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Effect of handball specific aerobic training on body composition and VO_2 max of male handball players

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Abstract: The aim of this study is to assess the effect of four and eight weeks small-sided handball game on body composition and VO_2 max of male handball players. Sixteen (16) male university handball players volunteered to act as subjects and were randomly assigned to small-sided handball game group (SSHG) and control group (CG). Small-sided handball game was administered three days in a week for eight weeks. Subjects were measured on percent body fat, lean body mass and VO_2 max on three occasions first before administration of training as pre-test, after four weeks of training as mid test and after eight weeks of training as post-test. A two-way repeated measure ANOVA with last factor repeated revealed that percent body fat and lean body mass remained unaltered after four and eight weeks of training. However, VO_2 max improved ($p<0.05$). VO_2 max showed an improvement of 4.75% after four weeks and 8.83% % after eight weeks of small-sided handball game training in male handball players. This study shows that small-sided handball game (4 vs. 4) is effective in improving aerobic capacity in four and eight weeks of training but body composition elicited no changes.

Keywords: percent body fat, lean body mass, handball, small-sided game, VO_2 max

Introduction

Handball is fast and body contact sports which require both aerobic and anaerobic endurance [1,2]. Players with high level of aerobic and anaerobic endurance enable them to perform quick action and sprints without getting fatigue, which have a crucial impact on match results.The game handball composed of repeated sprint of players for fast breaks and quick counter attacks which require great aerobic capacity. The players with greater aerobic capacity tend to show lower fatigue index which show negative correlation in handball players [3].

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

Successful competition in sports has been associated with specific anthropometric characteristics, body composition and somatotype [4]. In team sports, special attention has been paid on the morphological characteristics of Olympic athletes at the expense of national level athletes. The success of an athlete depends a lot on the body type. Body size, build, and body composition can impair or help performance. Athletic performance relates to body type (body shape and size), and body composition (muscular development and amount of body fat). Body fat contributes no strength advantage and limits endurance, speed, and movement through space [5].

Today coaches use various conditioning skills among, skill based conditioning is prescribed to all level players, because this type offers many benefits. One of the benefits of implying this type of training is the combination of sports specific skills and fitness. According to Bompa (1983) [6] maximum benefits are achieved when the training stimuli are similar to competitive demands. In order to reproduce similar playing situation as that of real match play [7-9], coaches often use small-sided game (SSG) in their training programs. SSG which are very popular in soccer, basketball, handball and rugby, where players use smaller play area and less number of participants during small-sided games, each player comes into contact with the ball and deals with common game situations more often [10]. These situations require good technical skills such as passing, dribbling, feinting and shooting as well as tactical skills such as running without the ball, unmarking and cooperation with other players. The advantages of this training ensure the players to perform optimally during a game. This study attempts to find the effect of small-sided handball game for short duration on university male handball players. Therefore, the aim of this study is to assess the effect of four and eight weeks small-sided handball game on body composition and VO_2 max of male handball players.

Methods

Subjects

Sixteen (16) university level handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram, Tamilnadu, India. The selected subjects represented Annamalai University in Indian University Competition. The selected handball players age 22.12 ± 3.22 years; height 174.50 ± 7.83 cm and weight 65.62 ± 7.79 kg. These players have minimum of eight years of playing experience and gave willingness to take part in the study.

Study design

The subjects were randomly assigned to two groups. Group 1 (n = 8) performed handball specific aerobic training while Group 2 (n=8) served as control group. Testing of each group was

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

performed on three occasions first before administration of training, after three weeks of training and after six weeks of training.

Variable and test

Body composition

Measuring percentage of body fat by taking the 'skinfold' thickness at selected points on the body with a skinfold calipers. Skinfold caliper and measuring tape were used for assessing skinfold thickness. The skinfold measurements were taken from three to nine anatomical sites, that too only on the right side of the body. In this study, four sites (abdominal, triceps, thigh and suprailliac) as proposed by Jackson and Pollock (1985) [11] was considered. The tester pinched the skin at the appropriate site to raise a double layer of skin and the underlying adipose tissue, but not the muscle. The calliper was then applied 1 cm below and at right angles to the pinch, and a reading in millimetres (mm) taken two seconds later. The mean of two measurements was taken. whenever the two measurements differed greatly, a third was done, and then the median value was taken.

Abdominal:

A mark was made 5 cm adjacent to the umbilicus (belly – button), to the right side. Then a vertical pinch was made at the marked site, and the caliper placed just below the pinch.

Triceps:

A mark was made at the mid-upper arm, midline of the posterior aspect of the arm over the triceps muscle, measured with the elbow bent at 90°, used for identifying the biceps and triceps SFT. During the measurement, the arm was hang down freely by the side, palms inwards towards the thighs.

Thigh:

The mid-point of the anterior surface of the thigh, midway between patella and inguinal fold was marked. After making anterior thigh landmarks, a vertical pinch was taken. This measurement was taken with the subject in sitting position and the knee bent at right angles.

Suprailliac:

It was marked a centimetre above the anterior superior iliac spine in the mid-axillary line. The measurement was done horizontally when the subject breathed gently.

Formula to Calculate

Percentage of body fat was calculated using the following equation of Jackson and Pollock (1985) [11]:

- **Percent body fat = {**(0.29288 x sum of skinfolds) – (0.0005 x square of the sum of skinfolds) + (0.15845 x age) – 5.76377}
- **Fat Weight =** Body mass (kg) × (Percent body fat/100)
- Lean body mass = **Body mass – Fat weight**

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

VO_2 max

The VO_2 max of handball players was measured through Yo-Yo intermittent recovery test level II. The players were administered with ten minutes of warming up. Then players were asked to line up in front of twenty meter marked area with cones. The tester instructs the subjects to run half way and return to the starting point when the sound signal produced from music player. The tester keeps recording the distance covered by the players. We used formula for estimation of VO_2 max = distance in meter × 0.0136 + 45.3 [12].

Handball specific aerobic training

Handball specific aerobic training will be performed 3 days per week for six weeks. They perform 4 repetitions of high intensity game with duration of 4 minutes with intensity of 90 to 95% of HRmax and 4 minutes of active recovery with intensity of 60 to 65% of HRmax they performed handball passing drills. The players were strapped with polar heart rate monitor and exercise heart rate were fixed and if they perform below or above the fixed range it produces the beep sound alert the players.

Rules

The coaches encourage the players to perform activity of high intensity. In this training 4 players play against 4 players at high intensity in a standard handball court of 40 × 20 meters. In order to play at high intensity we simplified handball rules in order to avoid interruption in the game and increase the exercise load. The rule modifications are a) dribbling and defence contacts are not allowed, b) walking, ball hitting below the knee of court player and illegal dribbles were not penalised, c) goal keeper throw was granted immediately after a goal, d) goal will not be validated unless all four players present in the opponents court at the time of goal, e) ball will be replaced immediately when it is thrown out of the playing area, f) throw in administered immediately without delay, g) penalty throw, substitutions, warning and disqualifications were not granted, g) goalkeepers were instructed to remain inside goalkeeper area during the entire duration.

Statistical technique

A two-way repeated measure ANOVA with last factor repeated was applied to examine the difference in body composition and VO_2 max between groups and testing conditions. When interaction is significant simple effect was applied and Scheffe S post hoc test was applied to the difference between different testing conditions. All the statistical tests were calculated using the statistical package for the social science (SPSS) for windows (Version 16). The level of statistical significance was set at $p < 0.05$.

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

Results

The following section details the results pertaining to body composition and VO_2 max of handball players. The mean changes in percent body fat, lean body mass and VO_2 max, after four weeks of training and after eight weeks of training in SSHG and CG (Figure 1, 2 & 3).

Figure 1. Mean and standard deviation of SSHG and CG on percent body fat.

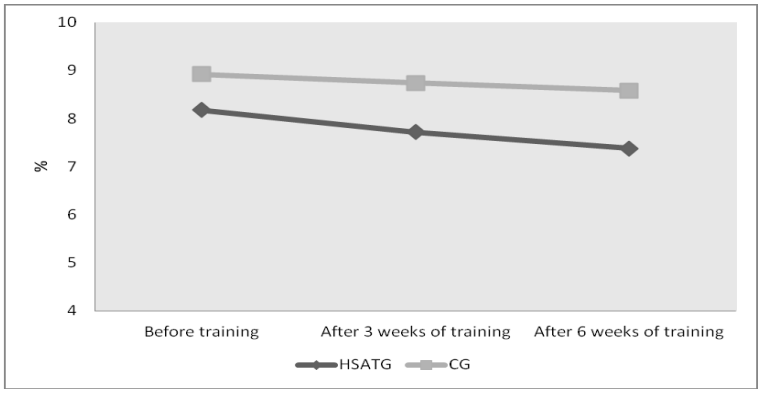
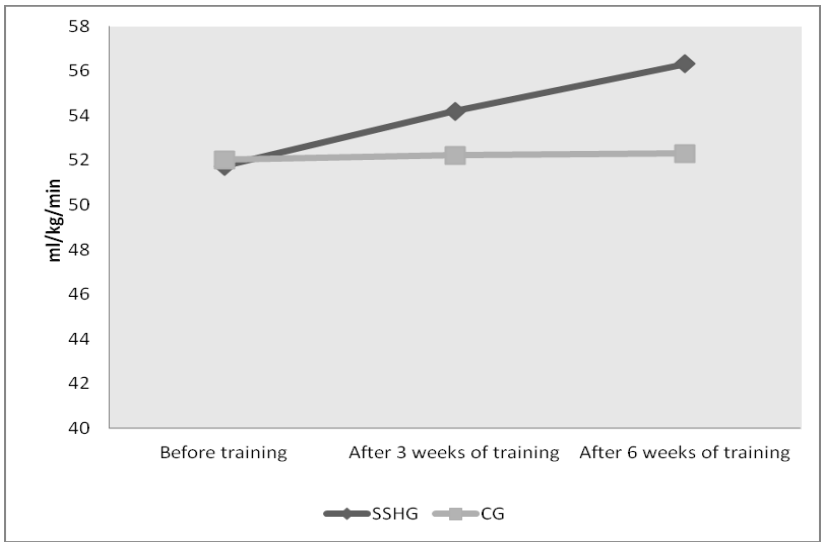


Figure 2. Mean and standard deviation of SSHG and CG on lean body mass.

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

Figure 3. Mean and standard deviation of SSHG and CG on VO_2 max.



Percent body fat

The two – way repeated measures ANOVA revealed no significant main effect for groups (F = 0.46, p = 0.508), different testing conditions (F = 1.913, p = 0.085) and interaction effect (F = 0.83, p = 0.445). This shows that small-sided handball game has no effect on lean body mass after four and eight weeks of small-sided handball game.

Lean body mass

The two – way repeated measures ANOVA revealed no significant main effect for groups (F = 0.06, p = 0.800), different testing conditions (F = 1.890, p = 0.170) and interaction effect (F = 2.76, p = 0.080). This shows that small-sided handball game has no effect on lean body mass after four and eight weeks of small-sided handball game.

Aerobic Capacity

The two – way repeated measures ANOVA revealed a significant main effect for groups (F (1, 14) = 8.39, p = 0.000), different testing conditions (F (2, 28) = 65.40, p = 0.000) and interaction effect (F (2, 28) = 51.36, p = 0.000). It also clearly show a significant differences between the groups after four and eight weeks of training, where SSHG had greater aerobic capacity than CG. The Scheffe S post hoc test within SSHG displayed 4.75% (MD - 2.46 ml/kg/min) improvement after four weeks of training and 8.83% (MD - 4.57 ml/kg/min) after eight weeks of small-sided handball game training in male handball players. This shows that small-sided handball game has

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

large effect and which confirm that aerobic capacity improved after four and eight weeks of small-sided handball game.

DISCUSSION

In the present study the results have elicited no changes in the body composition of handball players due to handball specific aerobic training. The percent body fat level of the handball players were to the optimal level and tend to reduce but statistically significant difference was not elicited. Earlier studies had proved that high intensity endurance training significantly reduce the percent body fat level. However, the duration of the training and training intensity was not sufficient enough to bring desirable changes in body composition.

In the present study handball specific aerobic training for four and eight weeks duration resulted in significant improvement on aerobic capacity of male handball players. This game based training results in significant improvement in aerobic capacity by 8.83%. Earlier, Chittibabu (2013) [13] in his study showed that handball specific repeated sprint training for eight weeks is more effective in increasing aerobic capacity of men handball players. The training load adopted in repeated – sprint training with game specific which resulted in 11.79% of changes in aerobic capacity.

In the present study skill based conditioning games was used which constituted both handball specific skills and fitness. The high intensity game and active recovery facilitate to improve aerobic capacity of male handball players. Similarly, Helgerud *et al*. (2001) [14] proved that aerobic power has been shown to improve in soccer players. Similarly, Coutts and his colleagues (2010) [15] clearly state that game based training improves both fitness and skill. The present study clearly shows that 4 weeks of training resulted in 4.75% of improvement and 8.83% after eight weeks of training. This clearly shows that short duration of this training can improve aerobic capacity of male handball players. The improvement in aerobic capacity due to SSHG occurs due to increase in maximal cardiac output, resulting primarily from improved stroke volume [16].

CONCLUSIONS

In Conclusion, the result from the present study suggests that small-sided handball game (4 vs. 4) is effective in improving aerobic capacity in four and eight weeks of training but body composition remained unaltered after four and eight weeks. This suggests that smalls sided handball game training is efficient enough to run without getting fatigue during a match.

ISSN: 2277: 5447 | Vol.3.No.4 | December 2014

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