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RESEARCH ARTICLE

Effect of Sports Specific Endurance Circuit Training on Peak Anaerobic Power and Aerobic Power of High School Male Basketball Players during Competitive Season

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ABSTRACT

The purpose of the study was to evaluate the effectiveness of a basketball specific endurance circuit training on peak anaerobic power and aerobic capacity on high school male basketball players. A total of twenty four (24) male high school basketball players were selected from Neyveli Lignite Corporation Sports School, Neyveli and St. Joseph Higher Secondary School, Manjakuppam, Cuddalore. These subjects were randomly distributed into two groups namely sports specific endurance circuit training group (TG) (N=12) and control group (CG) (N=12). Peak anaerobic power and aerobic capacity were selected as criterion dependent variable which was measured by vertical jump test and multistage fitness test. The Sayers equation was used for estimation of peak power output (Peak Anaerobic Power Output or PAPw) which was applied to calculate peak anaerobic power. The training group (TG) is supplemented with sports specific endurance circuit training for 3 days per week for 6 weeks between 90 to 95% maximum heart rate and CG underwent regular basketball training. The result of the study showed a significant difference between TG and CG on aerobic capacity ($F_{(1,21)}$ = 7.89, p = 0.011) and no difference on peak anaerobic power ($F_{(1,21)}$ = 1.472, p = 0.239). It is concluded that sports specific endurance circuit training is effective in improving aerobic capacity and maintains vertical jump performance of high school male basketball players during competitive phase.

INTRODUCTION

Traditionally, the coaches and trainers have planned conditioning programs for their teams by following regimens used by teams that have successful win-loss records. This type of reasoning is not sound because win-loss records alone do not scientifically validate the conditioning programs used by the successful teams. In fact, the successful team might be victorious by virtue of its superior athletes and not its outstanding conditioning program. Without question, the planning of an effective athletic conditioning program can best be achieved by the application of proven physiological training principles. Optimizing training programs for athletes is important because failure to properly condition an athletic team results in a poor performance and often defeat.

The importance of developing good conditioning programs based on the specific physiological demands of each sport is considered a key factor to success (Gillam, 1985; Taylor, 2003; 2004). The basketball player needs to train multiple components of fitness. Thus, the athlete will concurrently perform various modes of training (e.g., strength, anaerobic, endurance). In the present study sport specific circuit training was employed. This incorporates skills and movements specific to the sport, at intensities sufficient to promote aerobic adaptations, are being increasingly implemented in professional team sports environment (Lawson, 2001). The perceived benefit of performing sports-specific exercise is that the training will transfer better into the athletes competitive environment and that the greatest training benefits occur when the training stimulus simulates the specific movement patterns and physiological demands of the sport (McArdle, Katch and Katch, 1996). The purpose of the study was to evaluate the effectiveness of a basketball specific endurance circuit training on peak anaerobic power and aerobic capacity on high school male basketball players.

MATERIALS AND METHODS

Subjects

A total of twenty four (24) male high school basketball players were selected from Neyveli Lignite Corporation Sports School, Neyveli and St. Joseph Higher Secondary School, Manjakuppam, Cuddalore. These subjects were randomly distributed into two groups namely sports specific endurance circuit training group (TG) (N=12) and control group (CG) (N=12). The mean age of the selected players was 16.85 ± 0.67. The selected players had 3.8 ± 3.1 years of playing experience and regularly participate in training prior to the commencement of this study. All subjects were subjected to medical examination by a general medical practitioner before

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participation in the study to ensure that there was of sufficient standard to be able to take part in fitness testing and training.

Variables

The variables such as peak anaerobic power and aerobic capacity were selected as criterion dependent variables. Peak anaerobic power was measured by vertical jump test and aerobic capacity was measured by multistage fitness test. The Sayers equation (Sayers, *et al*., 1999) also estimates peak power output (Peak Anaerobic Power Output or PAPw) which was applied to calculate peak anaerobic power.

Collection of Data

All the subjects were tested on physiological variables prior to training and after six weeks of training at Neyveli and Cuddalore. The testing session consists of warm-up and test interspersed with rest. All tests were explained and demonstrated. Before testing, subjects were given practice trials to become familiar with the testing procedures. All tests were counterbalanced pre and post testing to ensure that testing effects were minimized. Subjects performed each test as per test procedure and the scores of best trials were taken for this study. In the morning of the first day of testing measurements like height, weight and vertical jump were measured, however in the evening aerobic capacity was evaluated.

Training Interventions

TG is supplemented with sports specific endurance circuit training for 3 days per week for 6 weeks and CG underwent regular basketball training. The training was carried out in outdoor basketball court. This sports specific circuit training was based on a previous design (Smith, 2004) and adapted to mimic as closely as possible the movement patterns of basketball match play as reported by Mclnnes *et al*., (1995). The sports specific circuit training was administered 3 days per week for six week. The TG performed 2minutes of work at 90 to 95% of targeted heart rate using Karvonen method. They performed 8 repetitions during first and second week, followed by 10 repetitions during third and fourth week and 12 repetitions during fifth and sixth week of training. This was followed by 2 minutes of active resting at 70 to 80% of targeted heart rate. In this study 1:1 work rest ratio was followed. This training protocol was adapted from Helgerud *et al*., (2001). The average running time of one circuit was 59 s and the total distance covered during one lap was approximately 153 m, with 60.2% of the movements forward sprinting and 39.8% side shuffling. The portion of the circuit considered 'offence' activity where a basketball was dribbled, was 55.6% while 44.4% was considered 'defensive' activity without ball. Three layups, three rebounds, seven vertical jumps, one pivot and 20 change of direction were completed during one repeat of the circuit.

Heart rate monitor was used to measure peak heart rate when performing the circuit. The subjects wore polar heart rate transmitter belt and watch (Polar heart rate monitor watch, Finland). The training intensity was fixed between 90 to 95% of THR. When the players perform below or above the prescribed intensity the watch will produce beep sound to alter their intensity accordingly. The sports specific endurance circuit training details are presented in thesis for further reference.

The description of the circuit

1-2 forward sprint; 2-3 hurdle jump; 3-4 forward sprint; 4 pivot left; 4-5 shuffle left; 5-6 shuffle right; 6-7 shuffle left; 7-8 shuffle right; 8-9 shuffle left; 9-10 shuffle right; 10-11 hurdle jump; 12 vertical jump (collect ball upon landing); 13-14 Zig Zag Dribble; 14-15 speed dribble with complete layup; 15 collect the rebound; 15-16-15 speed dribble with complete layup; 15 collect the rebound; 15-17-15 speed dribble with complete layup; 15 collect the rebound; 15-18 run and place the ball in basket; 18 throw the medicine ball; 18-19-20 forward sprint.

Statistical technique

The collected data was evaluated using Analysis of Covariance (ANCOVA). The proposed hypothesis was tested at 0.05 level of confidence. Beside this mean and standard deviation were also calculated. SPSS statistic software package (SPSS Company, America, version 16.0) was used. The value of 0.05 was set for statistical significance.

RESULTS OF THE STUDY

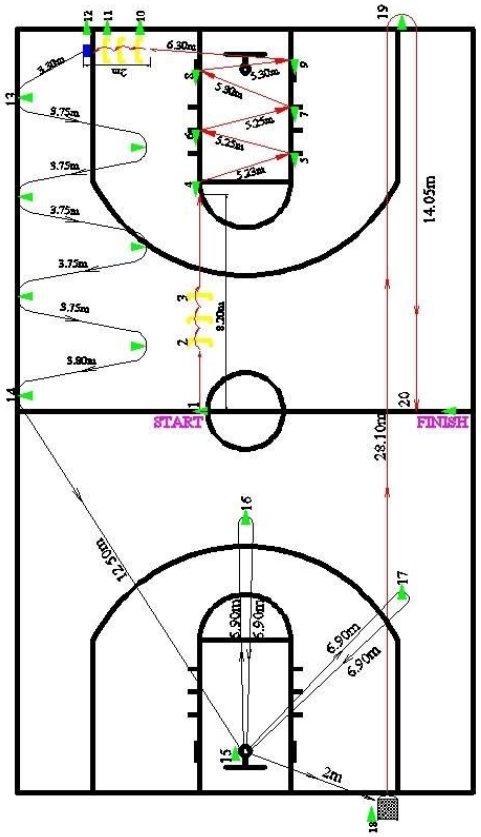

Figure1: Basketball Specific Circuit Training

It is inferred from table 1 that in TG aerobic capacity improved 3.29% after sports specific circuit training was implemented as compared with their pre-test data. Similarly, in CG aerobic training improved 1.03% as compared with their pretest data. The results of the study showed a significant difference between TG and CG on aerobic capacity ($F_{(1,21)}$ = 7.89, p = 0.011). It is also inferred that sports specific endurance circuit training showed a significant impact on aerobic capacity on high school male basketball players. However, peak anaerobic power in TG increased 0.54% after sports specific circuit training was implemented as compared

with their pre-test data. But, in CG peak anaerobic power declined 0.22% as compared with their pretest data. The results of the study showed no significant difference between TG and CG on peak anaerobic power ($F_{(1,21)}$ = 1.472, p = 0.239). This clearly showed that sports specific endurance circuit training elicited no changes in peak anaerobic power on high school male basketball players.

Table 1 Descriptive statistics of TG and CG on aerobic capacity before and after training

Variables	Testing periods	TG (12)	CG (12)
Aerobic capacity	Pre-test	53.36 ± 5.82	53.31 ± 3.68
	Post-test	55.12 ± 5.42	53.86 ± 3.60
	MD	-1.76	-0.55
	%	3.29%	1.03%
Peak anaerobic power	Pre-test	3398.8 ± 305.68	3190.6 ± 578.50
	Post-test	3417.3 ± 277.46	3183.3 ± 584.70
	MD	-18.5	7.3
	%	0.54%	0.22%

DISCUSSION

In the present study, TG which undergone basketball specific endurance circuit training for six week has significantly improved aerobic capacity 3.29%. Similarly, in CG 1.03% of improvement is elicited in aerobic capacity. The changes observed in the present study have been reported previously in basketball (Balabinis, Psarakis, Moukas, Vassiliou and Behrakis, 2003) and soccer players (Helgerud, Engen, Wisloff and Hoff, 2001). The changes elicited in the present study found to be lower than the 7.5 to 9% increases in VO_{2peak} observed in soccer players following eight to ten-weeks of performing a similar sport-specific aerobic endurance training circuit compared to control group (Chamari *et al*., 2005; McMillan, Helgerud, Macdonald and Hoff, 2005). Sports specific endurance circuit training results in increase capillary and mitochondrial density, enzyme activity (creatine phosphokinase and myokinase), metabolic stores (ATP, Creatine phosphate and glycogen), connective tissue strength (ligament and tendon) (Baechle and Earle, 2000; Amigo *et al*. 1998). These factors result in slight improvement in aerobic capacity in male high school basketball players.

In contrast to aerobic capacity, TG showed no changes in Peak anaerobic power as a result of sports specific endurance circuit training on male high school basketball players. Previous research suggests that aerobic endurance training can interfere with the development of strength and this could potentially limit improvements in speed and explosive power (Bentley, Zhou and Davis, 1998; Dudley and Djamil, 1985; Glowacki *et al*., 2004). In the present study sports specific endurance circuit training did not reduce power related performance. This observation of no interference effect parallel the results of similar aerobic endurance training studies involving in soccer players (Helgerud, *et al*., 2001; McMillan, *et al*., 2005).

CONCLUSION

Sports specific endurance circuit training is effective in improving aerobic capacity and maintains vertical jump performance of high school male basketball players during competitive phase.

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