The Effects of Exhaustive Exercise on Some Physiological Variables in Handball Players

Dr. Nawaf Alshammari

Associate Professor, Ph. D College of Basiuwaitc Education, Kuwait
dr.nawaf_@hotmail.com

Abstract: Objective: The objective of this study was to investigate the effects of exhaustive exercise on some physiological variables in handball players. **Materials and Methods:** Male handball players (n=10) and male non-athlete control group (n=10) were included. All Subjects executed standardized exhaustive test. Blood samples were collected at rest (baseline) and immediately after the test. Pulse rate and performance time were recorded and serum concentration of lactate (accusport), cortisol and testosterone (ELISA) were measured. **Results:** Following exhaustive exercise, pulse rate, blood concentrations of lactate, cortisol and testosterone and performance time were significantly increased in both handball players and control groups ($p< 0.01$). However, there were lower pulse rate, lactate, and cortisol levels ($p< 0.01$), whereas higher testosterone concentration and performance time ($p< 0.01$) among the handball players when compared to the control group. **Conclusion:** It is concluded that exhaustive exercise has a positive impact on fitness, anabolic state and performance ability.
[Dr. Nawaf Alshammari. **The Effects of Exhaustive Exercise on Some Physiological Variables in Handball Players.** *Nat Sci* 2017;15(6):122-125]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 13. doi:10.7537/marsnsj150617.13.

Keywords: Exhaustive exercise, pulse rate, lactate, cortisol, testosterone, performance time, Handball players.

1. Introduction

The endocrine system integrates the influences of diet and exercise on the remodeling process of the body and on the resulting athletic performance. In addition, exercise imposes demands on the body in two ways: first, mechanical load impose stress, strain and damage on working muscle, second, exercising muscle requires metabolic fuels from which they extract the energy to overcome these mechanical load ***(Anne Loucks, 2006).***

Ganong (2000) stated that the control of heart rate is mediated by the sympathetic and parasympathetic nerves. Heart rate is accelerated by some factors, such as inspiration, anger, excitement, painful stimuli, fever and exercise. Heart rate is slowed by expiration, fear and increased intracranial pressure. In general pulse rate correspond to heart rate and it can be used as fitness indicator.

Although for many years lactate was considered simply a metabolic byproduct of glycolysis, there are now convincing data that lactate is an important metabolic intermediate during and after exercise, being a substrate for oxidative metabolism in contracting skeletal and cardiac muscles and a gluconeogenic precursor. The concept of a lactate shuttle has been developed, and there is evidence in support of exchange of lactate between active and inactive muscle during exercise ***(Brooks, 2000)***.

Davies and Few (1993) found cortisol levels to be higher or lower than levels before exercise in proportion to the extent to which relative workhoods were greater or less than 60% of VO_2 Max. Testosterone increases muscle protein synthesis without having any effect on neither protein breakdown, nor does testosterone has any effect on the transport of amino acids into muscle fibers ***(Ferrando et al., 1998).***

The objective of this study was to investigate the effects of exhaustive exercise on pulse rate, performance time and blood concentrations of lactate, cortisol and testosterone in Handball players.

2. Materials and Methods

Ten male Handball players and 10 non-athletic and served as a control group were recruited in the present study. Characteristics of the Handball players and the control group are shown in table 1.

All participants were free from diseases and were randomly assigned to the study. All participants gave their informed consent before enrollment, and the study protocol was approved by the Health Science Department,. All experimental procedures were done in the Faculty of physical Education,.

All subjects performed an exhaustive exercise test until signs of fatigue are observed. These inlude sweating, pulse rate exceeding 150 /min., inability to continue exercise, and pain of the legs. The duration of exercise, i.e., performance time was registered for each subject including warming up to 5 min., and cooling down for 5 min. Blood samples were withdrawn using 10 ml plastic syringes before and within minutes after exhaustive exercise. Blood samples were collected under standadized conditions and at the same time point from all subjects (between 8-8.30 a.m.).

The weight in Kilograms divided by the square of the height in meters resulted in body mass index. Pulse rate was measured using pulse meter. Lactate concentration was assessed by accusport and testosterone and cortisol levels were determined using ELISA technique.

Statistical analyses

Paired Student's t-test was used to compare values among each group, whereas two samples with equal variance Student's t-test was used to compare values between Handball players and control group. P- Value <0.05 was considered significant.

3. Results

Results of characteristics of the Handball players and control one showed no significant difference of age, height, weight and body mass index (Table 1).

Before exhustive exercise, no siginficant difference was observed between both groups regard````ing the blood concentrations of lactate, cortisol and testosterone, howev``er the pulse rate of the Handball players was significantly less than the control group (p<0.01) (Table. 2).

Following exhustive exercise`` of the control group, all parameters of the study, i.e., pulse rate, and blood``` concentrations of lactate, cortisol and testosterone showed significant inc`rease (p<0.01). Similarly, all study parameters showed significant increase following exhustive exercise among the Handball players (p<0.01) (Table. 3,4).

The most obvious changes were se`en between both groups following exhustive exercise. The pulse rate and blood concentrations of lactate and cortisol were significantly lower among the Handball players when compared with the control group (p<0.01`). In contrast, blood concentration of testosterone and performance tim``e siginficantly increased among Handball players when compared with th``e control group (p<0.01) (Table. 5).

The pertcentage c```hange following exhustive exercise showed similar results in both groups, i.e., lower pulse rate and blood concentration of lactate and cortisol, whereas higher blood concentration of testosterone. The most striking change was the marked increase of lactate concentration exceeding 3 fold increase in both groups (Table. 6).

Table 1. Characteristics of the subjects.

Characteristics	Control n=10	Experimental n=10	Mean Difference	t
Age (yr)	19.13 ± 0.13	19.31 ± 0.43	0.18	1.27
Height (m)	182.30 ± 1.77	181.50 ± 1.43	0.80	1.11
Weight (Kg)	76.10 ± 1.79	75.00 ± 1.49	1.10	1.49
Body mass index	22.70 ± 0.16	22.60 ± 0.21	0.10	1.19

No significant difference between control and experimental groups was detected.

Table 2. Parameters of the study before exercise.

variables	Control n=10	Experimental n=10	Mean Difference	t
Pulse rate (beats per min)	73.80 ± 1.99	68.60 ± 2.68	5.20	4.93*
LA (mmol)	1.46 ± 0.21	1.30 ± 0.26	0.16	1.50
Cortisol (ng/dl)	13.23 ± 2.74	13.68 ± 2.32	0.45	0.40
Testosterone (ng/dl)	514.80 ± 8.82	521.70 ± 9.39	6.90	1.69

The experimental group showed significantly lower pulse rate in comparisone with the control group ($p < 0.01$).

Table 3. Parameters of the study before and after exercise among control group (N = 10).

variables	Mean before	Mean after	Std. Deviation	Mean Difference	t
Pulse rate (beats per min)	73.80	166.00	4.94	92.20	59.03*
LA (mmol)	1.46	6.50	0.47	5.04	34.29*
Cortisol (ng/dl)	13.23	25.90	4.47	12.67	8.96*
Testosterone (ng/dl)	514.80	782.10	36.69	267.30	23.04*

Following exhaustive exercise, control group showed significantly higher values of all measured Parammeter ($p < 0.01$).

Table 4. Parametrs of the study before and after exercise among experimental group (N = 10).

variables	Mean before	Mean after	Std. Deviation	Mean Difference	t
Pulse rate (beats per min)	68.60	152.60	4.85	84.00	54.73*
LA (mmol)	1.30	5.20	0.47	3.90	26.16*
Cortisol (ng/dl)	13.68	22.74	3.14	9.06	9.11*
Testosterone (ng/dl)	521.70	832.00	38.56	310.30	25.45*

Handball players group showed significantly higher values of all the study parammeter ($p < 0.01$).

Table 5. Comparisone of parameters of the study between the control and experimental groups after exercise.

variables	Control n=10	Experimental n=10	Mean Difference	t
Pulse rate (beats per min)	166.00 ± 4.11	152.60 ± 4.72	13.40	6.77*
LA (mmol)	6.50 ± 0.42	5.20 ± 0.27	1.30	8.20*
Cortisol (ng/dl)	25.90 ± 2.67	22.74 ± 2.67	3.16	2.64*
Testosterone (ng/dl)	782.10 ± 39.29	832.00 ± 40.74	49.90	2.79*
Performance time (min)	18.00 ± 1.63	22.00 ± 1.49	4.00	5.72*

Handball players group showed significantly lower of pulse rate, lactate and Cortisol levels ($p < 0.01$), where as significantly higher values of testosterone level and performance time ($p < 0.01$).

Table 6. the percent changes of parameters of the study in both groups.

variables	Control n=10		Percent change	Experimental n=10		Percent change
	Mean before	Mean after		Mean before	Mean after	
Pulse rate (beats per min)	73.80	166.00	124.9 %	68.60	152.60	122.5 %
LA (mmol)	1.46	6.50	345.2 %	1.30	5.20	300.00 %
Cortisol (ng/dl)	13.23	25.90	95.8 %	13.68	22.74	66.2 %
Testosterone (ng/dl)	514.80	782.10	51.9 %	521.70	832.00	59.5 %

Evident percentage increase of all measured parameter with marked increase of lactate concentration accounting for mor than 3 folds in both groups. ($p < 0.01$).

3. Discussion

Results of the present study showed significant changes of pulse rate, performance time and blood levels of lactate, cortisol and testosterone concentartions among Handball players when compared with non-asthelet healthy individuals following exhustive exercise.

Although the pulse rate significantly increased in both the Handball players and control group following exhustive exercise, it was significantly less than the control group, denoting that Handball players are conditioned. ***Guyton and Hall (2006)*** stated that during maximal exercise, both the heart rate and the stroke volume are increased to about 95% of their maximal levels. They also added that the lower pulse rate after exercise is an indication of higher physical fitness. Frequency analysis of pulse rate during exercise has shown that sympathetic curve decreased and the parasympathetic is completely removed, indicating the decreased involvement of neural regulation of heart rate during exercise. Presumably, humoral regulation of the heart rate predominate during exercise ***Kamath et al, (1991)***. This finding provides explanation of the observed lower pulse rate among Handball players following exhustive exercise in the prsent study, being more physicaly fit than non-athlete controls.

Similar to pulse rate, lactate levels significantly increased in both groups after exhaustive exercise; in the experimental group, lactate level was significantly lower than control one. Lactate, which is the end product of the anaerobic carbohydrate breakdown, is the metabolite displaying the most spectacular concentration changes in muscle and blood with exercise. In general, the decreased level of lactate after exercise among athletes indicates a higher physical level than non-athlete ***Vassilis Mougios, (2006)***. Accordingly, it is justifiable to assume that Handball players of our study are at a higher physical level that non-athelet control group.

No significant difference of cortisol concentration was observed between Handball players and control group before exercise. However, it significantly incresed following exhustive exercise in both groups, though the increase was significantly lower in Handball players than the control group. Cortisol increases glucose production in liver, promotes lipolysis, increases hepatic glycogen by activation of glycogen synthetase and suppresses the immune response. It is also necessary for maintenance of normal blood pressure and cardiac output ***Murray et al, (2000). Bloom et al. (1996)*** stated that in exhaustive exercise, cortisol level increases, the intensity-dependent increase of cortisol reflects the primary control of this hormone by the central nervous system. Ther fore The lower level of cortisol in Handball players in comparisone with the control group denotes an efficient energy consumption by the former group.

Testosterone level increased in both basketbakll players and control group following exhustive exercise. However, in contrast to lactate and cortisol, it remained significantly higher among the Handball players than the control group. Testosterone exerts its principal effect on tissues by altering cellular biochemistry in interaction with the cell nucleus. In addition, it is responsible for the development of primary sexual characteristics and regulation of spermatogenesis in males and that the anabolic effects of testosterone are considered to be those promoting protein synthesis and muscle growth ***David Mottram, (1996); Kandeel et al. (2001).*** Therefore, the increased level of testosterone of the experimental group in the present study may promote muscle growth in Handball players.

Changes of blood concentrations of lactate, cortisol and testosterone detected in the prsent study are unlikely to be due to duirnal variation as bllod samples were collected under stadardized conditions and at the same time point.

The performance time showed also significant extension among Handball players in comparisone with the control group, clearly indicating a higher physical fitness level. ***Robergs and Roberts (1997)*** evaluated the effects of different training programs on athletic performance. They showed that significant improvements in strength and performance occurred which is in agreement with the findings of the present study.

The percent changes of study parameters showed almost similar values of pulse rate, and testosterone level between the Handball players and the control group. On the other hand, lactate and cortisol levels were conspiquosly lower among the Handball players. Indeed, these changes are desirable and beneficial to the fitness and performance of the Handball players and in general for the athlete. ***(Green and Dawson, 1993; Billat, 1996; ViRu and ViRu, 2001; Mougios, 2006)***.

In cconclusion, exhaustive exercise has a positive impact on fitness, anabolic state and performance ability. Further research is needed to examine the effects of training on performance in different sports activities.

References

1. Anne Loucks (2006): The endocrine system. Lippincott, Williams and Wilkins; P. 453.
2. Billat L (1996): Use of lactate measurement for prediction of exercise performance and control of training. Sports Medicine; 22: 157-175.
3. Bloom S, Johson R and Park D (1996): Hormonal response to exhaustive exercise. J Physiol.; 390: 1-18.
4. Brooks G (2000): Intra- and extera-cellular lactate shuttles. Med Sci Sports Exerc.; 32: 790-799.
5. David Mottram (1996): Drugs in sport. E and FN Spon, New York; P. 174.
6. Davies C and Few J (1993): Effects exercise on adrenocortical function. J Appl Physiol.; 135: 885-891.
7. Ferrando A, Tipton K and Doyle D (1998): Testosterone injection stimulates protein synthesis but not tissue amino acid transport. Am J Physiol; 275: 864-871.
8. Ganong W (2000): Review of Medical Physiology. A Lange Medical Book, USA.; P. 550.
9. Green S and Dawson B (1993): Measuring of anaerobic capacities in humans. Sports Medicine; 15: 312-327.
10. Guyton A and Hall J (2006): Textbook of Medical Physiology. El-Sevier Saunders, USA.; P. 1055.
11. Kamath M, Fallen E and McKelvie R (1991): Effect of steady state exercise on the power spectrum of heart rate. Med Sc Sports Exer.; 23: 428-434.
12. Kandeel F, Koussa V and Swerdloff R (2001): Male sexual function and its disorders. Endocr Rev.; 22: 342.
13. Murray R, Granner D and Rodwell V (2000): Harper Biochemistry. A Lange Medical Book, New York; P. 503.
14. Newsholme E and Crabtree J (1981): Flux generating and regulatory steps in metabolic control. Trends Bioch Sc.; 6: 53-55.
15. Robbergs R and Roberts S (1997): Exercise Physiology. Mosby, USA.; P. 628.
16. Vassilis Mougios (2006): Exercise biochemistry. Human Kinetics, USA.; P. 285.
17. ViRu A and ViRu M (2001): Biochemical monitoring of sport training. Human Kinetics, Champain.