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RESEARCH ARTICLE

CHANGES OBSERVED ON EXERCISE HEART RATE OF MALE HANDBALL PLAYERS DURING A HANDBALL MATCH

***Chittibabu, B.**

Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram – 608002, Tamilnadu, India

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ABSTRACT

The study was proposed to investigate the changes observed on exercise heart rate of male handball players during a handball match. We selected twelve (12) university represented male handball players from Department of Physical Education and Sports Sciences, Annamalai University, Tamilnadu. However, in the present study goalkeepers were excluded from the study. The players exercise heart rate was measured at every 15th minute during the 60 minute handball match. The results of the study show that peak heart rate of handball players was significantly affected during the handball match as F (3, 33) = 3.071, $p < 0.05$, $\omega^2 = 0.38$. Similarly, mean heart rate of handball players was significantly affected during the handball match as F (3, 33) = 3.300, $p < 0.05$, $\omega^2 = 0.40$. It is concluded that handball players peak heart rate and mean heart rate was affected moderately during the handball match.

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INTRODUCTION

Handball is a fast body contact Olympic team sport that requires greater amount of fitness among which upper and lower extremity explosive power plays a vital to throw, jump and sprint frequently during a hard fought sixty minutes handball match. To achieve this players are exposed to various types of training modes either individual or combined form during preparatory and competitive phase of training. When the players are exposed to strength training would enhance both upper and lower extremity strength which in turn improves the throwing performance, jumping and sprinting ability (Chelly *et al*., 2014, Hermassi *et al*., 2011, Cherif *et al*., 2012). The importance of fitness analysis during a game can elicit the weakness and strength of the players based on which the training programme can be administered. Along with this coach has to understand the nature and demand of the game. It has been proved that handball game is of intermittent nature, so high anaerobic fitness produce high level of explosive strength. Simultaneously, players must have high aerobic fitness to enable quick recovery. The game includes numerous repetitive actions like full speed running, changes in speed and direction, jumping, throwing and collisions between players (Marques *et al*., 2007). Earlier several methods have been used for evaluating the physiological demands of players in competitive situations.

Corresponding author: Chittibabu, B.
Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram – 608002, Tamilnadu, India.

The physiological responses during a match play have been previously examined with the analysis of the blood lactate, core and muscle temperatures, depletion of muscle glycogen stores and heart rate (Bangsbo 1994; Buchheti 2008; Ekblom 1986; Eniseler 2005; Helgerud *et al.,* 2001; Stølen *et al.,* 2005; Stølen, *et al.,* 2004). The study was proposed to investigate the changes observed on exercise heart rate of male handball players during a handball match.

MATERIALS AND METHODS

Subjects

We selected twelve (12) university represented male handball players from Department of Physical Education and Sports Sciences, Annamalai University, Tamilnadu. The selected handball player's age were 22.12 ± 3.22 years; height 174.50 ± 7.83 cm and weight 65.62 ± 7.79 kg. However, in the present study goalkeepers were excluded from the study and number of players based on position was considered as limitation of the study.

Variables and test

The peak and mean heart rate recorded during the match was selected as criterion variables. The heart rate was recorded through Polar heart rate monitor which consisting of a transmitter and a wrist watch. The subjects wore Polar heart rate monitor and played the handball match. The electrical

signal transmitted through the heart muscle by the heart was detected at the skin by the transducers and those electromagnetic signals containing heart rate data were sent by the transmitter to the watch wore at the wrist by the subjects for the display of heart rate. The number of heart beat per minute at the moment the exercise testing was terminated, was recorded as displayed in the Polar watch.

Collection of data

The data was collected during every 15 minutes during 60minutes handball match. Monitoring the exercise heart rate of handball players was performed between 07:30 to 08:50 am, during a handball match organised prior to south zone inter university handball tournament during the month of September 2014. The exercise heart rate data were obtained at 15th minute, 30th minute, 45th minute and 60th minute. At each data collection time 1 minutes break was granted to collect.

Statistical technique

The data collected on exercise heart rate was statistically analysed to examine the changes. The one-way repeated measure ANOVA was applied to examine the difference between testing conditions on handball players. When the F was significant Bonferroni post hoc test was applied which control the Type I error. 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 $p < 0.05$.

RESULTS

Peak heart rate

The data on peak heart rate of the handball players was analysed and the results thus obtained was tabulated and given in Table 1.

Table 1. Means and standard deviations on peak heart rate of handball players

First half		Second half			
15 min M ± SD	30 min M ± SD	45 min M ± SD	60 min M ± SD	F	df
187.75 ± 7.59	179.50 ± 12.04	180.08 ±13.58	179.42 ± 11.38	3.071*	3,33

* ($p < 0.05$)

Mauchly's test indicated that the assumption of sphericity had not been violated, χ^2 (5) = 9.878, $p > 0.05$, therefore degrees of freedom was not corrected. The results show that peak heart rate of handball players was significantly affected during the handball match as F (3, 33) = 3.071, $p < 0.05$, $\omega^2 = 0.38$. Handball players peak heart rate was affected moderately during the handball match. Since the obtained F value (3.071, $p = 0.041$) is significant post hoc test was applied. Bonferroni post hoc test revealed no significant difference on the peak heart rate comparisons (all ps > 0.05). This clearly show that peak heart rate of handball players drastically reduced in last 15 minutes of the first and second half of the handball match.

Mean heart rate

The data on mean heart rate of the handball players was analysed and the results thus obtained was tabulated and given in Table 2.

Table 2. Means and standard deviations on mean heart rate of handball players

First half		Second half			
15 min M ± SD	30 min M ± SD	45 min M ± SD	60 min M ± SD	F	df
165.58 ± 15.79	157.83 ± 11.08	161.42 ± 14.63	157.08 ± 14.94	3.300*	3,33

* ($p < 0.05$)

Mauchly's test indicated that the assumption of sphericity had not been violated, χ^2 (5) = 4.646, $p > 0.05$, therefore degrees of freedom was not corrected. The results show that mean heart rate of handball players was significantly affected during the handball match as F (3, 33) = 3.300, $p < 0.05$, $\omega^2 = 0.40$. Handball players mean heart rate was affected moderately during the handball match. Since the obtained F value (3.300, $p = 0.032$) is significant post hoc test was applied. Bonferroni post hoc test revealed no significant difference on the mean heart rate comparisons (all ps > 0.05). This clearly show that mean heart rate of handball players considerably reduced in last 15 minutes of the first and second half of the handball match.

DISCUSSION

The mean and peak heart rate was affected moderately during the handball match ($p < 0.05$). The players heart rate was measured for every fifteen minutes and altogether it was calculated for 60 minutes with mean heart rate of 160.48 ± 3.89 beats.min^{-1} and peak heart rate of 181.69 ± 4.05 beats.min^{-1}. These players displayed higher values of mean and peak heart rate during first fifteen minutes of handball match (165.58 ± 15.79 beats.min^{-1} and 187.75 ± 7.59 beats.min^{-1}) and lower at last fifteen minutes 157.08 ± 14.94 beats.min^{-1} and 179.42 ± 11.38 beats.min^{-1}). The range of mean and peak heart rates reported previously in handball with respect to playing position on elite female handball players (Michalsik, Madsen and Aagaard 2014). It is well known that monitoring heart rate is reliably used to estimate the relative intensity of an exercise and to quantify training loads. So when considering the stress imposed on heart during handball match was lower when compared to similar studies, such as Platen and Manchando (2011), Belka *et al*. (2014) and Souhail *et al*. (2010). In the present study data was obtained in a single match, similarly Platen and Manchando (2011) obtained data from a single match. Match analysis studies showed that mean and peak heart rate was found to be high in first half when compared to second half but they fail to narrate the exact changes within first half and second half. In our present study the mean and peak heart rate found to be high in first 15 minutes and low at last 15 minutes. The drop in mean and peak heart rate may be due to reduction in number of runs in the last 15 minutes (28.33% to 26.73%) along with that execution of free throw and penalty throws which may also be a reason for reduction in mean and peak heart rate, similar result was obtained in

Mclnnes *et al*. (1995). Extra care was taken before interpreting the result because heart rate can be affected by several factors which are not considered in this study. These include nutrition, hyperthermia, dehydration, many psychological factors, such as anxiety and motivation and performance. Conflicting results have been reported in the literature, showing either a significant decrease or no change in heart rate between the first and the second half of games in various team sports (Bangsbo and Lindquist 1992; Coutts *et al*. 2003).

We conclude that the heart rate responses of the subjects indicate that participation in handball places considerable demands on the cardiovascular system. Substantial decreases in the heart rate values were only evident during stoppages in the game due to free-throws, penalty throw, throw in, throw off and time-outs. The peak and mean heart rate of the players remained fluctuated during handball game as a result of reduction in running time. It is also clear from this study that this study demonstrate greater utilization of aerobic metabolism in playing competitive handball which also undergoes alterations.

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