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Effect of active and passive recovery on blood pressure and heart rate in male athletes

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ABSTRACT

Recovery is one of the most important stages of training. Lack of recovery makes the athletes not to benefit enough from exercises. The purpose of the present study was to investigate the effects of active and passive recovery on systolic and diastolic blood pressures, and heart rate in male athletes. 20 young volunteer athletes were assigned in active recovery (n=10) and passive recovery (n=10) groups. Subjects performed cooper test. Subjects' blood pressure and heart rate were measured immediately after the test, and 20 minutes after the test. Data analysis was performed using dependent and independent T- test. Findings showed that there were significant differences in heart rate and systolic blood pressure values between active and passive recovery groups between the two stages, immediately after and 20 minutes after the test (p=0.0001). There were no significant differences in diastolic blood pressure values at the two stages. Also no significant differences in blood pressure and heart rate between groups were observed. Results showed that there were no significant differences between passive and active recovery on systolic and diastolic blood pressures, and heart rate in athletes.

Key words: Active and passive recovery, Blood pressure, Heart rate, athletes.

INTRODUCTION

Athletes participating in competitive sports particularly at elite level are frequently exposed to exhausting training sessions two or three times a day. Failure to appropriately recover after intense training sessions may result in physiological and psychological stresses and consequently impairs performance and increases the risk of injury. Appropriate recovery after exercise decreases fatigue, accelerates the rate of physiological and psychological regeneration and improves fitness levels. Recovery can therefore be considered as a significant component of athletic training and performance. Active recovery process of re-establishing physiological resources and states that allow the athletes to use these resources again. It is very important to know the features of recovery and accelerated recovery processes. During the recovery process lost energy resources are reconstructed and re-established and this process continues [1-3].

Excessive volumes of intense exercise, particularly with inadequate recovery, can place great physiological demands on the nervous, immune, metabolic systems and musculoskeletal, potentially causing a negative effect on training and competition in professional athletes, and predispose some players to overload injuries [4,5], especially during a congested fixture period where players are required to compete and train repeatedly within a short time frame [6,7]. The capacity to recover from intense exercise considered an important determinant of subsequent performance. To facilitate the recovery, different post-exercise recovery modes have been suggested, classified into two categories: active and passive recovery. Active recovery may include submaximal physical activity and stretching training. In practice, active recovery strategies are used for the purposes of enhancing recovery during cool down protocols both

after training and competition in professional athletes [8,9]. The theoretical advantage reported that submaximal physical activity and stretching training establishes a greater blood flow to active muscles, prevents venous pooling in the muscles after exercise, improve restoration from metabolic perturbations and decreases muscle-damage [7,10,11].

During exercise, human body uses the circulatory and cardiovascular systems which are important physiological systems for athletes. These systems play a significant role in carrying ergogenic material to the limbs and excreting wastes from the body. Meanwhile, intensive and exhausting exercises not only deteriorate the performance of involved muscles, but also affect the functions of nervous system. Cardiovascular System responds differently to various kinds of exercises. Simple and non-invasive measures of investigating cardiovascular response include blood pressure and heart rate [12,13].

There is an established link between heart rate and cardiovascular health. Heart rate is a very important and easy-to-measure index of myocardial work. Heart rate response to exercise and it's falling during recovery are also very good markers for controlling heart autonomic nervous system. Heart rate change is a non-invasive factor of measuring cardiac autonomic system and is used as a factor of autonomic system [14,15].

The mechanisms contributing to heart rate changes at the start and during exercise have been well explored, but less attention has been paid to the events underlying the fall in heart rate after exercise. In recent years, this issue has had beneficial effects in assessment of different training regimens by athletic coaches. In some endurance training events falling heart rate due to exercise is of great importance [3,16,17]. According to the importance of knowing and understanding the characteristics of recovery and the ways to more quickly reach the rest, the effect of active and passive recovery on systolic and diastolic blood pressure, and heart rate in athletic men were studied as it can enable coaches and athletes to succeed in sport events.

MATERIALS AND METHODS

The subjects were 20 young athletes practicing in different sports teams in recent years to attend in provincial and national competitions. Subjects' characteristics are presented in Table 1. After selection, subjects were made aware of research topic, aims, methods and applications of the study. Subjects participating in the study signed a voluntary consent and medical health questionnaire. The criteria for participating in the study included general health, lack of a special diet and medication, being an athlete and having 18-30 years old. Qualified individuals were randomly assigned in active recovery (n=10) and passive recovery (n=10) groups.

Table 1- Participants' Characteristics

Parameter	active recovery	passive recovery
Age (year)	22.80±3.25	24.20±6.61
Height (cm)	182.80±8.27	174.50±5.08
Body weight (kg)	76.10±13.01	68.30±8.38
Body Mass Index (kg/m2)	23.03±1.94	22.49±3.03
VO_{2max} (ml/kg/min)	48.20±6.83	46.56±3.94

Height, weight and body mass index were measured before starting the main test. The initial blood pressure was measured by a mercury manometer (diplomat model, made in Germany) when the subjects were still sitting and leaning. Resting heart rate was measured by counting the rate of carotid arteries. Then the subjects ran around the football field in 12-minute Cooper test until exhaustion. Immediately after the test, blood pressure and heart rate were measured in both groups. The subjects participating in the active recovery group performed 20 minutes of active recovery (12 minutes of light jogging and 8 minutes of static stretching) and subjects participating in the passive recovery group were sitting idle. Finally, blood pressure and heart rate were measured after 20 minutes.

Statistical analysis was performed using SPSS version 18. Data normality was investigated using the Kolmogorov-Smirnov. Dependant t-test was used for within-group comparison and independent t-test was used for between-group comparison. The significance level of the test was considered $p \leq 0.05$.

RESULTS

Table 1 compares within-group variables. The findings showed that in active and passive recovery groups, heart rate and systolic blood pressure values between the two stages, immediately after, and 20 minutes after the test showed significant difference (p=0.0001). Diastolic blood pressure values were not significantly different between the two stages (p=0.615).

Table 3 compares the two groups based on measured averages. The results showed no statistically significant differences between groups.

Table 2. Comparison of within-group variables in both groups (Means±Sd)

Parameter	group	Post exercise	P value	group	recovery	P value
Systole (mmHg)	**active recovery**	139.20±6.40	0.0001	**passive recovery**	140.00±6.60	0.0001
		112.20±5.86			113.00±6.70	
Diastole (mmHg)		77.50±12.19	0.615		83.40±9.21	0.271
		79.40±6.73			76.40±10.12	
Heart rate (beats/min)		136.20±17.99	0.0001		140.80±10.96	0.0001
		100.10±10.96			104.50±11.13	

Table 3. Comparison of between-group variables in both groups (Means±Sd)

Parameter	phase	active recovery	passive recovery	P value
Systole (mmHg)	Post exercise	139.20±6.40	140.00±6.60	0.786
	recovery	112.20±5.86	113.00±6.70	0.780
Diastole (mmHg)	Post exercise	77.50±12.19	83.40±9.21	0.238
	recovery	79.40±6.73	76.40±10.12	0.445
Heart rate (beats/min)	Post exercise	136.20±17.99	140.80±10.96	0.449
	recovery	100.10±10.96	104.50±11.13	0.385

DISCUSSION

The present study was designed to investigate the effect of active and passive recovery on systolic and diastolic blood pressure values, and heart rate in male athletes. Research findings showed that systolic blood pressure in both active and passive recovery groups reduced significantly during the two stages; immediately after and 20 minutes after the test. The results were consistent with Guru et al (2013) and Arazi et al (2012) but did not match with Nikbakht et al (2012) and McMaster et al (1987). Increased systolic blood pressure is due to an increase in cardiac output which is itself along with increasing amount of working. Increased blood pressure helps to speed up the blood flow through vascular network. Blood pressure determines the amount of fluid leaving the capillaries into the tissue and delivers the materials required to it. Autonomic nervous system is activated during exercise, leading to different cardiovascular reactions such as increased cardiac output [20]. Possibly, after exercise completion autonomic nervous system reduces cardiovascular reactions and decreases cardiac output values; the process which active and passive recovery can accelerate.

Research findings showed that diastolic blood pressure in both active and passive recovery groups was not significantly different during the stages of immediately after and 20 minutes after the test. These research results were consistent with Kulandaivelan et al (2009) and Guru et al (2013), but did not match Arazi et al (2012) and Nikbakht et al (2012) findings. During exercise, diastolic blood pressure does not change significantly [22]. Diastolic blood pressure is less influenced by environmental factors and exercise and even small changes in diastolic blood pressure is dangerous for body systems, because most of the cardiac cycle relates to when the heart is resting, which is associated with diastolic blood pressure [22]. Reduction in diastolic blood pressure during exercise causes complete emptying of the left ventricle into the aorta (afterload reduction). This leads to increased cardiac output and decreased myocardial oxygen consumption. Also physical activity increases intra- thoracic pressure and reduces venous return to heart, accumulates blood in general blood circulation, and increases systolic blood pressure [24]. Probably one of the reasons for lack of significant changes in diastolic blood pressure values is due to decreased afterload; the body requires blood urgently, so active muscles' requirements are satisfied by an increase in systolic blood pressure and cardiac output and a reduction in oxygen consumption of heart muscle.

The results showed a statistically significant reduction in heart beat in both active and passive recovery groups between the two stages; immediately after and 20 minutes after the test. Research results were consistent with Javorka et al (2002) and Ramezanpour et al (2010) but did not match with Jougla et al (2010). Recovery should allow the next iteration to improve enough and keep exercise benefits; and heart rate should approach 120 beats per minute at the end of recovery. Recovery after exercise stimulates the brain which is responsible for heart rate rapid reduction. A decrease in body temperature and catecholamine are also effective in heart rate reduction after exercise. However; parasympathetic activation is known as a key mechanism to reduce the heart rate after exercise. Heart rate reduction during recovery in moderate to heavy exercises is usually known as an indicator of cardiovascular fitness. Autonomic nervous system is not known as a key factor in lowering the heart rate during recovery [25,28]. Parasympathetic activation after the test probably led to heart rate approaching the original values before exercise in both both groups.

CONCLUSION

Limitations of this study probably influencing the results, included the lack of control on intensity of recovery, lack of recovery time measurement, lack of control on diet, sleep, subjects' psychological state the day prior to study and subjects' differences in genetic factors. Given that the subjects in both groups were athletes participating in the same exercises and having the same sports background, it can be concluded that there is no significant differences between the two types of active and passive recovery in individuals' systolic and diastolic blood pressures and the heart rate.

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