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Effect of plyometric and weight training programs on vertical jump in female basketball players

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Abstract
The aim of this study was to compare the effect of combined exercises (plyometric and weight training) on vertical jump of female basketball players. Out of 35 basketball players who competed in first division league of Chitradurga Basketball clubs, 16 players (age: 20.38±3.7 yr, weight: 65.5±11.5 kg and height: 174.78±6.23 cm) participated voluntarily in this study. They were randomly assigned to two experimental and control groups. The experimental group performed plyometric exercises (which consisted of side hop, lay up jump, depth jump) and weight exercises (which included leg press lying, calf raises, leg press standing) 3 days per week for 8 weeks while the control group performed only the vertical jump that was measured with Sargent Jump test. Both groups took part in the pretest and posttest. The accepted level of significant was $p<0.05$. The results indicated the significant effect of combined exercises on vertical jump ($p<0.05$). In addition, the results revealed that the vertical jump of experimental group was significantly greater than control group ($p<0.05$). The results showed that these exercises can also build up foot muscles and increase explosive feet power. Therefore, the Application of combined exercises to jumping sports was suggested.

Keywords: Combined exercise % Basketball % Plyometric % Weight training % Vertical jump % Explosive

1. Introduction
In sports that require jumping and quick movements, there is a need for muscular strength and power such as basketball. One of the basketball skills is rebounding. The player tries to rebound with a quick long jump without stretched arms as well as the slam-dunk technique that depends on a vertical jump with lots of power. The aim of this study was to increase the vertical jump of female players through combined exercises. The necessity to attain ultimate ability to perform skills has motivated coaches and trainers to apply different solutions and exercises for the success of players in order to improve in any sport, in addition to necessary knowledge of principles and techniques, the player should have the necessary required fitness. in order to increase vertical jumping, we should pay special attention to the factor of power which is one of the factors of physical fitness Power is defined as a product of force and velocity or force multiplied by displacement over time This needs high strength and high speed and in order to improve it, strength and speed should be improved Some players are genetically endowed with good physical structure, physiology and body composition features Some of these potentially exist in some players and it is necessary to revive, increase and improve it with suitable planning and special training. The structural and physiological features that affect vertical jumping are the gravitational center of the body and the knee extensor muscles which can help players reach maximum height in jumping [4]. Therefore, this study was carried out on players taller than 170 centimeters; weight training exercises were used to increase muscle strength and plyometric exercises to increase explosive power (strength × speed).

Table 1: Descriptive characteristics of subjects

Group	Age (years)	Weight (Kg)	Height (Cm)
Experimental group	21.0±2.0	63.86±4.60	174.5±5.38
Control Group	19.9±4.7	66.78±15.09	175±7.14

2. Materials and Methods

A population of 35 female basketball players who were at least 170cm high and members of one of Chitradurga Basketball club were invited to take part in the study. Sixteen players participated in the trainings voluntarily. The participants aged between 19 and23 (Table 1). All subjects were pretested and divided into two groups randomly. The experimental group performed special training program. After performing the exercises in the given sessions, both samples were post tested.

Plyometric exercises included side jump over benches, depth jumps and lay-up jumps; each of which were carried out as follows: Side jump began over the benches from four jumps and leaded to 11 jumps in 10 sets at the eighth week, over benches with the height of 45 cm and width of 30 cm. Depth jumps were performed with10 jumps a session and the height of the boxes began from 42 cm at the first week and increased to 70 cm at the eighth week. Lay-up jumps started with 6 jumps a session and leaded to 12 jumps at the last week. Weight training included lying leg press, standing leg press and calf workout using Delorm method and workload increased by the overload principle. The subjects had to repeat the third set of the last session of each week as many times as they could. Based on the number of repetitions, the weight was determined for the next week. Weight training exercises were carried out for 25 minutes the first week and 35 minutes the last (or eighth) week.

Weighing scale, tape measure and white powder were used to measure vertical jump. Harman specifies that vertical jump test is a test in which the standing reach of a subject is measured. The subject then performs a countermovement jump (for the purpose of the study) and marks the wall with chalk at the highest point they reach. By subtracting the standing reach from the height of the jump, you will determine the vertical jump score of the subject [21]. Independent and paired student t test at a significance level (p<0.05) and SPSS18 software were used for data analysis.

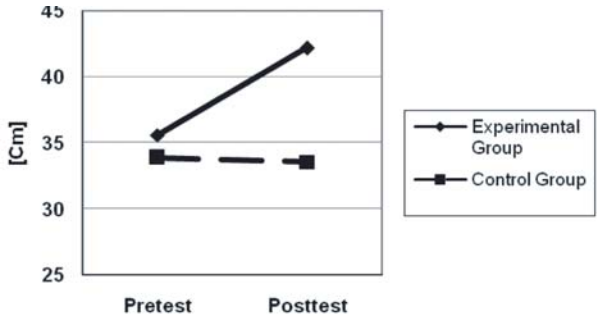

Fig 1: Vertical jump (cm) in pretest and posttest of experimental and control groups

Table 2: The effect of combined training± program on vertical jump

Group	Test	m±SD (cm)	df	t	
Experimental	Pretest	35.6±5.06	6	5.96*	0.034
	Posttest	42.2±5.42			
Control	Pretest	33.89±4.59	8	0.08	0.628
	Posttest	33.57±5.12			

*level of significance is p<0.05

In order to find out whether the combined training group had made significant improvement, a dependent 't' test was run. Table 2 shows the effect of the combined training program on the vertical jump of female basketball players in experimental and control groups.

According to data obtained from Table 2, there was a significant difference in vertical jumps of female basketball players between the pretest and posttest of the experimental group. Comparing the average vertical jump of female basketball players in pretest and posttest, the result showed that the experimental group subjects showed significant improvement as a result of combined exercises. It means that the vertical jump of female basketball players in posttest (42.2cm) was more than the pretest (35.6cm). The pretest and posttest of the control group showed no significant difference at P=0.05; there is not a significant difference in the amount of vertical jump of female basketball players of the control group before and after basketball exercises. The mean vertical jumps in pretest and posttest of both experimental and control groups are presented in Figure 1.

Findings also revealed no significant difference in the amount of vertical jump of female basketball players in the pretest. So, it can be concluded that both groups were homogeneous in terms of vertical jumping. In other words, both groups had no significant difference in the beginning of the experiment (Table 3).

The combined training program test on the amount of vertical jump of female basketball players among two experimental and control groups are summarized in Table 4.

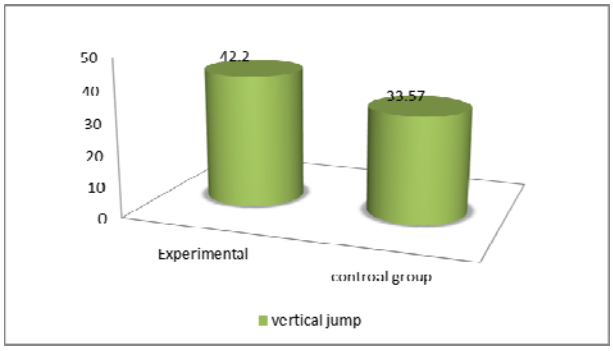

Fig 2: Comparison of vertical jump in posttest (according to cm)

Table 3: Independent t test results comparing vertical jumps in pretest

Group	m±SD (cm)	df	t	
Experimental	35.6±5.06	14	0.63	0.749
Control	33.89±4.59			

*Significance level is D <0.05

Table 4: Independent t test results on vertical jump in posttest

Group	m±SD (cm)	df	t	
Experimental	42.2± 5.41	14	2.194*	0.024
Control	33.57± 5.12			

*Significance level is D <0.05

Table 4 showed that the vertical jump of female basketball players in the posttest of experimental and control groups was significantly different. Comparing the average amounts of the vertical jump of female basketball players in posttest of both experimental and control groups, it can be concluded that the vertical jump of female basketball players of experimental group (42.2cm) was more than the vertical jump of female basketball players of the control group (33.57cm). In other words, the combined training program had a significant effect on the increase of the vertical jump of female basketball players of the experimental group (P=0.024). The comparison of the average amount of both experimental and control groups in posttest are presented in Figure 2.

3. Discussion and Conclusion

According to the results obtained, the chosen combined weight training and plyometric exercises have a significant effect on vertical jumps and leads to an increase in the amount of the participants' jump. It should be mentioned that all subjects were selected from 12 professional teams of Chitradurga basketball clubs and no research has yet been carried out using such sample. The results show that the method used in this study demonstrates a higher increase in comparison with other training methods such as weight training and plyometric exercises, which are performed on men who are more muscular than women. The vertical jumps of the experimental group of this research showed an increase of about 7cm at the end of the training period the effect of plyometric exercises resulted in a 4 cm increase

The results of these studies indicate the higher increase of vertical jumps of participants of the combined exercise group compared to the other training methods which are entirely in line with the results of the present study. It can be concluded that this increase is probably due to the strengthening of leg muscles and boosting instant energy resources. In view of the fact that power is a combination of muscle strength and speed, applying such exercises boosts power. The importance of power is because it is influential in increasing vertical jumps. Jumping is of importance in many sports, especially in basketball, in which the difference of less than a centimeter of height can lead to the loss of the ball and failure. This shows why performing these exercises are of great importance in such sports.

The results obtained illustrate the significant effect of combined exercises on vertical jumps and therefore the success of athletes. It is recommended that this exercise method be used with precise planning and adequate study in teams where anaerobic power and vertical jumps lead to their success.

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