Research Article

Effect of basketball specific endurance circuit training on the heart rate of high school male basketball players

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Abstract

The purpose of the study was to evaluate the effectiveness of a basketball specific endurance circuit training on the heart rate of high school male basketball players. To achieve the purpose of the study 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 students were randomly distributed into two groups namely basketball specific endurance circuit training group (N=12) and control group (N=12). The mean age of the selected players was 16.85 ± 0.67. Resting and exercise heart rate were selected as criterion variables. Exercise heart rate was measured during multistage fitness test using polar heart rate monitor. The basketball specific endurance circuit training was administered 3 days per week for six weeks. They performed 2 minutes of work at 90 to 95% of targeted heart rate using the Karvonen method. They performed 8 repetitions during the first and second week, followed by 10 repetitions during the third and fourth week and 12 repetitions during the fifth and sixth week of training. This was followed by 2 minutes of active resting at 60 to 70% of targeted heart rate. In this study 1:1 work rest ratio was followed. Both the groups were tested before and after training, the collected data was analysed using ANCOVA. The result of the study showed that resting heart rate and exercise heart rate between the groups was significant, indicating a significant difference between the two groups on post-test scores. The findings of the study show that significant decrease in resting and exercise heart rate. It can be concluded that basketball specific endurance circuit training is effective in improving the cardiovascular fitness of male high school boys during competitive phase.

Keywords : Grip strength, Grip dynamometer, Cricket, Handball and ANOVA

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 defeats.

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 and 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

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was employed. This incorporates skills and movements specific to the sport, at intensities sufficient to promote aerobic adaptations, are being increasingly implemented in the 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 *et al.,* 1996). The purpose of the study was to evaluate the effectiveness of a basketball specific endurance circuit training on aerobic capacity and heart rate of high school male basketball players.

Methodology

Selection of 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, Tamil Nadu. These subjects were randomly distributed into two groups namely basketball specific endurance circuit training group (N=12) and control group (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 participation in the study to ensure that there was a of sufficient standard to be able to take part in fitness testing and training.

Variables and tests

Aerobic capacity, resting heart rate and peak heart rate were selected as criterion variables. Exercise heart rate was measured during the multistage fitness test by wearing polar heart rate monitor. Initially the resting heart rate was measured after 10 minutes of rest.

Design of the study

For the present study pre test – post test randomized group design (Thomas *et al.,* 2005) which consists of a control group (CG) and an experimental group (TG) was used to find out the effect of sports specific circuit training on the selected physiological variables. Equal numbers (twelve) of subjects were assigned randomly to all the groups. TG was exposed to training with a set of drills selected for specific purposes. The TG underwent training for a period of six weeks (42 days). The training sessions were conducted three days a week (i.e. Monday, Wednesday and Friday).

Collection of Data

All the subjects were tested on physio-logical 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 counter-balanced 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.

Sports specific circuit training

TG is supplemented with sports specific circuit training replaced the regular physical fitness activity. However, control group performed regular physical activity. 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 weeks. The TG performed 2minutes of work at 90 to 95% of targeted heart rate using the Karvonen method. They performed 8 repetitions during the

first and second week, followed by 10 repetitions during the third and fourth week and 12 repetitions during the 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 adopted 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 basket-ball was dribbled, was 55.6% while 44.4% was considered 'defensive' activity without the ball. Three layups, three rebounds, seven vertical jumps, one pivot and 20 changes of direction were completed during one repeat of the circuit.

The 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 fig.- 1.

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 lay-up; 15 collect the rebound; 15-16-15 speed dribble with complete lay-up; 15 collect the rebound; 15-17-15 speed dribble with complete lay-up; 15 collect the rebound; 15-18 run and place the ball in basket; 18 throw the medicine ball; 18-19-20 forward sprint.
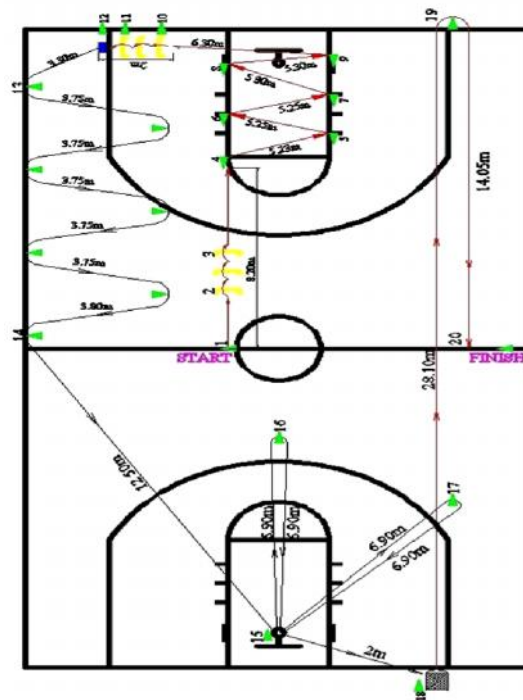

Fig.-1. Basketball specific circuit training

Statistical analysis

The collected data were evaluated using Analysis of Covariance (ANCOVA). The proposed hypothesis was tested at 0.05 level of confidence. SPSS statistic software package (SPSS Company, America, version 17.0) was used. The α value of 0.05 was set for statistical significance.

Results

Table 1 clearly shows that aerobic capacity, resting heart rate and peak heart rate between the groups was significant, it indicate that after adjusting pre-test scores, there was a significant difference between the two groups on post-test scores on aerobic capacity, resting heart rate and peak heart rate. The findings of the study show that significant increase in aerobic capacity and decrease in resting and peak heart rate. The changes are presented in table - 1.

Discussion

In the present study, basketball specific endurance circuit training for six weeks has significantly decreased resting and exercise heart

Table – 1. Changes in aerobic capacity and heart rate

Variables	Groups	Pre-test	Post-test	% of changes	*F*
Resting HR (beats/min)	TG	55.66 ± 2.53	52.08 ± 2.23	6.43	28.05* (p = 0.000)
	CG	54.50 ± 2.57	54.75 ± 2.83	0.42	
Peak HR (beats/min)	TG	198.58 ± 3.57	192.33 ± 3.82	3.14	32.20* (p = 0.000)
	CG	197.08 ± 4.81	197.67 ± 3.22	0.29	

CG – Control Group ; TG – Treatment Group

rate. Resting heart rate refers to the number of times a heart contracts in one minute (beats per minute or BPM) while at complete rest. The normal heart rate depends upon age, gender and health and can vary greatly for both athletes and non-athletes. In general, a person's resting heart rate indicates their basic fitness level. The stronger the heart, the more blood it can pump during each contraction, and the less frequently it needs to beat to get adequate blood flow (circulation) and oxygen to the body tissues. A well trained athlete can have a very low resting heart rate and pump more blood than an unconditioned individual. In the present study TG showed 3.58 beats/min changes is elicited. The percentage reduction in resting heart rate between pre to post was 6.48%. These changes are elicited as a result of sports specific endurance circuit training imparted to the high school male basketball players. The amount of blood pumped out of the left ventricle of the heart with each contraction is called the stroke volume. Although some conditions can affect a person's stroke volume, endurance and high intensity cardio-vascular exercise training often increases stroke volume (Bonaduce *et al.* 1998). A larger stroke volume results in a lower (resting) heart rate (Nottin *et al.* 2002). However, longer diastole influences the resting heart rate in athletes (Nottin *et al.* 2002).

In this study TG showed 3.14% (6.25 beats /min) reductions in peak heart rate. These alterations are caused because of sports specific endurance circuit training which resulted in improvement of aerobic capacity. Heart rate increases in parallel with increasing exercise intensity. Heart rate is stimulated to increase through the activation of mechano-, chemo- and baroreceptors sending afferent signals to the cardiovascular control centre in the brain. This in turn adjusts sympathovagal balance to the SA node bringing about a change in HR. At the onset of exercise, there is a rapid increase in HR. Due to its speed of response, this is suggested to arise through a withdrawal of parasympathetic modulation which enables the HR to increase up to the intrinsic rate of approximately 100 beats/min. Thereafter, any increase in HR is stimulated through an increased sympathetic modulation. Increased sympathetic cardiac modulation is evident from approximately 25% peak VO_2 onwards and by the time exercise reaches an intensity of 50–60% of peak VO_2, data suggest that vagal modulation disappears all together. Very few studies have reported the dynamics of autonomic control of HR during exercise in children. Those studies that have been performed report similar findings to those observed in adults. Due to training adaptations these changes are found in the present study.

Conclusion

Basketball specific endurance circuit training is effective in improving the cardiovascular fitness of male high school boys during competitive phase.

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