Using Heart Rate Monitor to Optimizing Aerobic Endurance Training

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Abstract: This study aims to determine whether aerobic endurance exercises using heart rate monitoring technology (heart rate monitor) is more optimal than without using heart rate monitor. A total of twenty male football athletes who join in university football club participated in this experimental study. With the randomized pretest-postest control group design the sample was divided into two groups, treatment group (n = 10) and control group (n = 10). Both groups followed a jogging aerobic endurance training program. The time for each training session varies from 45 minutes to 90 minutes, for 11 weeks, 3 times a week. VO2max is measured by Cardiopulmonary Exercise Test by gas analysis method. The results showed that there was a difference of VO2max increase between treatment group and control group.

1   INTRODUCTION

Football is a popular sport worldwide, where football players need engineering, tactics and skills to succeed in the sport. The research also focuses on Techniques and tactics so that research on physical conditions such as strength, speed and endurance is a little bit marginalized.

Based on the duration of the game, football includes a sport that relies heavily on aerobic metabolism. The average work intensity, measured as percent of the maximal heart rate (*fcmax*), during a 90-min soccer match is close to the lactate threshold (LT), or 80-90% of fcmax (Stølen, 2005). That way the most basic physical condition component in football is aerobic capacity. A football player (male adult) must have a VO2max between 50-75 mL • kg-1 • min-1 (Stølen, 2005). The challenge for trainers is how to increase aerobic capacity of a player during one stage of certain exercise periodization. Various training methodologies were developed by experts to address such challenges, such as High-Intensity Training, which can increase VO2max 5% -10% (Iaia et al., 2009), other studies of the same method may increase in VO2max from 60.5 to 64.4 mL • kg-1 • min-1 and 55.5 to 60.4 mL • kg-1 • min-1 (Helgerud, 2001) Other studies with Plyometric Training and creating supplementation may increase endurance in female soccer players (Ramirez-Campillo, 2015). In addition, Aerobic Interval Training can also increase VO2max from 50.89 + 3.04 to 53.11 + 3.01 (Honceriu and Trofin 2014). Furthermore, using Tabata Exercise may increase VO2max from 37.7 mL / (kg • min) to 40.5 mL / (kg • min) (Imanudin and Sultoni 2017).

One of the keys to successful exercise methods for increasing aerobic capacity is by controlling the intensity of exercise (Helgerud, 2001). The intensity of exercise can be monitored by heart rate variability (Fletcher, 2008). With the controlled heart rate of the athlete, the coach can more easily make a more measurable and controlled exercise program (O'Donovan and Denis, 2008). However, studies that optimize the use of heart rate monitors in exercise are limited, especially at the stage of certain exercise periods. An annual training program is an important tool or grip for trainers to serve as a guide in planning a year's exercise or for a certain period of time. In order for the program to be functional and beneficial for athlete development, the annual training program plan should be based on the concept of periodic and practice principles (Bompa 1999; Bompa 2006; Bompa and Carrera 2005; Bompa and Haff 2009; Bompa and Buzzichelli 2015).

The general preparation stage is the first stage of the period. At this stage the athlete's physical condition starts to be built, including the aerobic capacity. But the trainers should be careful in

establishing the physical condition of the athlete at this stage. The thing to note is that the athlete's ability should be up to the target of the stage. Often the peak performance is achieved before the game. It is because athletes are trained with too heavy training loads and less given the opportunity for regeneration (fully recovered). On the contrary often the top achievement is achieved after the game is due to the too light exercise.

Therefore, the purpose of this study is to see the optimization of heart rate monitor in endurance training to improve aerobic capacity soccer player.

2 METHODS

The research design that will be applied by the researcher is the design of Randomized Pre-test and Post-test Control Group Design. The sample of research that will be taken is the students who joined in sports activity unit of student soccer achievement of 20 male (+19,3 YO). By random assignment sample is divided into two groups, treatment group (N = 10) and control group (N = 10). Both groups undergo the training process in accordance with the training program that has been prepared. Before and after the training process is done testing to compare the results of Aerobic ability improvement.

2.1 Training Protocol

The endurance training was administered as an extension of the regular training, twice per week over an 8-wk period. A regular week of training consisted of four times 1.5 h of practice and one game. All players in the Treatment Group are hired HRM in the form of a censor tire. HRM that is used during the exercise program is Polar RC3GPS which has the ability to record and track heart rate, speed, route and running time of the athlete.

2.2 Measurement

Research instruments used to determine Aerobic Capacity, i.e. Aerobic Ability measured through Cardiopulmonary Exercise Test with gas analysis method (Levett and Grocott 2015). The test protocol used to measure VO2max is to use a 12 km/h protocol.

Table 1: Descriptive data of VO2max pretest posttest tg and cg.

	TG (N = 10)		CG (N = 10)	
	Pretest	**Postest**	**Pretest**	**Postest**
VO_{2max} $(mL \cdot kg^{-1} \cdot min^{-1})$	47.31(7.19)	54.50(5.64)	47.10(4.15)	51.36(4.75)

The descriptive data of VO2max for both treatment and control group are shown in Table 1.
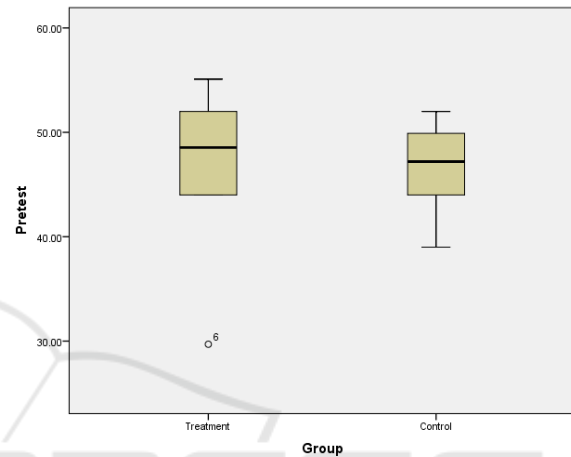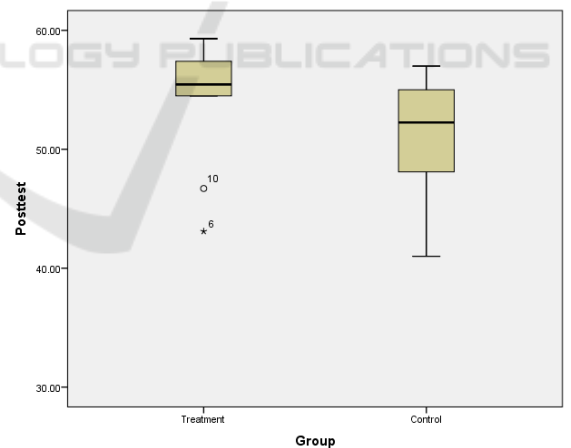

Figure 1: Mean VO2max for pretest.

Figure 2: Mean VO2max for posttest.

Figure 1 and Figure 2 present VO2max average data at pre-test and post-test between treatment group and control group. Based on figure 1, it can be concluded that both groups, treatment and control groups, have increased VO2max score. But on Post-test data Figure 2 it is seen that the mean VO2max treatment group is higher than the control group.

3   RESULTS AND DISCUSSION

In addition, the standard deviation score of the two groups VO2max has a different tendency, where the standard deviation in the treatment group is more tightly than the control group. It is interesting to see the treatment group when the pre-test averages its VO2max is 47.31 and when the post-test average VO2max increases to 54.50. After tested with paired sample t test statistic there is significant difference between pre-test and post-test data on TG with value $P = 0.000$ ($P < 0.01$). In the HR treatment group they are monitored by the trainer so that the intensity of the training provided by the trainers is tailored to their respective abilities. That way the VO2max increase can be achieved significantly. When seen stdevnya on pre-test is 7.19 and it decreased to 5.64 at the time of post-test. This can happen because the player whose VO2max is still low will increase drastically, while the player whose VO2max is already high will not be drastic (Stølen, 2005), so stdev VO2max on post-test will be close to each other.

To see the difference of influence of the use of HRM with the control group was done independent statistical test sample t test on post-test data between TG and CG. The results show that there is no significant difference $P = 0.195$ ($P > 0.01$).

Based on the results of data analysis, it appears that the use of HRM in endurance aerobic exercise is more optimal in improving aerobic capacity. This is because when a football player using HRM to control the intensity of the exercise will be easier for himself to determine the speed of running. When the heart rate shown at the polar clock is too high beyond the heart rate of the training target at that point then the practicing player will reduce the running speed so that the expected workout intensity is achieved. In contrast to players who practice without HRM, which controls their speed only by intuition or estimate only. While in the training period, a practicing person must adhere to the intensity of the planned exercise (Bompa 1999; Bompa 2006; Bompa and Carrera 2005; Bompa and Haff 2009; Bompa and Buzzichelli 2015).

4   CONCLUSIONS

Endurance is the main physical condition that must be owned by soccer players. Football players need to improve their aerobic capacity at the general stage of the training period. Players will be more optimal in training their aerobic capacity if it controls heart rate by using heart rate monitor when practicing.

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