active jump (cm) values significant improvement ( $p < 0.05$ ) Kurt & Taşkıran (2004) meaningful development in both groups in vertical and horizontal jump as a result of 12-week plyometric training in their studies, which divided the athletes into two groups according to their anaerobic power. Öztin et al. (2003), meaningful improvement in vertical jump as a result of the eight-week quick strength and plyometric training program applied to 15-16 year old basketball players ( $p < 0.01$ ); Luebbers et al. (2003) meaningful improvement in the vertical jump values of the subjects as a result of four-week plyometric training. Kutlu et al. (2001), In this study, which was conducted to investigate the effect of plyometric training on the anaerobic power of young football players, the subjects were divided into three groups as 17 football players participating in the plyometric exercise program, 17 football players who continued their normal training and 17 students in the sedentary control group, and in this study, meaning development in the vertical jump in the experimental group ( $p < 0.01$ ); Al-Ahmad (1990), They determined that there was a meaningful improvement in vertical jump values at the end of the six-week plyometric training with 14-18 age group basketball players.

#### **Horizontal jump rate of the subjects**

The arithmetic mean of the pre-measurement rate of the sprint exercising group is, 219.53 cm. The lowest rate was calculated as 183 cm. while the highest rate was calculated as 254 cm. The arithmetic mean of the last measurement is 225.33 cm. The lowest rate was calculated as 191 cm., while the highest rate was calculated as 261 cm. The difference between the first and the last measurement is 5.8 cm. which equals to 2.64%. The arithmetic mean of the pre-measurement rate of the plyometric exercising group is 214.6 cm. The lowest rate was calculated as 176 cm. while the highest rate was calculated as 243 cm. The arithmetic mean of the last measurement is 221.93 cm. The lowest rate was calculated as 185 cm, while the highest rate was calculated as 248 cm. The difference between the first and the last measurement is 7.33 cm. which equals to 3.42 %. The arithmetic mean of the pre-measurement rate of the control group is, 220.2 cm. The lowest rate was calculated as 176 cm.

while the highest rate was calculated as 272 cm. The arithmetic mean of the last measurement is 220.66 cm. The lowest rate was calculated as 180 cm. while the highest rate was calculated as 267 cm. The difference between the first and the last measurement is 0.46 cm. which equals to 0.21 %.

Accordingly, in the horizontal jump test, in the sprint training group, 5.8 cm. improvement and significant ( $p < 0.01$ ); in pliometric training group 7.33 cm. improvement was found and significant ( $p < 0.01$ ). In the control group, there was an improvement of 0.46 cm and it was not found significant ( $p > 0.05$ ). In the horizontal jump, more improvement occurred in the pliometric training group compared to the sprint training group. At horizontal jump, significant improvement is thought to be due to the training effect of sprint and pliometric exercises applied to the horizontal jump. The results obtained in our study were in line with the previous study results on horizontal jump.

### **Some literature studies about horizontal jump**

Kurt et al.(2016), meaningful improvement in the horizontal jump variables of the experimental group as a result of the ten-week study in which they studied the impact of anaerobic training together with basketball training, in a study they conducted on 28 hearing-impaired male basketball players studying at a special education vocational high school ( $p < 0,01$ ); Kurt et al. (2013), In the study, in which 32 soccer player aged 15-16 participated who were divided into two groups as an experiment ( $n=16$ ) and control ( $n=16$ ), meaningful improvement in horizontal jump parameters was detected in the eight-week modified training and stretch and shortening cycle exercising; Markovic et al. (2007), As a result of their studies investigating the effects of sprint and stretch and shortening cycle exercising on muscle function and athletic performance, they found a meaningful improvement in the horizontal jump values of sprint and plyometric training groups. Cicioğlu et al. (1997), as a result of the plyometric training applied to 14-15 years old boy basketball player; Öztin et al. (2003), as a result of the eight-week-long plyometric and quick power applied to male basketball player aged 15-16 ( $p < 0.01$ ). Günay et al. (1994) as a result of plyometric training exercised by 19-25 years old top-tier athletes, the meaningful improvements were recorded on

vertical jump value. Gamar (1987), As a result of the eight-week study that allocated the subjects as a weight training group, plyometric training group, and control group, 11.2 cm for the weight training group, 9.5 cm for the plyometric group and 5.0 cm for the control group were determined.

### **20 meter speed rate of the subjects**

The arithmetic mean of the pre-measurement rate of the sprint exercising group is, 3.1806'sec.. The lowest rate was calculated as 2.94 sec. while the highest rate was calculated as 3.76 sec. The arithmetic mean of the last measurement is 3.0666 sec. The lowest rate was calculated as 2.84 sec., while the highest rate was calculated as 3.51 sec. The difference between the first and the last measurement is 0.114 sec.. which equals to 3.58 %. The arithmetic mean of the pre-measurement rate of the plyometric exercising group is 3.226 sec. The lowest rate was calculated as 2.81 sec. while the highest rate was calculated as 3.76 sec. The arithmetic mean of the last measurement is 3.156 sec. The lowest rate was calculated as 2.78 sec, while the highest rate was calculated as 3.78 sec. The difference between the first and the last measurement is 0.07 sec. which equals to 2.17 %. The arithmetic mean of the pre-measurement rate of the control group is, 3.113 sec. The lowest rate was calculated as 2.81 sec. while the highest rate was calculated as 3.42 sec. The arithmetic mean of the last measurement is 3.123 sec. The lowest rate was calculated as 2.85 sec. while the highest rate was calculated as 3.45 sec. The difference between the first and the last measurement is 0.01sec. which equals to 0.32 %.

Accordingly in the 20 meter speed test, in the sprint training group, 0.114 sec. improvement and significant ( $p < 0.01$ ); in the pliometric training group, 0.07 sec. improvement was found and significant ( $p < 0.01$ ). In the control group, there was an improvement of 0.01 sec. and it was not found significant ( $p > 0.05$ ). In the 20 meters speed, more improvement occurred in the sprint training group compared to the pliometric training group. At 20 meters speed, significant improvement is thought to be due to the training effect of sprint and pliometric exercises applied to the 20 meters speed. The results obtained in our study were in line with the previous study results on 20 meters of speed.

### Some literature studies about 20 meters speed

Kurt et al. (2017), the subjects with hearing impairment in which they practiced aerobic and interval training programs were divided into experiment (n=16) and control (n=16). In the study, positive development in 20 meter speed variable ( $p<0.05$ ); Pamuk & Özkaya (2017) investigated the effect of pliometric and resistant pliometric training applied to 15-17 year-old boys basketball players on sprint and agility performance, and in the 12-week study of 35 male basketball players who participated in regular training, they made a 3-meter run time improvement ( $p<0.05$ ); Kurt et al. (2010a), eight-week elongation-shortening cycle applied by the experimental group in the study where the 15-16-year-old male footballers studied the effect of the training program performed with the length-shortening-cycle muscle study and separated the subjects as experiment (16) and control (16). As a result of training, significant improvement in 20 meter speed test ( $p<0.01$ ); Markovic et al. (2007), as a result of their studies investigating the effects of sprint and pliometric training on muscle function and athletic performance, they found a significant improvement in sprint and pliometric training groups at 20 meter speed.

#### 30 meter speed rate of the subjects

The arithmetic mean of the pre-measurement rate of the sprint exercising group is, 4.578 sec..The lowest rate was calculated as 4.12 sec. while the highest rate was calculated as 5.19 sec. The arithmetic mean of the last measurement is 4.4173 sec. The lowest rate was calculated as 4.08 sec., while the highest rate was calculated as 4.88 sec. The difference between the first and the last measurement is 0.1607 sec.. which equals to 3.51 %. The arithmetic mean of the pre-measurement rate of the plyometric exercising group is 4.578 sec. The lowest rate was calculated as 4.18 sec. while the highest rate was calculated as 5.12 sec. The arithmetic mean of the last measurement is 4.396 sec. The lowest rate was calculated as 4.14 sec, while the highest rate was calculated as 5.04 sec. The difference between the first and the last measurement is 0.182 sec. which equals to 3.98 %. The arithmetic mean of the pre-measurement rate of the control group is, 4.48 sec.The lowest rate was calculated as 4.15 sec. while the highest rate was calculated as 4.15 sec. The arithmetic mean of the last measurement is 4.469 sec. The lowest rate

was calculated as 4.20 sec. while the highest rate was calculated as 4.79 sec. The difference between the first and the last measurement is 0.011 sec. which equals to 0.25 %.

Accordingly in the 30 meter speed test, in the sprint training group, 0.1607 sec. improvement and significant ( $p<0.01$ ); in the pliometric training group, 0.182 sec. improvement was found and significant ( $p<0.01$ ); In the control group, there was an improvement of 0.011 sec. and it was not found significant ( $p>0.05$ ). In the 30 meters speed, more improvement occurred in the sprint training group compared to the pliometric training group. At 30 meters speed, significant improvement is thought to be due to the training effect of sprint and pliometric exercises applied to the 30 meters speed. The results obtained in our study were in line with the previous study results on 30 meters of speed.

### Some literature studies on sprint speed of 30 meters

Kurt et al. (2010b), the eight-week study conducted by the experimental group in their studies, where they investigated the effect of rapid force station studies on the sprint speed of 30 meters and 60 meters of young athletes aged 15-18, separated the subjects as experimental group (n=10) and control group (n=10). significant improvement in 30 and 60 meters values as a result of rapid strength training ( $p<0.01$ ); Ateş et al. (2007), 10 week pliometric training applied to 16-18 age players, significant improvement in the 30-meter speed values of the experimental group ( $p<0.01$ ); Son et al. (2007), 30 players in the 15-16 age group participated in the study, meaningful improvement over 30 meters as a result of intensive interval training sessions applied to 15 male players for eight weeks ( $p<0.05$ ); Öztin et al. (2003), a significant improvement in 30-meter speed ( $p<0.01$ ) as a result of eight-week quick strength and pliometric training applied to 15-16 year old boys basketball players; Polat et al. (2002), a significant improvement in 30-meter sprint values ( $p<0.01$ ) in the study where they investigated the effect of rapid strength training on some physical parameters and 30-meter sprint values; Eler & Sevim (2002) investigated the effect of handball-specific strength training on some performance parameters of young male handball players, development of experimental groups at 30 meter speed ( $p<0.01$ ); Diallo et al (2001) improves the sprint values of 20, 30 and 40



meters as a result of the exercise applied to children aged 10-12 3 days a week; as a result of eight-week rapid-strength station studies; Sevim & Erol (1993) found a significant improvement ( $p<0.01$ ) in 30-meter sprint values after eight weeks of rapid strength training.

#### **Anaerobic power rate of subjects**

The arithmetic mean of the pre-measurement rate of the sprint exercising group is 109.588' kg.m/sec. The lowest rate was calculated as 77.95 kg.m/sec. while the highest rate was calculated as 135.99 kg.m/sec. The arithmetic mean of the last measurement is 110.589 kg.m/sec. The lowest rate was calculated as 81.46 kg.m/sec. while the highest rate was calculated as 139.46 kg.m/sec. The difference between the first and the last measurement is 1.001 kg.m/sec. which equals to  $0.91\cong\%$ . The arithmetic mean of the pre-measurement rate of the plyometric exercising group is 114.432 kg.m/sec. The lowest rate was calculated as 90.78kg.m/sec. while the highest rate was calculated as 159.40 kg.m/sec. The arithmetic mean of the last measurement is 116.408 kg.m/sec. The lowest rate was calculated as 93.90 kg.m/sec. while the highest rate was calculated as 159.92 kg.m/sec. The difference between the first and the last measurement is 1.976 kg.m/sec. which equals to  $1.73\cong\%$ . The arithmetic mean of the pre-measurement rate of the control group is 113.194 kg.m/sec. The lowest rate was calculated as 61.110 kg.m/sec. while the highest rate was calculated as 146.70 kg.m/sec. The arithmetic mean of the last measurement is 113.928 kg.m/sec. The lowest rate was calculated as 63.58 kg.m/sec. while the highest rate was calculated as 145.199 kg.m/sec. The difference between the first and the last measurement is 0.734 kg.m/sec. which equals to  $0.65\cong\%$ .

Accordingly, 1,001 kg.m /sec in anaerobic power, sprint training group. improvement and significant ( $p<0.05$ ); In the plyometric training group, 1.976 (kg.m/sec.) there was improvement and it was found significant ( $p<0.01$ ). In the control group, an improvement of 0.734 kg.m/s was found and found significant ( $p<.05$ ). There was more improvement in anaerobic power in the plyometric training group than in the sprint training group. Significant improvement in anaerobic power is thought to be due to the training effect of sprint and plyometric exercises applied to improve anaerobic power. The increase in the control group is thought to be due to the increase in the body

weight of the subjects. The results obtained in our study were in line with the previous study results on anaerobic power.

#### **Some literature studies on anaerobic power**

Kurt et al. (2018), in the studies in which 28 male basketball players with hearing impairment participated, in the studies in which subjects were divided into experimental ( $n=14$ ) and control ( $n=14$ ), significant improvement in the anaerobic power after the 10-week anaerobic training applied by the experimental group ( $p<0.05$ ); Kurt et al. (2017), in the study of male basketball players with hearing impairment, in which they applied aerobic and interval training programs, the subjects were divided into experimental ( $n=16$ ) and control ( $n=16$ ), significant improvement in the anaerobic power variable ( $p<0.05$ ); Son et al. (2007), in the study of 30 male players aged 15-16 years, significant improvement in the anaerobic power of the experimental group as a result of the intensive interval training applied to 15 soccer players for eight weeks ( $p<0.05$ ); Ateş et al. (2007), the development of the anaerobic power of the experimental group, along with some other parameters, as a result of the ten-week plyometric training they applied to football players aged 16-18, ( $p<0.01$ ); Öztin et al. (2003), the improvement of anaerobic power values ( $p<0.01$ ) as a result of eight weeks of rapid strength and plyometric training applied to 15-16 year old boys basketball players; Kutlu et al. (2001), as a result of their study to investigate the effect of plyometric training on the anaerobic power of young footballers, significant improvement in the anaerobic power of the experimental group ( $p<0.01$ ); Cicioğlu et al. (1997), in the study in which they investigated the effects of plyometric training on 14-15 age group basketball players, significant improvement in anaerobic power values ( $p<0.01$ ); Günay et al. (1994), as a result of their plyometric training with senior athletes between the ages of 19-25, found a significant improvement ( $p<0.05$ ) in their anaerobic power values.

#### **Conclusion**

Sprint and plyometric training in different protocols applied to hearing-impaired athletes for 8 weeks apart from club work caused positive differences in the speed, jump and anaerobic power variables of the athletes. However, sprint workouts showed more improvement in speed



parameters, while pliometric workouts showed more improvement in jump and anaerobic power parameters. There was no significant difference in the variables of the control group. The difference between the three groups participating in the study in the direction of sprint and pliometric training groups is thought to be due to the training effectiveness of sprint and pliometric exercises to improve the performance in related parameters. As a result, sprint and pliometric training programs applied to hearing-impaired athletes between the ages of 18-21 have positive effects on the body weight, vertical jump, horizontal jump, 20 and 30 meter speed and anaerobic power variables; When applied correctly and methodically, it can be said that it can be used as an effective and useful training method.

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