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# INFLUENCE OF PLYOMETRIC TRAINING CIRCUIT TRAINING AND WEIGHT TRAINING ON MUSCULAR ENDURANCE FLEXIBILITY AND JUMPING ABILITY AMONG INTER COLLEGIATE VOLLEYBALL PLAYERS

**M. Sivakumar[1], Dr. S. Johnson[2] & Dr.K.Rajendran[3]**

[1]Research Scholar, TNPESU, Chennai, Tamil Nadu.
[2]Assistant Professor, Y.M.C.A College of Physical Education, Chennai, Tamil Nadu
[3]Assistant Professor, Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram, Tamilnadu, India.

***ABSTRACT***

*The purpose of the study was to analyze the influence of plyometric training; circuit training and weight training on muscular endurance, flexibility and jumping ability among inter collegiate volleyball players. To achieve the purpose of the study, 60 men volleyball players from various colleges affiliated to Madras University, Chennai who had represented inter collegiate level volleyball competition were selected as subjects. Their age, height and weight ranged from 17 years to 25 years, 164 cm to 176 cm, 56 kg to 78 kg respectively. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Group-I underwent plyometric training, group-II underwent circuit training, group-III underwent weight training and group-IV acted as control. The selected subjects were medically examined by a qualified physician and certified that they were medically and physically fit enough to undergo the training programme. The selected variables for which data were collected from four groups prior to and after experimentation on selected parameters were statistically examined for significant difference, if any, by applying the analysis of covariance (ANCOVA) with the help of SPSS package. The level of significance was accepted at P < 0.05. The result of the study showed that plyometric training group circuit training group and weight training group improved significantly on the selected dependent parameters when compared to control group.*

***Key Words**: plyometric training, circuit training and weight training*

## INTRODUCTION

Volleyball is a sport that requires a multitude of athletic abilities, such as explosive, agility, muscular endurance and strength in the lower body, muscular balance and high levels of neuromuscular co-ordination, body awareness and stamina, the ability to know where the body is, and being able to move it, good flexibility to avoid injury and correct balance between the quadriceps and hamstrings, as well as strength imbalances between the left and right leg. Thus, every volleyball player is interested to improve their game performance.

Volleyball is an Olympic sport played professionally in many European countries. However, notwithstanding the professionalization, which is advancing in this sport, a lack of scientific information on its performance can be noticed. This can be due to many reasons, one of them is that most of the research which has been conducted in this field has been published in Eastern European countries

and is not readily accessible to the sport science community. Another reason can be attributed to the conservative approach most coaches have towards physical conditioning for volleyball players. Physical conditioning in volleyball is extremely important for top performance, so the correct approach to training should be based on the knowledge of the specific requirements of the performance and on the development of specific training means.

The training programmes that develop performance related fitness is very different from those that develop health-related fitness. For both elite and recreational athletes, proper training optimizes race performance, but also decreases the likelihood for injury, prevents over-training and provides greater satisfaction. The importance given to training by today's elite and recreational athletes striving for their personal best performance has demanded research on how best to train for a given event. Scientists of exercise physiology have responded to these needs, and numerous academic journals have been published on optimal training practices and on practices detrimental to improved performance (Roberg & Robert, 1997).

Training methods that are suitable to athletes have been markedly revolutionized. The rapid progress made in the understanding of the mechanism involved in the adaptation of athletes to different training procedures has significantly contributed to the development of various training methods. Sports training aim at achieving higher performance in sports competition for which training should be based on facts and principles, and executed in a planned and systematic manner. A system most suitable for achieving higher performance has to be first made on the basis for which sports training is planned. It is always assessed, planned, organized and improved by a coach or a sports teacher or the athlete himself. The sport training aim at finding hidden reserves and makes the sports person aware of it. It also aims at grater development of the reserves. The sports person controls their day to day routine in such a manner that they are able to do training once or twice a day with high effect. It is a continuous process of perfection, improvement and criterion of means and methods of improving sports performance and factors of performance. Strength is the ability of the muscle to exert force. Maximal strength is the maximal amount of force the muscle is able to exert in a single contraction. All endurance sports require strength, with the amount varying for each sport. How much is necessary for optimal performance? The answer rests with each individual athlete as well as with the technical requirements of the sport. Proper strength training elicits some interesting changes in the muscles.

Plyometric training is a type of exercise designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for the purpose of improving performance in sports. Plyometric is used to increase the speed or force of muscular contractions, providing explosiveness for a variety of sport-specific activities. Plyometric has been shown across the literature to be beneficial to a variety of athletes. Benefits range from injury prevention, power development and improvement in sprint performance.

Plyometrics have been shown to have benefits for reducing lower-extremity injuries in team sports while combined with other neuromuscular training (*i.e. strength training, balance training, and stretching*). Another advantage to plyometrics is that the central and peripheral nervous systems are training to react with maximum speed, thus stimulation the muscles to shorten rapidly and produce maximum force. Ply ometric drills can be used to convert an athlete's maximal strength training into sport-specific power helping to further improvement in performance.

Circuit training is a combination of high-intensity aerobics and resistance training designed to be easy to follow, gives us a great workout, and target fat loss, muscle building and heart-lung fitness. An exercise "circuit" is one completion of all prescribed exercises in the program; the idea being that when one circuit is complete, you start at the first exercise again for another circuit. Traditionally, the time between exercises in circuit training is short, often with rapid movement to the next exercise.

The 'circuit' is split into different exercises, which are known as 'workstations'. As the circuit progresses the trainer moves from

one exercise to another in a pre-determined sequence, completing a prescribed amount of work (sets/reps) at each station. Once the trainer has completed the prescribed work on each station, they move on to the next workstation. The trainer will work different muscle groups on each workstation. While one major muscle group is subjected to exercise, others are 'actively recovering'. This aspect of circuit training, coupled with the fact that the trainer does a prescribed number of repetitions at each station that is based on the endurance principle, allows the trainer to move quickly from one station to another, requiring relatively little rest between each station.

Strength is also useful in the games when they are pushing an opposing player in order to get the tackle. The training takes into account the number of repetitions, the amount of weight, and the amount of time the muscle is exposed to tension in order to maximize the amount of muscle fiber recruitment (Philbin, 2004).

Most of the studies reviewed were cross-sectional, and only a few reported data on performance related physical parameters of volleyball players. There is a need for additional manipulative studies to determine the influence of specific conditioning programmes on volleyball game performance. More research is required concerning the variation in different methods of training and its effects. The applicability of these methods of training to develop physical fitness parameters of volleyball players is not yet completely known. Hence, there is a need to find out whether plyometric training, circuit training and weight training are the helpful training methods in improving muscular endurance, flexibility and jumping ability of volleyball players.

## STATEMENT OF THE PROBLEM

Knowledge of the various methods of training is most essential for coaches and players to attain optimal gain. The purpose of the present study was to find out the influence of plyometric training, circuit training and weight training on muscular endurance, flexibility and jumping ability among inter collegiate volleyball players.

## METHODOLOGY

### Selection of Subjects

The purpose of the study was to analyze the influence of plyometric training, circuit training and weight training on muscular endurance, flexibility and jumping ability among inter collegiate volleyball players. To achieve the purpose of the study, 60 men volleyball players from various colleges affiliated to Madras University, Chennai who had represented inter collegiate level volleyball competition were selected as subjects. Their age, height and weight ranged from 17 years to 25 years, 164 cm to 176 cm, 56 kg to 78 kg respectively. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Group-I underwent plyometric training, group-II underwent circuit training, group -III underwent weight training and group-IV acted as control.

### Training Protocol

Adequate warm up was given to the subjects prior to the plyometric, circuit and weight training. Attention was given to jogging, stretching, striding and general mobility especially about the joints involved in the planned plyometric, circuit and weight training session. A cool down exercise was performed after each session. All subjects were instructed not to start any specific training programs during the 12-week period and to only perform activities of normal daily living. Prior to the study, procedures and guidelines were presented orally and in written form. Subjects agreeing to participate signed an institutionally approved consent form. The experimental groups trained at the same time of day in the morning session, three days a week, throughout the study. During the training, all subjects were under direct supervision and were instructed on how to perform each exercise. The experimental group-I performed plyometric training, group-II performed circuit training, and group-III performed weight training. Group-IV was the control group who did not underwent any training. A 12-week plyometric training program was developed using three training sessions per week. Training volume ranged from 100 foot contacts to 120 foot contacts per session. Rest interval of two minutes between each exercise repetitions, 5 minutes between sets and one day between plyometric sessions was given in order to allow the neuromuscular system to recover.

Less intensive plyometric exercises was incorporated during the early stages of training to gradually condition the subjects and more demanding exercises was included when training progress.

In the circuit training regimens, the subjects moved from one station to another, with weight for eight stations. The load was fixed for the experimental groups based on one repetition maximum (1 RM) of each participant in all the selected exercises. The duration of exercise for each exercises varied from 20 to 30 seconds. The number of circuits varied between three-and-four for twelve weeks, with a recovery interval of five minutes was given between circuits. The recovery interval of 1:1 work rest ratio was given between exercises. The weight training program was a total body workout consisting of 3 sets of 3-12 repetitions on 6 exercises that trained all the major muscle groups. The load was fixed for the experimental groups based on one repetition maximum (1 RM) of each participant in all the selected exercises. The intensity of exercise performed for each exercise was progressively increased once in two weeks. The rest interval of 2 minutes between exercises and 5 minutes between sets was given.

**Statistical Analysis**

These criterion variables were assessed using standard tests and procedures, before and after the exercises. The selected variables for which data were collected from two groups prior to and after experimentation on selected muscular endurance, flexibility and jumping ability parameters were statistically examined for significant difference, if any, by applying the analysis of covariance (ANCOVA) with the help of SPSS package. The level of significance was accepted at $P < 0.05$.

**RESULTS**

**Table-1**

**ADJUSTED POST TEST MEAN ON MUSCULAR ENDURANCE, FLEXIBILITY AND JUMPING ABILITY OF EXPERIMENTAL AND CONTROL GROUPS**

| Variables | PTG | CTG | WTG | Control group | S of V | Sum of Squares | df | Mean squares | Obtained 'F' ratio |
|---|---|---|---|---|---|---|---|---|---|
| Muscular Endurance | 33.06 | 37.60 | 35.75 | 30.79 | B | 840.20 | 3 | 280.40 | 109.04* |
| | | | | | W | 241.54 | 55 | 2.48 | |
| Flexibility | 35.16 | 34.44 | 33.44 | 27.21 | B | 984.08 | 3 | 327.35 | 61.57* |
| | | | | | W | 505.62 | 55 | 5.32 | |
| Jumping Ability | 48.07 | 42.67 | 44.69 | 36.06 | B | 1928.89 | 3 | 436.29 | 122.24* |
| | | | | | W | 489.66 | 55 | 5.22 | |

The required table value for significance at 0.05 level of confidence with degrees of freedom 3 and 55 is 2.78.

The table -1 shows that there is a significant difference existing between experimental and control groups, since the obtained F ratio on adjusted post test means are 109.04, 61.57, and 122.24 on dependent variables are greater than the required table value of 2.78 for given degrees of freedom at 0.05 level of confidence. The result of the study shows that significant differences existed between the adjusted post test mean of the plyometric training, circuit training, weight training and control groups in improving the muscular endurance, flexibility and jumping ability. Since, the adjusted post test F ratio value is found to be significant; Scheffe's post hoc test was applied to find out the paired mean difference.

**TABLE-II**
**SCHEFFE'S POST HOC TEST FOR PAIRED MEAN DIFFERENCE ON MUSCULAR ENDURANCE, FIEXIBILITY AND JUMPING ABILITY**

| Variables | Adjusted post test means | | | | Mean Diff | C I |
|---|---|---|---|---|---|---|
| | PTG | CTG | WTG | CG | | |
| Muscular Endurance | 33.06 | 37.60 | ----- | ----- | 4.54* | 1.28 |
| | 33.06 | ----- | 35.75 | ----- | 2.69* | 1.28 |
| | 33.06 | ----- | ----- | 30.79 | 2.27* | 1.28 |
| | ----- | 37.60 | 35.75 | ----- | 1.85* | 1.28 |
| | ----- | 37.60 | ----- | 30.79 | 6.81* | 1.28 |
| | ----- | ----- | 35.75 | 30.79 | 4.96* | 1.28 |
| Flexibility | 35.16 | 34.44 | ----- | ----- | 0.72 | 1.85 |
| | 35.16 | ----- | 33.44 | ----- | 1.72 | 1.85 |
| | 35.16 | ----- | ----- | 27.21 | 7.95* | 1.85 |
| | ----- | 34.44 | 33.44 | ----- | 1.00 | 1.85 |
| | ----- | 34.44 | ----- | 27.21 | 7.23* | 1.85 |
| | ----- | ----- | 33.44 | 27.21 | 6.23* | 1.85 |
| Jumping Ability | 48.07 | 42.67 | ----- | ----- | 5.40* | 1.82 |
| | 48.07 | ----- | 44.69 | ----- | 3.38* | 1.82 |
| | 48.07 | ----- | ----- | 36.06 | 12.01* | 1.82 |
| | ----- | 42.67 | 44.69 | ----- | 2.02* | 1.82 |
| | ----- | 42.67 | ----- | 36.06 | 6.61* | 1.82 |
| | ----- | ----- | 44.69 | 36.06 | 8.63* | 1.82 |

*Significant at 0.05 level.

Table-II shows that three training groups are significantly contributing to the improvement of selected muscular endurance, flexibility and jumping ability parameters; however there was a significant difference exists between training groups and control group. However there was a significant difference exists between training groups also. While considering the three training methods, it was found that plyometric training was better than weight and circuit training in improving flexibility and jumping ability. It was found that circuit training was better than plyometric and weight training in improving muscular endurance.

**DISCUSSION ON FINDINGS**

The results of this study suggest that twelve weeks of plyometric training, circuit training and weight training have a beneficial effect on muscular endurance, flexibility and jumping ability of the volleyball players. A wide variety of training studies shows that plyometric can improve performance in vertical jumping, muscle power, long jumping, sprinting and sprint cycling. It also appears that a relatively small amount of plyometric training is required to improve performance in these tasks. Just one or two types of plyometric exercise completed 1-3 times a week for 6-12 weeks can significantly improve motor performance (Blackey & Southard, 1987; Gehri *et al*., 1998; Matavulj *et al*., 2001). Circuit training is the popular exercise method that can maximize time-efficiency while addressing several aspects of fitness. The appeal of traditional circuit weight training (TRAD) is in the theoretical ability to enhance muscular strength and endurance as well as cardiorespiratory fitness, all in one exercise session (O'Shea, 1987; Simonson, 2010; Wilmore et al., 1978). Fourteen week manual resistance training and weight resistance training produced significant improvements in muscular strength and muscular endurance however, no significant difference was observed between the manual resistance training and weight resistance training groups for muscular strength or for muscular endurance after training (Dorgo *et al.*, 2009). The study by Reid ***et al.,***

(2003) observed that weight training produced significant increases in the strength and endurance. Falk *et al.,* (2002) documented that resistance training has been shown to be an effective in enhancing muscle strength among pre pubertal and adolescent boys. The results of this study suggested that twelve weeks of Plyometric training, circuit training and weight training have a beneficial effect on selected motor fitness components. These findings are in consistent with the result of the previous research studies **Ferrete, C.,(2014).**

**CONCLUSION**

1. It is concluded from the result of the study that the due to the effect of twelve weeks of plyometric training, circuit training and weight training the muscular endurance, flexibility and jumping ability of the volleyball players were significantly improved.
2. In improving muscular endurance circuit training is significantly better than weight training and plyometric training.
3. In the case of flexibility no significant differences were found between plyometric training, circuit training and weight training.

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