

The Effect of Six Weeks of Specific Volleyball Training and Plyometric Exercises on the Physical Performance of Female Volleyball Players

Tala Haj Mohammadreza¹, Farshad Ghazalian^{2,*}

¹Department of Physical Education and Sport Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran

²Department of Exercise Physiology, Science and Research Branch, Islamic Azad University, Tehran, Iran

Email address:

phdghazalian@gmail.com (Farshad Ghazalian)

*Corresponding author

To cite this article:

Tala Haj Mohammadreza, Farshad Ghazalian. The Effect of Six Weeks of Specific Volleyball Training and Plyometric Exercises on the Physical Performance of Female Volleyball Players. *International Journal of Sports Science and Physical Education*.

Vol. 8, No. 3, 2023, pp. 23-32. doi: 10.11648/j.ijsspe.20230803.11

Received: November 28, 2022; **Accepted:** January 16, 2023; **Published:** August 28, 2023

Abstract: Considering the needs of athletes to further improve some of the factors of physical preparation that are more applicable in their sports field and also the lack of use of some training methods in special conditions, such as injury and overweight, knowing the effects of different training methods on the factors of physical preparation Effective in the prevention of sports injuries, where balance is at the top, is one of the prerequisites for designing training programs, among which plyometric exercises can be mentioned. The purpose of doing this type of exercise is to increase the physical fitness and performance of the athletes. The general purpose of this study was to investigate the effect of six weeks of specific volleyball training and plyometric exercises on the physical performance of female volleyball players. Therefore, for this purpose, 24 female volleyball players participated in this research as subjects, and after homogenization, they were randomly divided into two experimental and control groups. In the next step, their height and weight were measured and then the records of the specified variables were evaluated through the prescribed tests. Then, the training program in the experimental group for 6 weeks, 3 sessions per week, carried out the selected program of specific volleyball exercises and plyometric exercises, and the control group was not affected by the training interventions and performed their routine volleyball exercises. Data analysis using independent and correlated t-tests showed that 6 weeks of specific volleyball training and plyometric exercises have significant positive effects on research variables, including explosive power, speed, agility and volleyball performance test. The results of this research showed that performing combined volleyball and plyometric exercises has a significant increase in explosive power, agility, speed, balance and coordination (volleyball specific test) and improves the physical performance of volleyball girls.

Keywords: Plyometric Exercises, Volleyball, Physical Fitness, Cardiovascular Fitness

1. Introduction

Considering the needs of athletes to further improve some of the factors of physical preparation that are more applicable in their sports field and also the lack of use of some training methods in special conditions, such as injury and overweight, knowing the effects of different training methods on the factors of physical preparation Effective in the prevention of sports injuries, where balance is at the top, is one of the prerequisites for designing training programs, among which

plyometric exercises can be mentioned [1]. Training is defined as any organized and regular activity that takes place in order to increase the performance of athletes, which is divided into different types according to the specific performance needs of athletes. Among the exercises that athletes use to improve their performance are strength and plyometric exercises. Historically, strength exercises have the meaning of increasing muscle strength and size; But recently, in order to increase power, speed and increase muscle stiffness and tone, to help rehabilitation and prevent injuries

and to help maintain muscle function in old age, they use strength training, coaches and athletes believe that plyometric training, poly They create a connection between strength and power and directly increase competitive performance. They often consider strength training as a resource for increasing general strength and plyometric training as a method of using this strength to develop performance, and also a combination of plyometric training and strength training in comparison to using these training alone and Separately, it can lead to achieving the highest performance[2].

In the game of volleyball, sudden, explosive and short-term efforts, from about 2 to 20 seconds, are usually required; For this reason, high-level athletes are characterized by high muscle power in the trunk and limbs, as well as an increase in anaerobic capacity of lactic acid and anaerobic capacity without lactic acid [3] With maximum strength and intensity required in a short period of time, sports science researchers are looking for the best training program to increase the performance of players during the season, and one of the research fields refers to plyometric exercises. In the last 30 years, plyometric exercises are a common strength training method in many eastern countries [4].

Plyometric exercises are considered as a popular physical exercise in athletes and healthy people to increase performance and in some special patients as a method for rehabilitation. These exercises include jumping movements with body weight and different types of medicine ball throws that use the stretching-shortening cycle. In the review studies that included the research conducted during the years 1966 to 2009 in authoritative publications. In most of these studies, they showed the effectiveness of plyometric exercises in improving muscle power and strength, speed, agility and jumping functions, as well as improving neuromuscular adaptations [5].

2. Statement of the Problem

Among the fields of interest of sports researchers regarding volleyball, physical fitness related to volleyball and different training methods can be mentioned, all of which are used to increase the aerobic and anaerobic capacity of athletes. In fact, in today's science of physical education, physical activity in the dimensions of heroism and health has no meaning without cardiovascular fitness, and this physical fitness is the basis of other physical fitness. In order to achieve optimal physical fitness, various training methods have been provided, of which plyometric exercises are one of its types. The purpose of doing this type of exercise is to increase physical fitness. Each person can benefit from these exercises according to their own conditions. Also, recent research has shown that periodic plyometric exercises (especially for athletes who are active at the championship level) can be more effective and improve their fitness. The reason for this is our rest between activities and the renewal of energy sources, which causes fatigue to occur with less prevalence and with a delay [7].

Volleyball is a sport with movement characteristics such as

power, agility and speed; therefore, in order to increase their performance, athletes must improve the neuromuscular coordination characteristic of volleyball [8]. Power is the ability of the neuromuscular system to produce fast force and is defined as the product of muscle force produced at the speed of movement; therefore, improving the strength or speed of athletes improves their ability to produce power [9]. Observing the conditions of the volleyball competition has shown that volleyball is associated with short-term and continuous high-intensity activities with low-intensity activities and short rest periods. Volleyball players need good development of speed and muscle strength and the ability to perform these maximal repetitions with limited recovery during the match (Shepard, 2013). Vertical jump is an integral part of volleyball game. The primary goal of any volleyball conditioning program should be to maximize vertical jump and minimize overexertion, both on takeoff and landing [10].

In this case, using the best training method, while maintaining the freshness and health of athletes in different age categories, is one of the principles that must be followed in championship sports. If we examine different sports in more detail, in most of them we will see skills and movements that require physical fitness, strength and speed at the same time (explosive power). For example, split spike And defense in volleyball and header in football confirm this issue [11]. Power is always considered one of the most important factors of physical-motor fitness and success of athletes in various sports fields. Some sports skills and movements are very much in need of this factor, including jumps in many sports fields. are of special importance; As the superiority and success of athletes in performing vertical jumps in athletics, volleyball, handball, football, is one of the factors of superiority in front of opponents [12]. On the other hand, explosive power is the most necessary part of many players' skills and enables players to not only reach the required height during the competition, but to have the best reaction at any moment. A volleyball player's use of explosive power in vertical, horizontal and lateral movements is vital. The connection between explosive power and the level of technique and tactics is especially evident when we observe the player's activity on the net, serve and spike. Using maximum power takes 0.5 to 0.7 seconds, although most explosive moves actually take less time. For this reason, in order to convert the maximum muscle power obtained into explosive power in the main muscle groups of the lower body that participate in flight, special strength training is required. The plyometric method is ranked among the most used volleyball preparation methods. This training method leads to the development of explosive power and reaction speed based on the improvement of CNS reaction and power, which is needed to absorb pressure during landing [6].

Plyometric exercises have brought significant success to athletes. The use of this training method in some sports fields such as athletics has caused the champions of other

sports fields to use plyometric exercises in their training programs. For this reason, a new horizon in the training method of most sports activities that Somehow they require explosive power, it has been opened and with the passage of time, plyometric exercises have found their special place among different sports disciplines. So that today, plyometric exercises as a useful and efficient training method can significantly guarantee the success of the heroes whose explosive power plays an essential role in their sports performance [13]. Considering the importance of increasing physical fitness among the athletes involved in volleyball and the lack of consistent research that has used plyometric exercises in addition to specific volleyball exercises, and carefully considering the fact that most of the research has been conducted on volleyball boys. Therefore, the researcher designed the above research with the aim of explaining the effect of plyometric exercises. Today, plyometric exercises are known as reactive exercises, stretching-shortening cycles. Today, specialized volleyball exercises and plyometric exercises are used in most parts of the world and at different levels, but unfortunately, less attention is paid to this issue in women's volleyball in our country, and generally, these types of exercises are mostly used at national or professional levels. By examining the effects of these exercises on female players and showing the results, this research tries to improve the exercises used by players and coaches and to use more specialized volleyball exercises and plyometric exercises at all levels of women's clubs.

Plyometric exercises means performing powerful and fast movements in which a period of muscle stretching is used before the muscle contraction phase in order to improve power. In other words, plyometric exercises have a cycle or stretching-shortening cycle [14].

Plyometrics are exercises that enable the muscles to reach maximum power in the shortest possible time. Doing these exercises will give you tremendous strength and help you to improve your vertical jump, which is one of the most important features. Increase is a volleyball player. These exercises can greatly increase your speed and reaction in volleyball and can even increase your jump up to 40-50 inches and even up to 60 inches (100-150 cm)! [15].

3. Research Method

The current research method was semi-experimental with a pre-test-post-test design with a control group and an experimental group.

The statistical population of the current research was made up of female volleyball players in Tehran with an age range of 15 to 18 years. At first, 50 people were selected in a targeted manner, whose selection criteria were not suffering from cardiovascular, respiratory, kidney, or metabolic diseases, as well as not having a history of surgery and taking

any special drugs, sports supplements, etc. He was chosen as a sportsman. Finally, 24 of them were randomly divided into experimental and control groups after homogenization. At the beginning of the work, a briefing session was held, including the introduction of the research conditions, including possible benefits and risks, and the necessary recommendations for the subjects. Before starting sports activities, preliminary evaluations based on determining age, height, weight and physical fitness factors were carried out in experimental conditions. Then, for 6 weeks, the experimental group did plyometric training and volleyball training 3 times a week, and the control group did their routine volleyball training. The overload principle was applied in plyometric training by increasing the number of sets, repetitions and the height of obstacles. In the end, to collect the data after the test, both groups did the tests again. It should be noted that in order to equalize the time of measuring the variables for all the subjects, all the measurements were done between 3 and 5 in the afternoon.

The independent variable of the research was six weeks of specific volleyball exercises and plyometric exercises, and the dependent variable of the research was physical preparation factors including explosive power, agility, speed, and volleyball performance test.

Sargent jump test was used to measure leg muscle strength. The method of conducting the test was that the subject stood facing the wall, hit the tip of the fingers of his upper hand on the scale plate that was installed on the wall, and after marking the mentioned point, the subject was asked to bend the knee. Ha, jump up and touch the highest point of the wall as much as possible at the peak of the jump. The test was performed in 3 times. The difference between the first point (the height of the subject with his hand extended without jumping) and the peak point of the jump was the score that the subject earned. The difference between the second and first height determines the person's jump in centimeters and is recorded as the test score.

The present study used a 36-meter sprint test to measure the subjects' speed. To measure and evaluate the agility of topics 4 x 9-meter running test was used.

4. Exercise Protocol

The training stages included selected plyometric exercises and specific volleyball exercises. Before starting the training, the subjects of the experimental group did 15 minutes of warm-up, including running and stretching exercises. Then they were divided into groups of 4 for plyometric exercises. And throughout the implementation of this research, the groups and the order of the research were fixed.. Implementation of plyometric exercises included jumping over hurdles, box squat jump, triple step + jump up (with both feet) and full jump from a long box, which was performed according to Table 1.

Table 1. Plyometric training program in 6 weeks.

	hurdle race			Box squat jump			triple jump+ Jump up (with both feet)			Full jump from the high box		
	set	repeat	Height	set	repeat	Height	set	repeat	Height	set	repeat	Height
Week 1	2	6	50	2	10	60	2	9	-	2	8	60
Week 2	3	6	50	3	10	60	3	9	-	3	8	60
Week 3	3	7	50	3	11	60	3	10	-	3	9	60
Week 4	3	7	50	3	11	60	3	11	-	3	10	60
Week 5	2	8	50	2	12	60	3	12	-	3	10	60
Week 6	3	8	50	3	12	60	3	12	-	3	11	60

The research was designed in such a way that volleyball players performed the same training and competition protocol. According to Table 2, the volleyball training program was held for six weeks, 3 sessions per week, on non-consecutive days for 80-100 minutes. The program of each session included warm-up, training and review of claw, forehand, serve, net defense and infield defense and tactics in various conditions and at the end of the class, a game to apply the training techniques.

Descriptive and inferential statistics methods were used to analyze the data in this research. Descriptive statistics were used to calculate centrality and dispersion indices, and K-S test was used to determine the normality of data distribution. Finally, independent and correlated t-test was used to study intra-group and inter-group significance in pre-test and post-test. All statistical operations were performed by SPSS software version 22, and the significance level of the tests was considered at $P \geq 0.05$.

Table 2. of volleyball training program.

Sessions 1-18 (non-consecutive days)	
exercises	
General activity + special warm-up with a ball for 25 minutes	Warm up
20 minutes of training that included low-intensity movement and combination of volleyball techniques.	Teaching technical exercises
Two exercises were performed two minutes apart.	
Small games (3 vs. 03, 4 vs. 4), where the volleyball court was divided into two smaller courts (9 x 4.5 meters). -	3 vs 3 exercises
Competitive training (6 vs. 6) with most of the free balls thrown by the coach	4 vs 4 exercises
The teams were rotating depending on the points. After each turn, the players rested for one minute. (40 minutes)	6 vs. 6 based on the game
For the muscle groups that were mainly involved in the exercises.	5 minutes of stretching

The characteristics of the subjects (age, height, weight, and body mass index) are presented in Table 3. All values are expressed as mean and standard deviation and are related to the measurements made before the start of the test.

Table 3. Characteristics of the research subjects.

Groups	Variables			
	age - years	Height (cm)	Weight (kg))	BMI (kg/m ²)
experimental group (12 people)	16/4±2/3	164±4	57/4±6/5	21/89±3
control group (12 people)	15/11±2/5	166±5	55/7±6/6	22/30±1

Findings related to research variables

The mean and standard deviation, pre-test and post-test of research variables are presented in Table 4.

Table 4. Mean and standard deviation of all research variables.

Groups	Variables	pre-exam	After the test
experimental	explosive power (cm)	35/46±5/56	41/60±4/52
the witness		36/25±5/41	37/11±5/51
experimental	Agility (9x4) (seconds)	13/37±0/58	11/43±0/68
the witness		13/72±0/07	14/05±0/32
experimental	Volleyball functional test (seconds)	36/56±0/50	27/66±0/61
the witness		35/01±0/85	37/98±0/27
experimental	Run 36 meters (seconds)	12/15±4/52	10/33±5/77
the witness		12/43±6/59	13/07±6/65

According to the results of the Kolmogorov-Smirnov test, the distribution of the data related to all the studied variables is normal. Therefore, parametric statistical tests were used to analyze the data and test the research hypotheses.

Table 5. Results of Kolmogorov-Smirnov test for all research variables.

Groups	Variables	Pre-exam		After the test	
		K-S	meaningful Z	K-S	meaningful Z
experimental	explosive power (cm)	0/546	0/713	0/534	0/941
control		0/541	0/921	0/522	0/963
experimental	Agility (9x4) seconds)	0/576	0/923	0/442	0/889
control		0/548	0/875	0/563	0/931
experimental	Volleyball functional test (seconds)	0/620	0/837	0/668	0/764
control		0/412	0/996	0/546	0/927
experimental	Run 36 meters (seconds)	0/905	0/220	0/414	0/995
control		0/480	0/975	0/675	0/752

Referring to the independent t-test results presented in Table 6 and based on the significance level obtained, it can be seen that there is a significant difference between the post-test results of the experimental and control groups ($p < 0.05$).

Table 6. Differences between groups.

Variable	Degrees of freedom	mean difference	t	meaningful
explosive power	22	6/37	5/39	0/001

The results of the correlation t-test between before and after the test of the experimental and control groups are presented in Table 7. As can be seen, the post-test values of

explosive power in the experimental group have a significant difference with the pre-test values, but the difference observed in the control group is not significant.

Table 7. Difference between pre-test and post-test of experimental and control groups.

Variable	Group	T	Degrees of freedom	meaningful
explosive power	experimental (12 people)	6/952	11	0/001
	Witness (12 people)	1/564	11	0/126

The second hypothesis:

Specific volleyball and plyometric exercises have a significant effect on the agility of female volleyball players.

Referring to the independent t-test results presented in

Table 8 and based on the significance level obtained, it can be seen that there is a significant difference between the post-test results of the experimental and control groups ($p < 0.05$).

Table 8. Differences between groups.

Variable	Degrees of freedom	mean difference	t	meaningful
Agility	22	11/2	6/85	0/001

The results of the correlation t-test between the pre-test and the post-test of the experimental and control groups are presented in Table 9. As can be seen, the post-test values of

agility in the experimental group have a significant difference with the pre-test values, but the difference observed in the control group is not significant.

Table 9. Difference between pre-test and post-test of experimental and control groups.

Variable	group	T	Degrees of freedom	meaningful
Agility	experimental (12 people)	5/054	11	0/001
	witness (12 people)	1/120	11	0/217

The third hypothesis: specific volleyball and plyometric exercises have a significant effect on the volleyball performance test of female volleyball players.

Referring to the independent t-test results presented in

Table 10 and based on the significance level obtained, it can be seen that there is a significant difference between the post-test results of the experimental and control groups ($p < 0.05$).

Table 10. Difference between groups.

Variable	Degrees of freedom	mean difference	t	meaningful
Volleyball performance test	22	7/45	08/7	0/001

The results of the correlation t test between the pre-test and the post-test of the experimental and control groups are

presented in Table 11. As can be seen, the post-test values of explosive power in the experimental group have a significant

difference with the pre-test values, but the difference observed in the control group is not significant.

Table 11. Difference between pre-test and post-test of experimental and control groups.

Variable	Group	T	Degrees of freedom	meaningful
Volleyball performance test	experimental (12 people)	5/784	11	0/001
	Witness (12 people)	0/985	11	0/541

Fourth hypothesis: specific volleyball and plyometric exercises have a significant effect on the speed of female volleyball players.

Referring to the independent t-test results presented in

Table 12 and based on the significance level obtained, it can be seen that there is a significant difference between the post-test results of the experimental and control groups ($p < 0.05$).

Table 12. Difference between groups.

Variable	Degrees of freedom	mean difference	t	meaningful
Speed	22	18/2	6/101	0/001

The results of the correlation t-test between the pre-test and the post-test of the experimental and control groups are presented in Table 13. As can be seen, the post-test speed

values in the experimental group have a significant difference with the pre-test values, but the difference observed in the control group is not significant.

Table 13. Difference between pre-test and post-test of experimental and control groups.

Variable	group	T	Degrees of freedom	meaningful
Speed	experimental (12 people)	5/658	11	0/001
	witness (12 people)	1/201	11	0/247

5. Discussion and Review

Referring to the independent t-test results and based on the significance level obtained, it can be seen that there is a significant difference between the post-test results of the experimental and control groups. The results of the correlation t-test between the pre-test and the post-test of the experimental and control groups showed that the post-test values of the explosive power in the experimental group have a significant difference with the pre-test values, and therefore specific volleyball and plyometric exercises on the explosive power of female volleyball players. It has a significant effect. Explosive power means the power by which a muscle can quickly react against a resisting force. The results obtained from this research are consistent with the results of Adibpour et al, Hubert and Thomas, Perez and Klondi. Emerging research has shown that many of the benefits of exercise are mediated through the role of skeletal muscle as an endocrine organ. In other words, muscle contraction releases many substances called myokines that promote new tissue growth, tissue repair, and multiple anti-inflammatory functions, which in turn reduce the risk of various inflammatory diseases. Gradual physiological adaptations to exercise occur as a result of long-term training, and how the body adapts to exercise or exercise is what sports physiologists want. Based on this, different people show different reactions to a specific exercise program. The results of the current research are inconsistent with the results of modern research (2014). It seems that the reason for the non-significance of the results of this research was due to the difference in the duration and intensity of the exercise in each session with the present

research. Because plyometric exercises, in addition to exercise, are influenced by factors such as age, type and degree of muscle tension, joint structure, body type and gender. Its physiological reason can be stated as that specific volleyball and plyometric exercises increase the contraction speed from the extroverted to introverted stage and the introverted activity starts with the participation of more movement units. As a result, more power will be produced. Jumping, leaping and strength exercises have significant changes in the anaerobic performance of muscles and as a result the explosive power of the athletes, which may be due to the age difference of the subjects, the type of exercises and the corresponding training program. In stating the physiological cause of this claim, it can be said that sports training increases the explosive power of leg muscles. Exercises include a series of muscle activities along with jumping tasks in which the stretching feedback of a muscle is used. These reflexes occur when the muscles contract immediately after being stretched. Various exercises, including explosive exercises, which are used to increase strength, have an effective role in improving the coordination and function of the nervous and muscular system. In this connection, there are also differences of opinion about the types of contractions with the types of physical exercises and their effect on the amount and increase of strength and power. There is, this has caused different methods of physical exercises to be used [16].

Referring to the independent t-test results and based on the significance level obtained, it can be seen that there is a significant difference between the post-test results of the experimental and control groups. The results of the correlation t-test between the pre-test and post-test of the

experimental and control groups showed that the post-test values of speed in the experimental group have a significant difference with the pre-test values, and therefore specific volleyball and plyometric exercises have a significant effect on the speed of female volleyball players. The results obtained from the present research are consistent with the results of Kavei et al. (2017) and Ronstad et al.

The mechanisms responsible for strengthening anaerobic performance due to speed training may be related to increasing force production and neural adaptation. The mechanisms that may be responsible for increasing anaerobic power include increasing the use of glycolytic pathways that increase the concentration of phosphofructokinase or phosphorylase enzymes and thus cause a relative increase in force production and neural adaptation [17].

Since jumping exercises in the contraction stretch cycle causes a change in the speed in the extroverted and introverted contraction phase, the increase and strengthening of these two phases reduces the time interval between the extroverted and introverted contraction phase. As a result, jumping exercises increase and improve speed. Various researches have also reported the significant effect of jumping exercises on running speed. But the reasons for these differences can be found in the nature of dependent variables as well as the content and combination of movements in the executive programs. It is also possible that the training program is long, and the age difference of the subjects and the training program is different. Yang et al. (2015) investigated the relationship between power and sprint performance and determined that peak power is maximal in short distances and absolute power is related to running speed [16]. Researches have shown that after speed training, muscle glycogen stores increase as an important fuel in activities with speed repetitions. This issue makes ATP reloading faster and therefore improves aerobic power. Various researchers have reported the ineffectiveness of this type of training on the cross-sectional level or the composition of the type of muscle fiber, but Wilsov et al. (2014) observed an increase in strength after a period of speed training. It has also been shown that after speed or resistance activities, the activity of enzymes involved in the glycolytic pathway, such as phosphofructokinase, myokinase, creatine phosphokinase and lactate dehydrogenase, increases. It has also been shown that speed training leads to a greater improvement in explosive power at the beginning. There are two races. As it is inferred, following extroverted and intense muscular exercises, changes in the physiological indicators of the body are created, and depending on the type of index measured and the time interval of extroverted/intense exercise, different results can be expected [18].

How and quality of effective exercises to increase anaerobic power can be divided into three different types: resistance exercises, plyometric exercises and combined exercises. Resistance training is known as a significant and effective helper in anaerobic capacity in puberty. The mechanisms responsible for strengthening anaerobic performance due to speed training may be related to

increasing force production and neural adaptation. The mechanisms that may be responsible for increasing anaerobic power include increasing the use of glycolytic pathways that increase the concentration of phosphofructokinase or phosphorylase enzymes and thus cause a relative increase in force production and neural adaptation, as well as speed training before any exercise. An increase in muscle volume will result in more enzymatic changes [19].

Also, because in speed training, the pressure on the muscles is maximum and the neuro-muscular adaptation causes the mobilization pattern of the movement units to change and work simultaneously. In any case, molecular analysis can determine this difference [20]. In explaining the physiological cause of this claim, it can be said that the increase in speed after exercise may be due to cellular-molecular changes in the central nervous system of motor units, the nerve-muscle junction, systems involved in the sarcoplasmic network of mitochondria, or in the proteins themselves. Contraction occurs. Therefore, different stimuli such as hormonal changes, type, duration and intensity of training can determine the main position of the changes. So that the researchers believe that the adaptation after speed training is caused by a lot of hormonal changes and intense stretching of the muscles during the activity, which these two factors cause a decrease in the H reflex [21]. In this case, more movement units are called for a specific action, which facilitates contraction and increases the muscle's ability to produce force. Such an increase in the recall pattern of motor units can be caused by stopping or reducing inhibitory impulses (muscle spindle) that allow more motor units to be activated at the same time. The higher the intensity of plyometric and strength exercises or the faster they are performed, the greater the increase in anaerobic power, because when the movement is performed with high speed, it can increase the use of motor units, the synchronization of emptying and muscle activation levels to further improve [22].

The results of the correlation t-test between the pre-test and the post-test of the experimental and control groups showed that the post-test values of agility in the experimental group have a significant difference with the pre-test values, and therefore specific volleyball and plyometric exercises have a significant effect on the agility of female volleyball players. The results obtained from the present research are consistent with the results of Kavei et al. and Ronstad et al, but they are not consistent with the results of Abdi and it seems that this contradiction is mainly due to the different implementation of the program. training, the degree of difference in the readiness of the subjects, the intensity and volume of the training program and the nature of the dependent variables.

Agility is one of the most essential factors for athletes and a set of other physical factors such as speed, reaction speed, strength and coordination and balance. The results of this research show that there has been a significant increase in the agility of female volleyball players who performed the plyometric training program and specific volleyball exercises.

Volleyball exercises require changing the position and direction of body movement, and due to the fact that they encourage the body to work well, they raise its temperature [21]. Physiological reactions to physical activity are short-term physiological reactions to exercise. When starting physical activity and exercise, the body's reaction to a piece of exercise should be adapted first, and this type of reaction is called a short-term reaction. After these gradual adaptations, the body gets used to successive stages of training. How are the physiological reactions to exercise determined? Elite champions and people who exercise daily to maintain health do not run in conditions where comprehensive control of physiological conditions is possible. But another important issue is the long-term reactions of the body to the pressure caused by successive bouts of exercise [21]. Physiological adaptations that occur as a result of exercising in the long term cause athletic progress and efficiency. Also, in the case of the physiological compatibility of compound exercises, a number of known factors such as neuromuscular, metabolic, hormonal and psychomotor factors play a role. In addition to morphological adaptations, these exercises create grounds for effective neural adaptations, which are probably the most important variables. Intense training increases this effect by regulating neuro-motor activities and releasing specific reflexes, which are important factors in the effectiveness of plyometric exercises [23].

6. Volleyball Performance Test

Referring to the independent t-test results and based on the obtained significance level, it can be seen that there is a significant difference between the post-test results of the experimental and control groups. The results of the correlation t-test between before and after the test of the experimental and control groups showed that the post-test values of the volleyball performance test in the experimental group have a significant difference with the pre-test values, and therefore specific volleyball and plyometric exercises on the players' volleyball performance test. The female volleyball player has a significant effect [22].

One of the most important things in the functional volleyball test is dynamic balance and neuromuscular coordination. In explaining the effect of this training method on dynamic balance, it should be said that maintaining the balance of the body position (posture) includes the sensory perception of body movements, the processing of sensory and motor information within the nervous system. It is the central and appropriate responses of the skeletal muscles, which itself depends on the health of the central nervous system, the visual system, and the skeletal muscle system, and the inputs from the internal and surrounding receptors of the joints, tendons, and ligaments, and in fact, the posture control system as a feedback control circuit operates between the brain and the skeletal muscle system. The physiological reactions of specific volleyball and plyometric exercises on increasing dynamic balance prove the claim that

increasing the strength of the lower limbs is related to the improvement of walking speed and increasing the strength of weak people. Scientific evidence indicates that the strength of the quadriceps muscle is important for maintaining dynamic stability during standing. It is very important to emphasize on strengthening exercises of lower limb muscles, especially extensor muscles such as quadriceps, hamstrings, gluteus maximus and medius, and leg muscles that provide support for balance while walking. The abductor and adductor muscles are the main muscles that control the lateral movements of the body weight. Increasing strength alone and without walking training is not enough to improve walking. Functional weight-bearing exercises, such as climbing and descending stairs, are used to improve force production, muscle contraction speed, and muscle activity [24].

The set of abdominal muscles, which include the transversus abdominis muscle, the internal and external oblique muscle, and the rectus abdominis muscle, stabilizes the spine with its contraction and provides a stronger base for the movements of the lower limbs. When the transverse abdominal muscle contracts, the intra-abdominal pressure and the tension of the thoracic-lumbar fascia increase, and these contractions create a strong base for movement and muscle activation before the body moves. The rectus abdominis muscle and the internal and external oblique muscles are also activated in specific movement patterns based on the movement of the body and control the posture. Activation of the rectus abdominis muscles and oblique muscles should be done before making the movement to maintain the person's balance. Also, the multifidus and transversus abdominis muscles, with the support of the spine, help to maintain dynamic balance in the movement of the lower limbs [25].

The physiological reason for coordination exercises is that neuromuscular coordination is essential for smooth movements. Movements that have opposition (such as the opposite movement of arms and legs while walking) and movements that cross the midline of the body cause movement difficulties. Performing complex movement patterns preserves neuromuscular efficiency. Since speed is a genetic factor, it can be enhanced by performing sports skills at maximum speed [26].

7. Conclusion

Physical fitness is a set of inherent and acquired characteristics that determine the ability to perform physical activity, and creating general health is the most important role that can be expected from it. Among the important factors of physical fitness are; He mentioned explosive power, agility, speed, balance and coordination. Since the samples of the present study were experienced teenage volleyball players, the amount and level of physical fitness of the statistical sample of this study was relatively higher than the studies that used inactive subjects. However, the results of this research showed that doing specific combined exercises for volleyball and plyometrics has a significant increase in

explosive power, agility, speed, balance and coordination (specific volleyball test) of volleyball girls. The ability or ability to increase speed and agility and coordination, explosive power and balance is considered a basic necessity for athletes involved in the field of volleyball, and improving and developing these factors helps athletes who participate in competitions.

8. Suggestions

Suggestions arising from the research:

- 1) It is suggested to carry out a general training period to create anatomical and physiological adaptation before carrying out the specific volleyball and plyometric training program in order to prepare athletes more and reduce injuries.
- 2) Due to the positive and significant effect of conducting specific volleyball and plyometric exercises at the same time, volleyball coaches can use the combination of these exercises to further increase and improve the physiological conditions of their athletes.

Conflict of Interest

No conflicts of interest are reported between the authors.

References

- [1] Jurkesh et al. (2006) The effect of different stretching warm-up protocols on the performance of two sprints of 20 meters of trained soccer players, Thesis. Ministry of Science, Research and Technology - Shahid Rajaei Tarbiat University - Faculty of Physical Education and Sports Sciences. 1386. Masters.
- [2] Khosrwanian et al. (2010) Investigating the effects of 3 different programs of static stretching, dynamic stretching and a combination of static and dynamic stretching in pre-exercise warm-up on Illi Noiz agility test in professional football players. *Journal of Sports Biology*, Winter 2013, No. 11 - pp. 15-26.
- [3] Radcliffe James, Christopher; Farentinos, Robert and Cho, Donald (2004). New sports exercises (plyometrics). (Mehdi Talebpour, translator). Mashhad: Astan Quds Razavi Publishing Co., Ltd. 14-32. (original publication of 1958).
- [4] Rahmani Nia Farhad, Rajabi Hamid, M. Timuri (2009) Facts about fitness, exercise and health, Gilan University Publications, third edition.
- [5] Rezaei, Khalil (1375). Comparison of body sizes and composition and skill execution index based on different playing positions among elite men's basketball. Master's thesis. Tarbiat Modares University.
- [6] Ramzanpour, Mohammad Reza. Moghadam, Amir. Alizadeh, Mehdi (1390). The effect of plyometric exercises on speed, agility, flexibility and aerobic capacity of taekwondo athletes. Sciences of Karaj Azad University, No. 5, pp. 32-38.
- [8] Gayini et al.(2013), the effect of eight weeks of aerobic and strength activity on cardiovascular risk factors of obese men, *Journal of applied studies of biological sciences in sports*, period 3, number 4, winter 2011.
- [9] Hayward Vivian H. (2013) Scientific principles and specialized exercises of physical fitness, translators: Gayini Abbas Ali, Rajabi Hamid, General Directorate of Physical Training of the Police Force.
- [10] Yektakar Muzaffar, Mohammadi Sardar (2013) Comparison of the effects of resistance, endurance and combined sports training on the lipid profile of middle-aged non-athletes. *Scientific journal of Kurdistan University of Medical Sciences/ 16th term/ winter 2010*.
- [11] Alexander T. Latinjak, Miguel Torregrosa & Renom, J (2011). Combining Self Talk and Performance Feedback: Their Effectiveness With Adult Tennis Players. *The Sport Psychologist*, 2011, 25, 18-31.
- [12] Bahari, M., M, Shojaei and P, Mokhtari. 2012). The effect of overt and covert self-ta on the performance of forceproduction task. *European Journal of Experimental Biology*, 2012, 2 (4): 1200-1203.
- [13] Bishop L Riemann, Scott M Lephart.(2007) The sensorimotor system, part 2, The role of proprioception in motor control and functional joint stability, *Journal of Athletic Training*, 37 (1): 80-84.
- [14] Joresteaj, L., Jones, G., & Gould, D. (2017) Understanding psychological preparation for sport: theory and practice. Chichester, UK.
- [15] Lance E. Davidson, PhD; Robert Hudson, MD, PhD; Katherine Kilpatrick, MD;(2016). Effects of Exercise Modality on Insulin Resistance and Functional Limitation in Older Adults. Downloaded from www.archinternmed.com at University of Alberta.
- [16] Theodorakis, Y., Beneca, A., Goudas, M., Antoniou, P., & Malliou, P. (1998) The effect of self-talk on injury rehabilitation. *European Yearbook of Sport Psychology*, 2, 124-135.
- [17] Thomas, O., Maynard, I., & Hanton, S. (2017). Intervening with athletes during the timeleading up to competition: Theory to practice II. *Journal of Applied Sport Psychology*, 19, 398–418.
- [18] Van Raalte, J. L., Brewer, B. W., Rivera, P. M., & Petitpas, A. J. (1994) The relationship between observable self-talk and competitive junior players' match performances. *Journal of Sport and Exercise Psychology*, 16, 400-415.
- [19] Vang, Y., Weinberg, R., Natsis, P., Douma, E., & Kazakas, P. (2010) The effects of motivational versus instructional self-talk on improving motor performance. *The Sport Psychologist*, 14.
- [20] Weinberg R and Gould D. (2016). *Foundations of sport and exercise psychology* (4th Ed.). Champaign, IL: Human Kinetics.
- [21] Weinberg, R. S., Grove, R., & Jackson, A. (2020) Strategies for building self efficacy in tennis players: a comparative analysis of Australian and American coaches. *The Sport Psychologist*, 6, 3-13.

- [22] Weinberg, R. S., Smith, J., Jackson, A., & Gould, D. (2016) Effect of association, dissociation, and positive self-talk on endurance performance. *Canadian Journal of Applied Sport Sciences*, 9, 25-32.
- [23] Schmidt, R., Lee, T. (2005) *Motor learning and control*. Translated: Rasool Hemayat Talab, Abdollah Ghasemi. Tehran. Science and movement Publication.
- [24] Yaratan, H. S., & Yucesoylu, U. 2014. Self-esteem, self-concept, self-talk and significant others' statements in fifth grade students: Differences according to gender and school type. *Social and Behavioral Sciences*, Volume 2, Issue 2, 3506-3518. Available online at www.sciencedirect.com
- [25] Wulf, G., Lauterbach, B., & Toole, T. (2013). Learning advantage of an external focus of attention in golf. *Research Quarterly for Exercise & Sport*, 70, 120-126.
- [26] Zinsser, N., Bunker, L. K., & Williams, J. M. (2008) Cognitive techniques for improving performance and building confidence. In J. M. Williams (Ed.), *Applied Sport Psychology: Personal growth to peak performance* (3rd ed.). Mountain View, CA: Mayfield. (pp. 225-242).