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Effect of circuit resistance training and plyometric training on strength endurance among college girls

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Abstract
The purpose of the study was to find out the effect of circuit resistance training and plyometric training on strength endurance among college girls. To achieve this purpose of the study, fourty five women students were selected as subjects who were from the various departments, A D M College for Women, Nagapattinam. The selected subjects were aged between 19 to 24 years. They were divided into three equal groups of fifteen each, Group I underwent circuit resistance training and Group II underwent plyometric training and Group III acted as control that did not participate in any special training apart from their regular sports and games practices. The subjects were tested on selected criterion variable such as strength endurance prior to any immediately after the training period. The selected criterion variable such as strength endurance was measuring by bent knee sit-ups. The analysis of covariance (ANCOVA) was used to find out the significant differences if any, between the experimental groups and control group on selected criterion variable. The 0.05 level of confidence was fixed to test the significance, which was considered as an appropriate. The result of the present study has revealed that there was a significant difference among the experimental and control group on strength endurance.

Keywords: netball, circuit resistance training, plyometric training, strength endurance.

1. Introduction
Physical fitness is most easily understood by examining these components, or elements, or parts i.e., (endurance, strength, speed, flexibility). Body composition is also considered as a component of fitness. It refers to the makeup of the body in terms of lean mass (muscle, bone, vital tissue and organs) and fat mass. An optimal ratio of fat to lean mass is an indication of fitness, and the right types of exercise will help to decrease body fat and increase or maintain muscle mass [1]. Training has been explained as a programme of exercise designed to improve the skills and increase the energy capacities of an athlete for a particular event. Training has been a part of human life since ancient times. It denotes the process of preparation for some task. Through systematic training programme one can improve his fitness both physically and mentally [2]. The concept of training is reflected in words or terms, which are given to separate components of training (technique training, strength training) or separate methods of procedures of doing physical exercise (interval training and circuit training). Training means are various physical exercises and their objective, methods and procedures, which are used for the improvement, maintenance and recovery of performance capacity and performance readiness. Physical exercises are the physical means of training. The other means are used in addition to physical exercises or separately as per requirement. Each training means has its own specific effect on the performance capacity. This effect may be direct or indirect. Physical exercises have a direct effect on performance capacity. Means like physiotherapy, autogenious training has indirect effect [3]. Circuit training is an interval training technique that minimizes rest between sets and exercises. It can consist of only weight training or alternating intervals of weight training and brief, high intensity cardiovascular exercise. Circuit resistance training effectively reduces the time devoted to strength training while allowing an adequate training volume to be achieved. Nonetheless, circuit training has traditionally been performed using relatively low loads for a relatively high number of repetitions, which is not conducive to maximal muscle size and strength gain. Resistance training is an even broader term than weight training because resistance can be supplied by weights, machines, rubber strands and any number of other devices that resist the movement of the exerciser. It is nearly impossible to engage in any vigorous resistance training without getting stronger. However, strength training is a means of training with resistance that is focused on improving strength, as compared with muscle size.

Resistance training, also known as strength or weight training has become one of the most popular forms of exercise to enhance an individual's physical fitness and condition athletes. The terms strength, weight and resistance trainings have all been used to describe a type of exercise that require to move (or attempt to move) against an opposing force usually presented by some type of equipments [4]. Plyometrics is defined as exercises that enable a muscle to reach maximum strength in as short time as possible. This speed strength ability is known as power. Although most coaches and athletes know that power is the name of the game, few have understood the mechanics, necessary to develop it. Plyometrics is a common training methodology used by competitive athletes to develop speed and power. Jumping, bounding, skipping, throwing or any basic recoil movement, which ballistically stretches muscles are characteristic of plyometric drills, and are characteristic of motions found virtually in energy sport. The acquisition of a more rapid and forceful contraction is the fundamental basis for engaging in plyometrics training. As with most forms of exercises there are varying degrees of difficulty of intensity. Muscles, along with bones, provide for posture and movement in the human body muscles are our only muscles selected structures that can lengthen and shorten. Unlike the other supporting structures, ligaments and tendons, muscles posses a unique ability to impart dynamic activity to the body [5].

2. Methodology

The purpose of the study was to find out the effect of circuit resistance training and plyometric training on strength endurance among college girls. To achieve these purpose 45 players were selected as subjects from various departments in the A D M College for Women, Nagapattinam and their age ranged between 19 and 24 years. They were divided into three equal groups of fifteen each, Group I underwent circuit resistance training and Group II underwent plyometric training and Group III acted as control that did not participate in any special training apart from their regular sports and games practice. The experimental group underwent the training programme for three days per week for eight weeks. Among the selected variable such as strength endurance was measuring by bent knee siups test. The data were collected at prior and immediately after the training programme for the selected variable. Analysis of covariance (ANCOVA) [6] was applied for analyze the data. In all the cases, 0.05 level was used to test this significance.

3. Results

The mean and standard deviation scores of pretest, posttest and adjusted posttest of strength endurance on circuit resistance training, plyometric training and control group are given in table. 'F'ratio test computed in regards to the strength endurance on circuit resistance training, plyometric training and control group in the pretest, posttest and adjusted posttest are also presented in table.

Table I: Mean Standard Deviation and 'F' Ratio of Circuit Resistance Training, Plyometric Training and Control Group On Strength Endurance

		Circuit Resistance Training	Plyometric Training	Control Group	F ratio
Pre	Mean	3.93	3.73	4.00	0.18
	S.D	1.00	1.18	0.82	
Post	Mean	5.40	9.13	3.96	36.16*
	S.D	1.31	1.82	0.81	
Ad Post	Mean	5.34	9.32	3.85	137.17*

Table shows the analysed data of strength endurance. The strength endurance pre means were 3.93 for the circuit resistance training group, 3.73 for plyometric training group and 4.00 for the control group. The resultant 'F' ratio of 0.18 was not significant at .05 levels indicating that the three groups were no significant variation. The posttest means were 5.40 for the circuit resistance training group, 9.13 for plyometric training group and 3.96 for the control group. The resultant 'F' ratio of 36.16 at .05 level indicating that was a significant variation. The difference between the adjusted post-test means of 5.34 for the circuit resistance training group, 9.32 for plyometric training group and 3.85 for the control group yield on 'F' ratio 137.17 which was significant at.05 level.

The results of the study indicate that there is a significant difference among circuit resistance training, plyometric training and control groups on the strength endurance. To determine which of the paired means had a significant difference, Scheffe's post-hoc test was applied and the results are presented in Table II.

Table II: Scheffe's Test for the Difference between the Adjusted Post-Test Paired Means of Strength Endurance

Adjusted Post-Test Means			Mean Difference	Class Interval
Circuit Resistance Training	Plyometric Training	Control Group		
5.34	9.32		3.98*	0.88
5.34		3.85	1.49*	0.88
	9.32	3.85	5.47*	0.88

The adjusted posttest mean difference of strength endurance between circuit resistance training and plyometric training, circuit resistance training and control group and plyometric training and control groups are 3.98, 1.49 and 5.47 respectively.

4. Discussion/Conclusions

The results of the study showed that circuit resistance training and plyometric training groups have significantlly differed on strength endurance when compared to control group, and between the training groups also significant difference was found. Hence it was concluded that both circuit resistance training and plyometric training was better method to increase the strength endurance. Jackson [7] found out maximum strength and strength endurance training improve strength and muscular endurance. Hass [8] noticed low and high volume of strength training increase strength and strength endurance. Plyometric training is a specific work for the enhancement of explosive power. It improves the relationship between maximum strength and strength endurance [9].

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