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Research Article

The Effects of Anaerobic and Aerobic Trainings Applied in The Preparation Period on Some Performance Parameters of Hearing-Impaired Sportsmen

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Abstract

Introduction and purpose: The preparatory period is generally a period in which all performance parameters are aimed to be developed and maximized concurrently. These workouts are known to be effective, versatile and motivating. However, the regulation and degree of training loading is very difficult to adjust. Sportive performance depends on the interaction of several physiological factors. Factors affecting the sportive performance may vary. Finding out the workload and the correct combination of exercise during workout to encourage the optimization of modifying factors in the long term is a challenge for coaches and athletes. Studies show that various problems are encountered in the programming of aerobic and anaerobic training together, and as a result, there are significant decreases in some performance parameters. This study was conducted on hearing impaired male sportsmen. Aim is to investigate the effects of 8-week anaerobic and aerobic training programs applied in the preparation period on some performance parameters of 19-22 years old hearing-impaired male sportsmen.

Method: The research was carried out in Samsun (2022-23). 42 Hearing-impaired male sportsmen aged 19-22, operating in deaf sports clubs, participated in the study voluntarily. After the first measurements, the subjects were randomly assigned to one of the three groups. (A) Experimental group, (n=14). Aged (20.86±1.23) years, height, (178.71±1.58) cm. Body weight, (69.98±7.28) kg., training age, (4.50±1.56). (B) Experimental group, (n=14). Aged (20.57±1.40) years, height, (179.21±4.56) cm. Body weight, (69.46±7.55) kg., training age, (4.36±1.65). (C) Control group (n=14). Age, (20.78±1.58) years, height, (178.14±6.57) cm., body weight, (70.86±11.96) kg., training age, (4.57±2.10). While the athletes were in the general preparation period and continuing their training in clubs, (Anaerobic training: Group A: Speed+strength training; Group B: Plyometric training. Aerobic training: A and B research groups together), training programs were applied to the experimental groups for 8 weeks, the content of which was determined beforehand. Two measurements were taken at the beginning and end of the study.

In statistical analysis: normality of distribution and homogeneity of variances were tested. One way analysis of variance (ANOVA) was used to determine the differences between the groups. When the differences were found, Tukey's HSD test was used. Within-group differences were assessed using paired t-tests. The $p<0.05$ criterion was used for establishing statistical significance.

Findings: There are not any statistically difference in parameters of age, height, weight and training age of the participants ($p>0.05$). 8 weeks of training, at the end of the results of experimental groups data, there are significant differences among body weight and body mass index, vertically jumping, sit-ups and anaerobic and aerobic power values increase, 20 meters speed and resting heart rate parameters positive increase ($p<0.01$). However, excluding the anaerobic power of the control group ($p>0.05$); As a result of club studies, a similar significant decrease ($p<0.01$) was recorded in body weight and body mass indexes, while a less significant improvement was found in other parameters compared to the experimental groups ($p<0.05$). As a result, the parameters tested in our study revealed that the 8-weeks speed+strength, plyometric and aerobic trainings approach resulted in a maximum improvement in pre-test and post-test performances and compared to the control group to which they were compared and provided stronger performance than other independent training approaches. Accordingly, it is a useful and effective training method for performance during all seasons.

Keywords: Hearing Impaired; Anaerobic; Aerobic; Performance; Sportsman

Introduction and Purpose

The idea of increasing the performance of the athletes has been one of the most important work topics of scientists and coaches from the past to the present. In the last 50 years, there have been remarkable developments in sports performance [1]. Sporting performance, on the interplay between several physiological factors; Therefore, depends on training physical, physiological, bio motor and technical characteristics together. There are many internal and external factors that affect performance. Therefore, it is difficult to attribute performance to a single criterion [2]. In general performance, the efficiency of the athlete includes multiple (physical, physiological, bio motoric, psychological, mental, sociological, technical, tactical, etc.) components. For performance improvement, many training methods have been developed in our time and combined training systems have started to be used [3,4]. The preparatory period is generally a period in which all performance parameters are aimed to be developed and maximized concurrently. Trainers must take account of physical, physiological and various biometric parameters like technics, tactics, velocity, agility, strength and endurance. These workouts are known to be effective, versatile and motivating. However, the regulation and degree of training loading is very difficult to adjust [5]. A challenge for coaches and athletes is to find the right combination of exercises and workload of exercises during training to promote a long-term optimization of all these factors. This is an important part of the periodization process, which is the division of training into phases with different objectives to promote performance and to avoid excessive fatigue and overtraining [6].

Information about positive correlation between development in aerobic system and anaerobic capacity and the significance of not only improving aerobic system, but also anaerobic capacity is wildly common in literature. [7,8]. On the other hand, the compatibility of different exercise modes, particularly power, strength and aerobic endurance exercise, 40 decades. Some studies on simultaneous studies in which Anaerobic and Aerobic training are programmed together; Regarding this, several investigators, report that combined (CE) or concurrent exercise (CE), in which power, strength and aerobic endurance training are included in the same training sessions or program, in other words interferes with the development of muscle strength or power (interference effect). Report that concurrent exercise (CE), in which power, strength and aerobic endurance training are included in the same training sessions or program, in other words interferans with the development of muscle strength or power (interference effect) [9,10,11,12,13,14].

Because of the need for the concurrent development of endurance and strength in certain sports [10], and the importance of both capacities for promoting performance [15], several studies have investigated simultaneous strength and endurance training to assess whether there are complementary or antagonistic adaptations between these types of training. Several explanations have been offered to explain the concurrent training or interference effects seen. One of the more popular theories is the chronic interference hypothesis, which postulates that the addition of endurance training results in overreaching and overtraining and stimulates competing adaptations over a long-term training program [16]. This is known as the interference effect.

Wilson and colleagues As a result of meta-analysis studies examining the interaction of aerobic and resistance exercises, they found that in running and cycling exercises performed concurrently with strength training, strength training performed concurrently with running, but not cycling, resulted in significant decreases in both hypertrophy and strength. In the study, they determined that the endurance training modality was a determining factor affecting the intervention, and that interference effects were also found to be specific to the body part, primarily in lower body strength, after endurance exercise activity. They also found that training volume accounts for a small portion of the interference effects seen when concurrent training is performed [17]. In another study, it was stated that long-distance running caused large increases in muscle damage, while ultra-distance cycling (230 km) did not [18]. They cite at least 2 possible reasons why running is more susceptible to falls than cycling; First, cycling is more biomechanically similar to most of the force measurements taken in the studies reviewed (compound free weights) [19,20.21]. A second possibility relates to skeletal muscle damage. While this was not excluded from the analysis, they note that it is predictable that different types of contractions influence the differences seen between running and cycling. Running has a highly eccentric component, whereas cycling consists mainly of concentric activity. These differences in contraction types (eccentric and concentric) can cause more damage in running than in cycling [17]. These studies have shown that endurance training can reduce the gain in strength and power resulting from strength training when both are performed simultaneously (i.e., interference effect) [9,10,14,22,23]. In a classic study of Kraemer and colleagues [23], these authors have shown that the training-induced strength gains were compromised by performance of simultaneous high-intensity strength and endurance training in young military men.

On the other hand, studies on the effects of strength training on aerobic capacity have demonstrated that this type of training can improve endurance performance, leading to a small increase in this capacity [24] and improvement in the economy of movement, that is, permitting aerobic activity with a lower oxygen consumption (O2) at submaximal intensities [25,26,27]. Improvement in maximal aerobic capacity because of strength training has been observed in older and sedentary young populations [24], whereas the improved endurance performance in athletes has been related to improved economy of movement, when strength training, especially explosive type, has been associated with aerobic training [25,28].

This study was conducted on hearing impaired male athletes. Studies have shown that the hearing impaired is the group with the highest participation in sports among individuals with disabilities [29]. Ozsoy [30]. 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 [30]. Hallahan and Kaufman [31] define the hearing impaired as "a person with mild to severe hearing defects" Wiley [32] states, "For the basic needs of life, deaf people do not function. Hearing people who have hearing sensation but who can function with or without hearing aid but who have malfunction." Aim is to investigate the effects of 8-week anaerobic and aerobic training programs applied in the preparation period on some performance parameters of 19-22 years old hearing-impaired male sportsmen.

Materials and Methods

Participants:

The research was carried out in Samsun (2022-2023). 42 Hearing-impaired male sportsmen aged 19-22, operating in deaf sports clubs, participated in the study voluntarily.

Research design and model:

Pre-test, post-test, and control group models from experimental models were used in the research design. After the first measurements, the subjects were randomly assigned to one of the three groups. (A) Experimental group, (n=14). Aged (20.86±1.23), years, height, (178.71±1.58) cm. Body weight, (69.98±7.28) kg., training age, (4.50±1.56). (B) Experimental group, (n=14). Aged (20.57±1.40) years, height, (179.21±4.56) cm. Body weight, (69.46 ±7.55) kg., training age, (4.36 ±1.65). (C) Control group (n=14). Age, (20.78 ±1.58) years, height,(178.14± 6.57) cm., Body weight, (70.86 ±11.96) kg., training age, (4.57±2.10). While the athletes were in the general preparation period and continuing their training in their clubs, (Anaerobic training: Group A (speed+strength) training; Group B: Plyometric training. Aerobic trainings: A and B research groups together) training programs were applied to the experimental groups for 8 weeks, the content of which was determined beforehand. Two measurements were taken at the beginning and end of the study.

Experimental approach to the problem

This study was conducted with hearing impaired athletes aged 19-22 years. The majority of participants were basketball players, football players and volleyball players; It was determined that they attended trainings in their clubs on average three days a week. In the study, aerobic training with strength, speed and plyometric training programs (different days and unit) were applied in order to eliminate the negative effects of aerobic training on some anaerobic training. The training groups that participated in our study performed the anaerobic training specified in table-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 aerobic training average of 50 minutes (in separate unit). In the study, the effect of training for eight weeks on same performance parameters was investigated. On this occasion, it was compared with the control group in which all the training was applied together, on the basis of the relevant parameters.

Before the studies, necessary permissions were obtained from the institutions and clubs of the athletes. Participants can leave the study whenever they want. Medical history, training characteristics, injury history and performance level of all subjects were investigated. Also, before participating in this study, a doctor performed a medical examination. Sportsmen were also asked to refrain from any additional strenuous physical activity and training interventions outside of the studies to be performed, and to maintain the same dietary habits.

Test procedures

Before the studies, a resting state post-test was administered, as well as the pre-test and at the end of the studies (48 hours after the last training). Subjects were tested while wearing standard sportswear (sport shoes, shorts, and T-shirt), 2–3 hours after their usual breakfast and lunch. Physical and physiological tests were performed at 10:00 AM, and bio motoric and performance tests were performed at 3:00 PM. Pretests and posttests in both groups were performed at the same time and in the same environment. The athletes did stretches and warm-up exercises. Tests completed in two days. The training program lasted 8 weeks, and each week had three training days, with each training session lasting two hours. In the present study, the psychological and socioeconomic conditions of athletes were not assessed.

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 20-22 C0, with an altitude of 759 mm-Hg at 10 altitudes, in the same environment and applied under conditions. Body mass index and anaerobic power have been calculated with the help of formulas that have been validated in this regard.

Measurements and test parameters: Participants' age, training age, body weight, height length, vertical jump height, resting heart rate, 20 meters basic speed, 30 second shuttle, cooper tests and body mass index, anaerobic power calculations were made.

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.

Physical and physiological measurements and tests: While physical measurements include body weight, height, and BMI, physiological measurements include resting heart rate (RHR, anaerobic and aerobic power calculations.

Body weight and height length measurement: Body weight was measured in kilograms with a scale 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 paint by taking a deep breath. The distance between the miter and the floor from the vertex point is recorded in centimeters.).

Calculation of body mass index (BMI): Body mass index (BMI) was calculated by dividing the body weight in kilograms by the square of the height in meters using the Pollack formula. It was calculated with the formula Body Mass Index (BMI)=Body Weight (kg / height (m^2) = kg / m^2.

Resting heart rate (RHR) measurement: The measured cardiovascular parameter (HRAS) (beats / minute) was determined by palpation with the help of an electronic stopwatch, after a 15-minute rest, from the carotid artery in the neck, with the fingertip. After the artery was found with the fingertip, the stopwatch was started when the first beat was taken, and the number of beats received in 30 seconds from 1 was multiplied by 2 (two).

Calculation of anaerobic power: Anaerobic power is work power that can be generated in a one-minute anaerobic way. Anaerobic energy sources: Adenosine Triphosphate (ATP) is Creatine phosphate (CP) and glycogen [33]. Although there is no satisfactory method that can measure anaerobic power with the desired accuracy [34], there are tests and indirect methods that partially reflect anaerobic power [35]. Most of these tests are standing vertical jumping, standing horizontal jumping, Margaria-Kalamen, and Wingate test [36]. 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 [37, 38]. Determination of Anaerobic Power with Lewis Nomogram: Lewis Nomogram is a formula frequently used to determine anaerobic power in sports sciences [39]. The formula gives the average power value. The original version of the formula gives the power value in kg·m·sec. 1. We used the original version here...

Lewis's formula:

P (Anaerobic Power) = $\sqrt{4.9}$ x (W) x $\sqrt{D}$ calculated with the formula. These values:

P=Anaerobic Power (kg.m/sn) W=Body weight (kilogram),

4.9 =Standard time (seconds), D=Distance jumped vertically (meter).

Biomotoric tests: In motor parameters, vertical jump (DS), 20 meters basic speed, sit-up and cooper tests were applied.

Vertical jump test: Jumping force is defined as the jump of the athlete vertically high and horizontally away [40]. 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 [5,41]. From this point of view, increasing the jump force provides high efficiency especially in sports such as football, volleyball and basketball [42, 43]. Bounce affects intense performance in sports that require this feature and has been the focus of researchers in recent years.

In practice: Free vertical jump test was applied to athletes. The best results were recorded as "cm" from a tool measuring digitally. "Takei jumper meters" was used with measurement capacity between 5 cm to 99 cm, showing the distance digitally by leaping with waist stuck. Performed three maximal unloaded jumps with 30 s of passive recovery between each effort. If the third jump was higher than the previous two, so on, until no further improvements were observed. The best jump was used to determine the maximal vertical jump height. With the help of the jump meter 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.

20-meter base speed test: To detect the basic velocity level, a 20-meter acceleration test has been applied as the indicator of the particular velocity. A new test brand photocell was used in the application. The athlete takes the high starting behind two meters from the start line and waits as the sign language translator gives the ready command (rising and waving white flag). He runs at his finest whenever he starts the parkour. Timing starts as the athlete enters the start point and it stops itself after the end of the 20-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.

Shuttle test (30 sec./piece) (ST): To assess abdominal strength and endurance, a 30-second crunches test was used. Application: The subjects were asked to lie on their backs with their knees bent at 90 degrees, with the palms on the side of the head, the shoulders in contact with the ground, and the sides of the elbows in contact with the ground. It was arranged in the final position by bringing the body forward and pressing the knees against the forehead. It aided in keeping the legs stable. This movement can be halted for 30 seconds by using the command 'Ready!' and 'Start!'. They kept going until they heard the command 'stop!' and then stopped. He counted how many crunches he made.

For aerobic power, the Cooper test was applied: Vehicles: 400 m. athletics track, stopwatch, whistle (to warn officials) and visual flags (red, white). This test, developed by Kenneth Cooper (1968) to determine the aerobic power of athletes, was carried out according to the exercise protocol of 12 minutes of running.

In practice: A 400-meter athletics track was used in the stadium. Before the 12-minute run, the running track is marked in 10-meter sections. The white flags held by the officials stationed at various points in the area continue as long as they are in the air. It ends when the white pennant is lowered, and the red flag is raised. At the end of 12 minutes, the number of laps of the athletes and each ten meters completed are taken into account. Athletes were divided into 4 equal groups (such as 4x11 = 44 athletes) and the runs were completed in the same unit. Athletes were asked to fill this time by running or walking for 12 minutes in line with their aerobic power [38].

Training procedures

From the first week until the end of the program, aerobic short and medium jogging and fartlek studies were applied to the experimental groups, Groub A, strength and speed exercises (6 weeks) from the third week, and Groub B, plyometric exercises (6 weeks) from the third week to be included in the program. The total session (training unit) duration varies according to the type of loads, in 60-75-minute sessions, two sessions (units) a day, between 110-125 minutes a day, a total of 48 training sessions (units) and approximately 45 hours of training programs has been applied as indicated in (Figure 1).

GROUPS	TRAINING TYPE	DAY And TRAININGS	NUMBER OF UNITS	TIME
(A) Experimental Group	Preparation period Club Workouts	*Conditioning, technics, tactics and other studies*	3	90-120 Min
	Strength+Speed Trainings	*Monday: Morning:A:Strengt+Speed=60-75* B: *Plyometric* =60-75 *Wednesday:Aftern.A: Speed=60-75 minutes* B: *Plyometric* =60-75 *Friday: Morning:* A:*Strengt+Speed*=60-75 B: *Plyometric* =60-75	*Afternoon: Aerobic durabl+ Fartlek, A and B Together*	50 minutes each
(B) Experimental Group	*Plyometric Trainings*			
	Preparation period Club Workouts	*Conditioning, technics, tactics and other studies*	3	90-120 min.
(C)Control Group	Preparation period Club Workouts	*Conditioning, technics, tactics and other studies*	3	90-120 min.

Figure 1: Weekly training programs of (A) and (B) experimental and (C) Control groups in the 8 weeks intermediate phase.

Anaerobic training: Group A (strength + speed) training; Group B: Plyometric trainings

Aerobic training: A and B research groups together.

A Training Unit: A training unit is the part of a training session in which features displaying distinct bio motor abilities (for example, structural differences such as strength, speed, endurance, flexibility, technique, and tactics) are investigated [44].

Loading volume-density and resting: Volume is typically defined as the total amount of work done during a given exercise session [17]. 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. According to individual loading principles, the sportsmen's own declaration was also taken into account [45]. In the training that included both strength and endurance training, the runners were instructed to undertake strength training first and endurance training second, with at least 5 hours between them (Figure 1.). At least 24 hours are devoted to each strength training session. Respectively, reflect the overall training plan as well as details of strength training data

Restings: rests, sets or series, 15 sec heart rates taken between maximal pulse between sets 90 beats / min. (full rest); 120-130 at / min in sets. (productive rest) was taken as basis. According to the individual loading principles, the workout continued, taking into account the athlete's own statement Kurt and colleagues, [45]. States that the training should be sportsmen-centered, and the athlete should feel ready for new loads.

Adaptive Trainings		
■*After technical training*	→	*Strength training*
■*Afer technical, tactical training*	→	*Endurance training*
■*After strength training*	→	*Endurance training*
■ *After technical training*	→	*Tactical training*
■ *After speed training*	→	*Strength training, can be done.*

Figure 2: Below is the harmony order of two training qualities to be done in on day (46).

As it is known, maximal loads with the same character (structure) in terms of energy potential (anaerobic, aerobic) delay the regeneration process. Therefore, if training methods of different intensities and characters are used one after the other, regeneration occurs earlier. For this reason, studies with different training characteristics should be included in a micro cycle [47]. On the other hand, we also know that strenuous endurance exercises that follow power and strength training, even if they are of the same character, create an interference effect. These two issues constitute the main theme of our study.

Weekly Workouts Applied to Experimental Group in The Eight-Week Intermediate Phase:

1-a) Strength trainings: In most studies in which strength training was shown to improve economy of movement, the type of training carried out included explosive strength training, with the exercises performed at the maximum speed of motion, or plyometric exercises [26,28]. According to Hollmann and Hettinger [49], force is "It is one of the bio motor abilities that determine the efficiency in sports". It is generally defined as "the ability to withstand resistance or to withstand resistance to a certain extent". It is defined as the ability of a muscle group to withstand a resistance with the greatest possible effort [50]. Scholich [51]. He distinguishes strength ability as maximal strength, quick strength and continuity in strength. He defines maximal strength as "the ability of the athlete to direct the maximum level of voluntary muscle contraction in the phase of very high external resistance". According to Bompa [52]; Quick strength is a dominant skill in many sports. It is the maximal force and maximal velocity that creates the quick force (power) [52]. ***P (power) = F (force) x V (speed).*** Therefore, quick force (power) is a product of speed and maximal force. Accordingly, it is more logical to develop the maximal force first and then convert it to quick force.

The strength training program was designed to improve muscular endurance in the first 3 weeks and subsequently to stimulate muscular hypertrophy and maximal strength gains. In the sportsmen participating in our study, strength training started from the 3rd week and the studies lasted for six (6) weeks. Various stations were used with the aim of developing maximal strength in the studies. Muratlı [53] recommends that the number of stations be between 6 and 10. Maximal strength exercises were followed by quick strength (strength) and strength persistence (endurance) exercises.

In Maximal Strength Studies, The Pyramidal Method and The Repetition Method Were Used as The Loading Method

Pyramidal method: In this research, the maximal weightlifting method was performed at various stations according to the pyramidal system. According to the principle of increasing load, the number of repetitions is reduced as the load increases. The studies and tests were started with 50 percent of the maximum of each athlete, the load percentage was increased by 10 and continued up to 80 percent, and the number of repetitions was decreased by 2 and continued up to 70 percent. Subsequently, the load was increased by 5 percent and the number of repetitions decreased by 1, and the 8th series was completed with 1 repetition and 100 percent load. The number of series is 8 and each series consists of 10-8-6-5-4-3-2-1 repetitions (Figure 3).

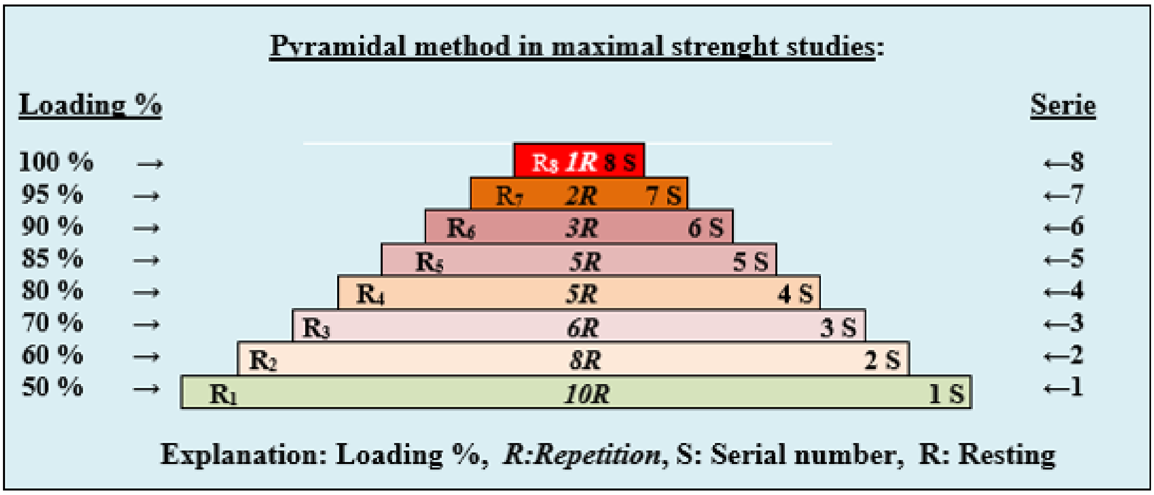

Figure 3: Pyramidal method in maximal strength studies.

In the pyramidal method, the number of repetitions per step and the change in intensity are as follows: As one increases, the other decreases. For example, as the number of repetitions increases, the intensity decreases (pyramidal descending method), as the intensity increases, the number of repetitions decreases (applied here) (pyramidal ascending method). For example, 80-5% reps, 85-4%, 90-3%, 95-2% 100-1 reps [54]. Suggests that 2 repetitions are required to determine 100 percent loading. In studies conducted according to the pyramidal (incremental loading) method, the amount of weight that the athlete could repeat (lift) at least 1 repetition was accepted as the athletes maximal. The exercises consist of sets (series) and repetitions.

Repetition method: It is a maximal strength training method that is generally used by beginners. For more muscle growth, the effective loading intensity varies between 50-60% of the maximal strength [54]. Repeat method; For maximal strength and rapid strength development; 70-85%, 6-10 reps, 2-4 min. rest, 3-5 series, fluid and slow, maximal strength (hypertrophy) [55].

1-b) Speed training: While Gundlach defines speed as "the ability to advance at full speed" [5], Zaciorskij, "The ability to complete a motoric action in a short time in an existing environment" [56], Grosser and colleagues, [57], "The ability to react as a result of a stimulus as soon as possible" [58,59]. It is defined as "the ability to move or move very quickly" Bompa [52]; "*The ability of man to move himself from one place to another at the highest speed*" [5]. Speed is the basis for performance in many sports. It is an explosive form of movement [60]. Speed is the determining factor in many sports related to sprints, skips and athletics [5,58,61]. It is stated that "speed can only be trained by being fast" [62], and training to be done for speed development should be 75-100% [54]. It is carried out by entering a certain submaximal and maximal loadings and oxygen borrowing.

Speed trainings (starting from the 3rd week, 6 weeks): 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:

1. Preparation and strengthening exercises (3rd. week)

a) Stair studies (single-double speed running)

b) Acceleration sprints

c) Acceleration sprints (positive, negative and constant acceleration: 10-20-30-40-50) m.

d) distances

e) Slalom studies and skipping rope

2. Speed drills (4th. week)

a) Stipping the knees to the abdomen - on-site and running forward

b) Slalon operation (3-4x 6) among towers (6 pieces)

c) Landing works (for speed barrier) (incline not more than 15 degrees)

3. Drawing drills and acceleration sprints (5.th and 6th week)

a) Hill climbing (on different slopes) 30-40 meters)

b) Hill climbing (on different slopes) and landing: (50-60 meters)

c) Changing direction, running at different speeds.

4. Submaximal and maximal sprint training (7th and 8th weeks)

a) Pramidal Sprint (incremental) load training, (10-20-30-40-50 m. (4-6

b) again) Submaximal (75-90 %), maximal (85-100 %) intensity,

c) Interval sprints: (20-30-40-50-60-70) m. (4-6 reps). Sub maximal (75-90%).

d) Interval sprints: (20-30-40-50-60-70) m. (4-6 reps). Maximal (85-100%).

Plyometric Trainings: 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. 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 human movement [63]. 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 [42,64]. Specifically, there is strong evidence that plyometric training causes significant improvements in vertical jump performance [42,64,65,66,67,68]. According to Stemm and Jacobson [69], plyometric training is considered as a “form of physical conditioning”. Therefore, plyometric training is used today in all kinds of sports by athletes of different levels to increase endurance and explosive power [70].

Plyometric training 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 muscles. Studies have shown that in the energy storage and flexibility of muscles [71], active working rate [72], in the nervous system [73] show that there is an increase in pre-activity pre-preparation [74] and motor coordination skills [72]. As a result of these adaptations, an increase in sportive performance is provided.

Plyometric trainings (starting from the 3rd week, 6 weeks): 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:

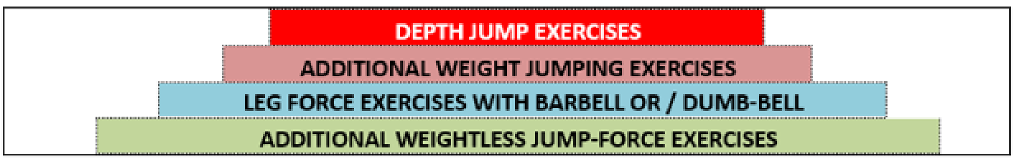

Figure 4: Stages of the bounce force level in plyometric training.

Weineck [75] suggests that depth jumps should be done last, after other studies have been done, and the following steps for jumping studies (Figure 4). Stages of the bounce force level (Weineck, cited from 1988: Dündar, 1994; adaptation: Kurt, 2011)

1. Preparation and strengthening studies (3rd week)

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a) Skipping rope (in various ranges and numbers)

b) High knee drills

c) Stair work. (Light and fast running on the stairs, jumping, tense knee jumping)

d) Stipping the knees on the abdomen (on-site and forward)

e) Double foot jumping (using arms-arms encede-arms with hips)

2. Jumping and power movements depending on the movement performed (4th week)

a) Leaping out of potty posture

b) Jumping from the taking-push-up state to the potty state

c) Jumping from flat tumble to potty state

d) Double foot jump using arms. Hexagonal work

3. Jumps on the 2nd Tool (driller) (5th and 6th week)

a) Jumping exercises on the rope ladder on the ground (single foot and double feet), etc.

b) Gymnastic order or jumping from low obstacle (single-double foot)

c) Kangaroo leaps (odd-even); frog leaps

d) Change lateral-direction, jump over low-middle obstacle (Hands, in different position)

e) On intermittent health balls (8 pieces: 3-5-7 rebound exercises

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

a) Jumps over barriers (by changing forward and direction)

b) Changing direction through the funnel and jumping

c) Depth leap through Gymnastic Boxes the crates (double feet); Increasing decreasing

d) heights in crates.

e) Depth leap through Gymnastic Boxes increasing and decreasing heights (double feet)

Fartlek and durability studies in the intermediate stage: Fartlek is a race that is suitable for the needs of the athlete and is made in the field with varying intensity according to the environment. In fartlek studies, rugged terrain, wooded areas, dried field rurally areas, river edges, hills, rural, pathways and so on. can be used. In this form, Fartlek is similar to variable paced conditions. But anaerobic periods (fast episodes) are a rapid stimulus for the development of VO2 Max. It also contributes to the continuity of strength, special balance, and strengthening of the knee, wrist and hip regions according to the characteristics of the terrain [44,76]. While the athlete is using the land, he/she makes fluctuations and different applications suitable for the terrain. Work is carried out with pleasure in a quiet and oxygen-rich environment. In the preparation phase, such exercises are very beneficial for the athletes in terms of resting and entertaining, as well as storing plenty of aerobic energy. In our study, fartlek applications were combined with examples from the Swedish running game and the Polish running game.

Polish running game (fartlek): We know that fartlek workouts are run on rough terrain, over long distances, at an ever-changing pace. Ulrich Jonath calls this type of exercise enriched in terms of movement, such as doing gymnastics from time to time, throwing stones, overcoming natural obstacles with jumps, “Polish style running game” [53]. In the Polish running game, the intervals in the form of walking and jogging, known in the Swedish running game, are passed with gymnastics and various movements. These movements can be in the form of stretching, bending, resting or jumping [44].

Fartlek studies were conducted for 8 weeks and three (3) days a week. In determining the training intensity of the group participating in the Fartlek studies, the number of heart beats in 15 seconds between runs and the athlete’s statement were taken into account.

In The Fartlek Studies, The Intensity of The Runs Was Made With 70-80 Percent of The Maximal Heart Rate

Training Intensity = 220-Age / 100 x 70 and 220-Age / 100 x 80 applied: Maximum heart rate in continuous slow running: With the formula 220-Age /100x70, the maximum heart rate (MHR) of a 20-year-old athlete: 220-20= 200, 70 percent of this is: 200x70:100≅140 beat/min. is found. If we take the average age of the athletes participating in our study as 20, with the formula, Heart Rate (MHR) = 220-Age/100x80 in continuous sprints, the maximal heart rate of a 20-year-old athlete is: 220-20= 200, and 80 percent of this: 200x80:100 ≅ 160 beat/min. is found. If we are doing it in the form of long medium runs, then 150 beats / min. as we take.

In statistical analysis, the test suggested that all variables were distributed normally. The homogeneity test of the variances was performed with the Bartlett test. One way analysis of variance (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. Within-group differences were assessed using paired t-tests. The $p<0.05$ criterion was used for establishing statistical significance.

Results

Test suggested that all variables were distributed normally ($p>0.05$). The homogeneity test of the variances was performed with the Bartlett test. Results of comparative analysis (One-way ANOVA) among control and experimental groups at baseline revealed that there were no statistically significant differences before the start of the training program (Tables 1-3).

Table 1: Homogeneity test of variances (S^2) before calculation of test statistic, Bartlett test.

VARIABLES	(A) strength+Speed Tr. Group (n=14)		(B) Pliometric Tr. Group(n=14)		(C) Control Group (n=14)		$\overline{S}^2$	ln²	X ²	p
	Mean-Sd	S²	Mean-Sd	S²	Mean-Sd	S²				
Age (years)	20.86±1.23	1.516	20.57 ±1.40	1,956	20.78 ±1.58	2.489	1.987	0.68663	0.767	p>0.05
Height (cm)	178.71±1.58	2.51	179.21±4.56	20.797	178.14±6.57	43.209	22.172	3.09883	5.57	P>0.05
Weight (kg)	69.98±6.89	47.52	69.46±7.55	56.996	70.86±12.05	145.24	83.253	4.42188	4.816	p>0.05
Training age (Yr)	4.50± 1.56	2.42	4.36 ± 1.65	2.71	4.57 ± 2.10	4.42	3.183	1.157825	1.0037	P>0.05

For this, when the 3 groups were compared with the Bartlett test; Age: (X^2 = 0.767; p>0.05); height: (X^2= 5.57 ; p>0.05); body weight: (X^2=4.816; p>0.05); training age: (X^2=1.0037; p>0.05) it was seen that the variances are homogeneous (Table 1).

Table 2: Comparison of participants' age, height, body weight, and training age parameters and one-way analysis of variance (One Way ANOVA) test results.

VARIABLES	(A) strength+Speed Training Group (n=14)			(B) Pliometric Training Group (n=14)			(C) Control Group (n=14)			F	P
	Mean-Sd.	Min	Max	Mean-Sd.	Min	Max	Mean-Sd.	Min	Max		
Age (years)	20.86±1.23	19	22	20.57 ±1.40	19	22	20.78 ±1.58	19	22	0.156	p>0.05
Height (cm)	178.71±1.58	167	184	179.21±4.56	174	189	178.14±6.57	166	187	0.198	P>0.05
Weight (kg)	69.98±6.89	61.1	80.4	69.46±7.55	57.7	82.6	70.86±12.05	45.4	92.4	0.086	p>0.05
Training age (Yr)	4.50± 1.56	2	7	4.36 ± 1.65	2	7	4.57 ± 2.10	2	8	0.052	P>0.05

As a result of one-way analysis of variance (One Way ANOVA) test of the participating groups; Age: ($F_{19.47}$=0.156; p>0.05); height:($F1_{9.47}$=0.198; p>0.05); body weight: ($F_{19.47}$=0.086; p>0.05); training age: ($F_{19.47}$=0.052; p>0.05), there is no significant difference between parameters (Table 2).

Table 3(a): (A) Pre / post test data of the speed+strength training group in various parameters paired (dependent) "t" test table.

	VARIABLES	Test	(A) SPEED+STRENGTH TRAINING GROUP (n=14)		t	p
			Mean- Sd.	Mean-D .		
1	Body weight (kg.)	Pre-test	69.98±6.89	-1.09	8.97	< 0.01*
		Post-test	68.89±6.64			
2	Body mass indeks(kg./m²)	Pre-test	21.91±1.89	-0.34	11.96	< 0.01*
		Post-test	21.57±1.36			
3	Resting heart rate (beats/ min.)	Pre-test	72.29±5.14	-2.29	5.55	< 0.01*
		Post-test	70.0±4.77			
4	Verticalle jumping (cm	Pre-test	50.86±7.63	2.85	9.72	< 0.01*
		Post-test	53.71±8.40			
5	Second shuttle test (min.)	Pre-test	22.93±3.15	2.5	9.96	< 0.01*
		Post-test	25.43±5.21			
6	20 Meters speed (sn.)	Pre-test	3.172±0.23	0.0957	9.56	< 0.01*
		Post-test	3.076±0.21			
7	Aerobic power (m/kg-min)	Pre-test	2708.57±224.87	37.86	4.86	< 0.01*
		Post-test	2746.43±238.34			
8	Anaerobic power (kg.m/sn)	Pre-test	110.488±15.30	1.386	3.56	<0.01*
		Post-test	111.884±14.82			

(*) (A) In the strength+speed training group, in the measurements made after 8 weeks; subjects' body weight (t=8.97; p<0.01), body mass index (t=11.96;<0.01), resting heart rate (t=5.55;p<0.01), vertical jump (t=9.72;p<0.01), 30 second shuttle test (t=9.96;p<0.01), 20 meters acceleration (t=9.56;p<0.01),), aerobic power, (t=4,86; p<0.01), anaerobic power, (t=3.56;p<0.01), statistically significant difference (development) was found in all parameters (Table 3-a).

These data show that the training applied to the plyometric training group, the subjects' body weights and it shows that it causes a decrease in body mass index and resting heart rate, 30 seconds of sit-ups, vertical jump height, 20 meters basic speed, aerobic and anaerobic increase (improvement) in anaerobic power (Table 3B).

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

	VARIABLES	Test	(B) PLIOMETRIC TRAINING GROUP (n=14)		t	p
			Mean- Sd.	Mean-D .		
1	Body weight (kg.)	Pre-test	69.46±7,55	-1.08	12.47	< 0.01*
		Post-test	68.38±6.98			
2	Body mass indeks(kg./m²)	Pre-test	21.62±2.23	-0.34	9.08	< 0.01*
		Post-test	21.28±2.19			
3	Resting heart rate (beats/ min.)	Pre-test	72.14±3.74	-2.71	10.21	< 0.01*
		Post-test	69.43±2.61			
4	Verticalle jumping (cm	Pre-test	51.0±9.13	5.14	11.61	< 0.01*
		Post-test	56.14±9.31			
5	Second shuttle test (min.)	Pre-test	21.57±3.78	2.86	8.27	< 0.01*
		Post-test	24.43±4.73			
6	20 Meters speed (sn.)	Pre-test	3.178±0.24	0.072	10.35	< 0.01*
		Post-test	3.106±0.23			
7	Aerobic power (m/kg-min)	Pre-test	2710.0 ± 252.98	38.57	6.62	< 0.01*
		Post-test	2748.57±251.35			
8	Anaerobic power (kg.m/sn)	Pre-test	109.31±15.50	4.4	6.3	<0.01*
		Post-test	111.884±14.82			

(*) (B) In the plyometric training group, in the measurements made after 8 weeks; subjects’ body weight (t=12.47; p<0.01), body mass index (t=9.08;p<0.01), resting heart rate (t=10.21;p<0.01), vertical jump (t=11.61;p<0.01), 30 second shuttle test (t=8.27;p<0.01), 20 meters acceleration (t=10.35;p<0.01), aerobic power (t=6,62; p<0.01), anaerobic power, (t=6.30; p<0.01), statistically significant difference (development) was found in all parameters (Table 3-b). *However, let’s examine the data of the control group in order to understand whether these improvements in both training groups are due to the training applied or the results of the routine training performed by the subjects in their clubs.*

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

	VARİABLES	Test	(C) CONTROL GROUP(n=14)		t	p
		Mean- Sd.	Mean-D .			
1	Body weight (kg.)	Pre-test	70.86±12.05	-0.87	6.47	< 0.01*
		Post-test	69.99±12.12			
2	Body mass indeks(kg./m²)	Pre-test	22.24±3.21	-0.29	6.77	< 0.01*
		Post-test	21.95±3.23			
3	Resting heart rate (beats/ min.)	Pre-test	70.86±3.66	-0.72	2.69	< 0.05*
		Post-test	70.14±2.77			
4	Verticalle jumping (cm)	Pre-test	50.64±9.57	0.57	2.51	< 0.05*
		Post-test	51.21±8.68			
5	Second shuttle test (min.)	Pre-test	22.86±3.82	0.78	2.90	< 0.05*
		Post-test	23.64±4.41			
6	20 Meters speed (sn.)	Pre-test	3.156±0.18	0.02	2.96	< 0.05*
		Post-test	3.126±0.16			
7	Aerobic power (m/kg-min)	Pre-test	2714.29±229.37	10	2.55	< 0.05
		Post-test	2724.29±223.94			
8	Anaerobic power (kg.m/sn)	Pre-test	111.43±22.45	-0.58	1.62	>0.05
		Post-test	111.884±14.82			

(*) (C)In the control group, cutup training in the measurements made after 8 weeks; subjects’ body weight (t=6.47; p<0.01), body mass index (t=6.77;<0.01), resting heart rate (t=2.69;p<0.01), vertical jump (t=2.51;p<0.01), 30 second shuttle test (t=2.90;p<0.01), 20 meters acceleration (t=2.96;p<0.5), and aerobic power, (t=2.55;p<0.05), statistically significant difference (development) was found in all parameters. However, no significant difference was found in anaerobic power (Table 3-c). This data shows the effectiveness of clup training applied to the control group in general. However, there appears to be greater improvement in the data of the speed+strength and plyometric training groups.

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Discussion

Kurt and colleagues [77]. In a study conducted by, considering the possible interference effect of aerobic endurance training on strength and power exercises, strength and power exercises were organized on different days and in different units. Thirty hearing-impaired male athlete volunteers participated in the study, which investigated the effects of different concurrent training programs on some physical, physiological and bio motor parameters of hearing-impaired athletes. At the end of the study, the control group (n=15), which participated in widespread concurrent training in its own sports club, and the experimental group (n=15), which participated in strength, speed, plyometric and aerobic endurance studies carried out in separate units for 10 weeks outside the club activities, tested the measured parameters in the pre-test. According to the post-test performances, more significant improvements were recorded in all parameters compared to the control group; Alp and colleagues [78]. As a result of the study in which they examined the effects of preparatory training on the bio motoric characteristics of children aged 10-12, they found a significant difference in push-up and sit-up test values; Saez de Villarreal and colleagues [79]. Compared the effects of dry field training (special strength training and plyometric training together), in-water training and combined training in a 6-week study in which 30 professional players participated in order to increase the performance of professional water polo players. They found significant differences in meter speed and other parameters in all three training groups: Nakajima and colleagues [80]. In their study to investigate the effects of training combined with respiratory resistance and continuous physical exercise to improve endurance capacity and respiratory muscle function in healthy young adults, training combined with respiratory resistance and sustained physical exertion is beneficial for increasing endurance capacity and respiratory muscle function; Aksen and Cengizhan [81], in their similar studies, also found that preparatory training had a positive effect on BMI values; Cadore and colleagues [82]. Twenty-three healthy men (65 ± 4 years old) participated in the study to investigate the effects of strength, endurance and concurrent training on aerobic power and dynamic neuromuscular economy in older men. In their study, participants were divided into 3 groups as simultaneous (CG, n = 8), strength (SG, n = 8) and aerobic training group (EG, n = 7). Each group did strength training, aerobic training or aerobic training 3 times a week for 12 weeks. Both training types were trained in the same session. The results show specificity in the adaptations investigated in older subjects, as the most pronounced changes in neuromuscular economy occurred in the aerobically trained groups. In another study, Cadore and colleagues [22]. Observed an inverse relationship between muscle activation during aerobic exercise with maximal strength and rate of force development, suggesting that stronger individuals were the most economical at the neuromuscular level. Therefore, it was hypothesized that strength training could improve the neuromuscular economy during aerobic exercise, which was not observed at the same magnitude as in the groups that trained aerobically. In another study, Izquierdo and colleagues [48]. Found that older men who performed aerobic and concurrent training obtained similar increases in the WO2 max on a cycle ergometer (16 and 18%, respectively), whereas both these groups obtained higher gains than the strength trained group in the same variable (10%).

Conclusion

Strength, speed and plyometric training in different protocols applied to hearing-impaired athletes for 8 weeks apart from club work caused positive differences in the body weight, body mass index, resting heart rat, vertically jumping, 20 meters speed, sit-ups, anaerobic and aerobic power variables of the sportsmen ($p<0,01$). However, excluding the anaerobic power of the control group ($p>0.05$); As a result of club studies, a similar significant decrease ($p<0.01$) was recorded in body weight and body mass indexes, while a less significant improvement was found in other parameters compared to the experimental groups ($p<0.05$).

This study shows that, when compared to the studies performed in the preparation period, strength and speed training and plyometric training, performed in the same period but independently of each other, and fartlek or running in a separate training unit provide better performance. These developments show that plyometric training, which is a form of conditioning, and strength training combined with speed are effective methods in improving the performance of sportsmen. As a result, the difference between the three groups participating in the study in the direction of strength, speed and plyometric training groups is thought to be due to the training effectiveness of strength, speed, plyometric and aerobic exercises to improve the performance in related parameters. According to this, it is thought that strength, speed and plyometric training programs, which are applied correctly and methodically, can be used as a more effective training method in improving the performance of sportsmen and it is a useful and effective training method on performance.

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Conflict of interest

No Conflict of Interest.

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