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THE EFFECTS OF TWO DIFFERENT ENDURANCE TRAINING PROGRAMS PERFORMED IN HOT ENVIRONMENT ON BODY TEMPERATURE AND SOME PHYSIOLOGICAL PARAMETERS

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Abstract

The purpose of this study was to compare the effects of two different endurance training programs performed in hot environment on body weight (BW), body fat percentage (BF %), body mass index (BMI), body fluid (humour) percentage (Bf %), basal metabolic rate (BMR), body temperature (BT) and maxVO_2. The subjects Ataturk University School of Physical Education and Sports were divided into two groups randomly as Interval Running Group (IRG) (n= 12) and Continuous Running Group (CRG) (n=12). The subjects participated in training program with three sessions per week during 8 weeks under the hot weather condition, mean weather temperature and humidity ration were 30.76 $\pm$ 1.76 C and 57.92 $\pm$ 5.8 % during 8 weeks period. Before and after the training program all parameters that were mentioned above tested as pre and post test. Also at the beginning and the end of the each training session some physiological parameters and body temperature of subjects were measured to examine adaptation level to the hot environment conditions.

Statistical analysis of data was done by two-way ANOVA with SPSS 11.5 for Windows statistical program.

At the end of the 8 weeks maxVO_2 scores of both groups significantly increased ($P<0.001$). Body temperature and loss of body fluid (***dehydration)*** significantly higher in CRG than that of IRG. Also except BMI, significant changes were observed in BW, BF%, BMR scores of both groups ($P<0.01$).

Consequently, although both endurance training methods are beneficial to improve aerobic capacity, to avoid damages of training in hot environment interval running method is more acceptable than continuous running method.

Key word : Hot Environment, Endurance Training, Aerobic Capacity, Body Temperature.

Introduction

In resting condition, organism produces approximately 1.5 kcal/min. energy. Especially during exercise with the increase in heat production 15 – 40 % of chemical energy converted into mechanical energy, the rest of the energy produced converted into heat that is required to remove from body to maintain heat balance (H.A. Devries, 1986; E.L. Fox, 1988).

Heat dissipation mechanism in body, is unable to cope with the metabolic heat production starts to accumulate and cause on increase in body temperature (S.S. Cheung et al., 2000). In normal weather conditions, players can use 80 % of energy reserves when exercising in hot environment, exhaustion occurs before it reached that level or they perform less work (T. Lav, 1995).

Exercise increases the metabolic heat generation, this increment can be 30 times more in heavy exercise. One important factor affecting body heat loss is the ratio of moisture in the air. In other words, unlike exercising the hot-dry weather the removal of heat is more important in hot-humid air.

Exercises in hot environments have different effects depending on type, duration and intensity of exercise. In such case, organism makes some physiological regulation to resume normal functions of the body. Increased heat during exercise done with 70 % of maxVO_2 removed from body with conduction

and convection (15 %), radiation (5 %) and evaporation (80 %) (J.H. Wilmore, 1994). Complete acclimatization of humanbeing to hot weather occurs in 8 – 12 weeks. Adaptation to heat reduces symptoms such as heat causes dizziness, fatigue, fainting and also body prepares itself for a comfortable working environment. Although different results obtained from different studies, common opinion of the researches about acclimatization to heat and to heat changes is initial adaptation can be observed first 4 – 14 days and complete adaptation occurs between 8 – 12 weeks (D. Wendt et al., 2007). The aim of the study was to determine and compare the effects of two different training programs performed in hot environment on body temperature and some physiological parameters.

Material and Methods

Totally 25 voluntarily university students who were from Ataturk University School of Physical Education and Sports, participated in this study. They were divided into 2 groups as Interval Running Group (IRG) (n=12) and Continuous Running Group (CRG) (n=12). Physical and physiological characteristics of subjects showed in Table 3. Subjects trained in average 30.76 $\pm$ 1.71 ^{o}C weather temperature and 57.92 $\pm$ 5.80 % humidity ratio environment conditions. Measurements were done before and after the training program and some parameters like body temperature (BT), body fluid percentage (Bf %) and basal metabolic rate (BMR) measured before and after the each training session to observe adaptation. The following test were done during study.

Tablo 1. Descriptive Statistics of Interval Running (IRG) and Continuous Running Groups (CRG)

	n	IRG	CRG
		X±SS	X± SS
Age (yrs)	24	24,27±2,71	22,73±3,51
Height (cm)		1,75±,06	1,73± ,06

Body Composition

Body weight (BW), body mass index (BMI), body fat percent (BF%), body fluid percent (Bf%) and basal metabolic rate (BMR) values of the subjects were tested by Bio-Impedance Analysis method with Tanita-TBF 300.

MaxVO_2 scores of the subjects were determined by 20 m Shuttle Run Test.

Body temperature of the subjects was measured with Braun IRT-4520 (Thermoscan) from inside of ear before and after the each training session.

During 8 weeks the subjects participated in either Interval Running Training (IRT) or Continuous Running Training (CRT) programs. The intensity of the training sessions were determined according to target heart rate of subjects that is calculated by Karvenon method. 5–10 min. before and after each session separated as warm-up and cool-down part of the session. Following training programs applied to the subjects during 8 weeks.

Table 2. shows the duration and intensity of interval running for one set. Program planned as first 2 weeks 1 set, 3 -6 weeks 2 sets and 7 – 8 weeks 3 sets.

Table.2. Duration and Intensity of Interval Running Training (IRT)

Running Distance	Maximal Running Times	Intensity (Target HR) beat/min		
		%60	%70	%80
250 m	40 sn	56	52	48
400 m	64 sn	90	83	77
650 m	114 sn	160	148	137
900 m	165 sn	231	215	198

Continuous Running Training (CRT) In this method the subjects trained with 80 – 70 % with Target HR from 25 to 60 min and 3 times per week during 8 weeks (Table.3)

Table.3. Duration and Intensity of Continuous Running Training (CRT)

	Duration (min.)	Yoğunluk (Target HR)	Day / Week
1. Week	25 min	%50	3 days / week
2. Week	30 min	%50	3 days / week
3. Week	35 min	%60	3 days / week
4. Week	40 min	%60	3 days / week
5. Week	45 min	%60	3 days / week
6. Week	50 min	%70	3 days / week
7. Week	55 min	%70	3 days / week
8. Week	60 min	%70	3 days / week

Statistical Analysis The effect of endurance training on body weight (BW), body mass index (BMI), body fluid percent (Bf %), body fat percent (BF %), basal metabolic rate (BMR), body temperature (BT) and maximal aerobic capacity (maxVO_2) were tested before and after training by 2 way ANOVA using General Linear Method (GLM) procedure (SPSS for windows 11.5.0 Chicago, IL,USA). Statistical significant was decelerated at $p<0.05$.

Results

Table 4 showed that at the end of the 8 weeks, maxVO_2 scores of both groups significantly increased ($p<0.001$). Body temperature and loss of fluid was significantly higher in CRG than that of IRG. Also except BMI, significant changes were observed in BW, BF %, and BMR scores of both groups ($p<0.01$).

Table. 4. The Effect of Type and Duration of Training in Hot Environment on Physiological Parameters, Body Temperature and MaxVO_2 Levels of Subjects

Type of Exercise	Time	Parameters						
		BW (kg)	BMI (kg/m^2)	BF (%)	Bf (%)	BMR (kcal)	BT (^{o}C)	MaxVO_2
IRG	**Pre-test**	74.5	24.15	15.23	62.64	1752	36.05	32.45
	Post-test	74.0	23.94	14.66	62.01	1746	36.47	45.93
CRG	**Pre-test**	71.9	24.14	14.46	63.00	1812	35.85	31.93
	Post-test	71.2	23.88	13.92	62.46	1806	36.47	45.63
SEM		0.6	0.12	0.17	0.12	9	0.03	
ANOVA		---------- P < ----------						
E		0.0001	0.74	0.0001	0.001	0.0001	0.0001	-
t		0.28	0.06	0.001	0.0001	0.54	0.0001	0.0001
T		1.00	1.00	1.00	1.00	1.00	0.001	0.75
E x t		0.91	0.84	0.91	0.75	0.99	0.0001	-
E x T		1.00	1.00	1.00	1.00	1.00	0.001	-
t x T		1.00	1.00	1.00	1.00	1.00	0.001	0.93
E x t x T		1.00	1.00	1.00	1.00	1.00	0.001	-

E= Exercise, t= Time, T= Tye of Training, Ext= Exercise and Time, ExT= Egzersiz and Training, ExtxT= ExercisexTimexTrainin

Discussion

In this study, it was aimed that which one of two endurance training methods was more effective to develop maxVO_2 and also in adaptation to hot environment.

Individuals who do endurance training, need less time for full adaptation to heat. The possible reason for this rising in core temperature during training. Thermoregulatory mechanism of the athletes should be strong. Activities carried out at ambient temperature at a level that can be tolerated by the body, through, if the body's thermoregulatory system is not normal, poor results are inevitable (K.B. Pandolf, 1998).

D.E. Rae et al. have done in their study of 35.627 bikes and marathoners, have followed the contest period and only 5 of the athletes were hospitalized with heat shock diagnosis were determined. The standard calculations existing environmental conditions and exercise rates, athletes none of that is difficult due to heatstroke and had a need while hospital admission during the riders' rectal temperature was 42.0 ºC and 41.2 ºC, marathoners' rectal temperature of 41.8 ºC were determined and in these cases death has resulted. As a result, it can be said that increased rectal temperature and disruption in body's cooling mechanism caused these deaths.

According to the results of the study, body temperature of the subjects showed the changes in IRG and CRG due to difference in load. When average body temperatures were analyzed at the beginning of trainings, although CRG had lower body temperature than that of IRG, they reached higher body temperature through the end of the trainings (table 4).

Results also indicated that while resting body temperature of CRG gradually decreased through out the training program, body temperature of IRG has not seen an extreme increase. That occurred as a result the training seems to be an adaptation to the heat environment. However, both endurance training methods resulted in a significant increase in body temperature.

J.G. Morris et al. (2005) compared the effects of the endurance exercise in hot environment at different times of the day (morning and afternoon). Compared to afternoon exercises to morning exercises, fatigue more quickly occurred in afternoon exercise. The reason of that was connected to initial body temperature of the subjects.

Maintaining of homeostasis, human body required to keep body temperature in a certain level (36.9 $\pm$ 0.5 ºC) (N. Altareki et al, 2009). This thermal regulation is much more important and difficult during exercise. There are many factors which affect the thermal regulation, some of them are maxVO_2 , body weight, body mass index, body fat %, body fluid % and basal metabolic rate. In this study, BMI , all parameters were affected from exercise but differences in training methods did nor show different effect against the above mentioned parameters (table 4).

One of the most important differences between individuals is BF %. The amount of fat is extremely effective in heat transfer by conduction and blood flow (M. Tunç, 2004).

At the end of the study both training methods effected, BW, BMI, BF%, Bf %, and BMR (table 4). Especially body fluid percent (Bf%) is very important for body. Normal Bf % range is known as 55 – 66 %.

D.A. Judelson et al. indicated that the athletes who started the endurance exercise with good body fluid level has better hormonal regulation in their body than the athletes with less body fluid level.

Consequently, the results showed that IRT was more beneficial in adaptation heat environment both training methods caused significant increase in maxVO_2 but body temperature further increased during CRT. Starting the exercise with low body temperature can facilitate adaptation to heat environment. Increment in body temperature may cause early exhaustion especially in CRT. Moreover from forth week of the training program, significant increases were not observed between pre and post-test scores of IRG.

In this study, except BMI, all parameters were affected from exercise but the differences in training methods showed different effect on above mentioned parameters.

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THE EFFECTS OF SWIMMING EXECISE AT 35°C WATER AND L-CARNITINE ON BLOOD CELLS OF MICE

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Abstract

Objective: We aimed to research the effects of swiming exercise that's water temparature35°C on blood cells of mice administred exhausted exercise.

Methods and procedures: It was used 48 male mice of the type of balb/C in this research. Mice in research were divided into four groups consist of non-training (n:12), swiming training (n:12), practical (n:12), and unpracticle (n:12) L-carnitine. L-carnitine as phamalogical agent was used the dose 100mgr/kg (0.4ml) to experiment groups. It was given saline solution at the same volume of L-carnitine to control group. The mice were swum until exhaustion in the morris water tank at 35°C ambiant .

Swimming exercise was applied during three weeks. Both control group and experiment group mice were measured blood parameters of their pre and post measurements. Blood samples (0.5ml) was taken twice from tail veins of the control and experiment mice during experiments.The blood cell parameter findings obtained by the blood cell counter device. All mice outenasied by eter inhalation long period after from experiment three weekly. All data for the exercise-trained groups were compared to the sedentary groups using ANOVA. The statistical significance among groups were excepted at $p < 0.05$.

Results: The data that's erythrocyte, hemoglobin, haematocrit and RDW, MPW, PDW were not founded significantly ($p>0.05$), when it was compared to the findings of control group with only swimming group. The values of leukocyte, erythrocyte, hemoglobin, RDW and trombocyte parameters were founded differences between two groups significantly ($p<0.05$) when it was compared to the findings of the control group with experiment group is swimming and taking l-carnitine. The values of MCV, PLT and PCT were found differences between two groups significantly ($p<0.05$) when the experiment group that's both swimming exercise and taking l-carnitine compared to with only swimming group.

Discussions and conclusions: The animals' performance exhaustion swimming exercise at 35°C water temperature obtained very low effects than 20°C water temperature on hematologic parameters of mice.It was conclude that data were found because of these factors did the swimming training and the temperature of water near to body heat, no effects of cold stress and the other factors

Key words: L-carnitine, Swimming training, Mouse Training**.**

Introduction

Swimming sports who are exposed to body temperature heat or sportive activity in hot environments may be in bad condition of heat stress. Exposure to diffrent heat can result in iportannt problems. Overheat stress can result in heat stroke, heat exhaustion, heat cramps, or heat rashes. Inadeqate heat levels can also decrease in the athletic performance. It is very important the effects of environmental factors on athletic performance. The athletic performance affects very bad to have inadequat body temperature in all different areas. Water temperature impacts to performance levels in the range of important (K. Tokizawa et al. 2010, R. Greger, U. Windhorst 1996, T.J. Doubt, 1991). The water temparature that changes to body tempererature 0,5°C is very effective on cardivascular performance levels and so the athletics peformance is being influenced negatively. There is many literatuture about the effects of different environmental temperature on functionel structure (D. Weinert, 2007, J. Bittel, 1992). It has to use more energy. L-Carnitine is very important to use for the mitokondrial energy production that increase during exercise at the brain, liver and kidney (L.A. Calò, 2008, S. Baptista 2008, V. Marken et al. 2003). Endurance sports affect on energy consumption and macrophage and these state obtains many advantage with both beta oxidation of fetty acits and immunity (J. Himms-Hagen, 1996, G.J. Icheng, 1990). Low temparature, humidity, body composition and other factors are negative effects on performance (T.J. Doubt, 1991, J.P. Wehrlin, 2006, P. Robach, 2005). The environmental and intrinsic factors stimulate to erythropoiesis. Swimming exercise affects also haemopoietic activity