THE INFLUENCE OF BODY HYDRATION ON CHOSEN PHYSIOLOGICAL REACTIONS TO SAUNA TRAINING

by

Wanda Pilch[1], Zbigniew Szygula[1], Malgorzata Zychowska[1], Marian Gawinek[2]

The main aim of this work was description of body hydration on chosen physiological reaction on sauna training. The experiment was conducted on 10 healthy men age 22 years. Subjects did not used sauna earlier and were not professional athletes. In first experiment subjects did not received any drinks during sauna session. In second experiment subjects drink water warmed to body temperature according to individual needs approx. 600 ml/person, while in third session received the same amount of 4% glycerol solution . In all series subjects were on empty stomach having last meal before $22^{\underline{00}}$ on the day before. Sauna session consisted from 3 repetitions (15 min.) with rests (2 min.) during which subject cooled down with water (20-22°C). The following variables were registered: Tre, HR, BWT, Hct, Hb and subjective thermal perceptions.

In I experiment body mass decreased by 0.78 kg, while stayed unchanged during II and III sauna schedule. The highest increase in HR were registered in I experiment, while in II and III the tendency was similar but changes significantly smaller. Rectal temperature increased at the slowest rate in III experiment and the increase was also the smallest one. The highest plasma loss was registered in I experiment, no change was observed in second, in small increase in third experiment. The value of subjective thermal perceptions (according to Bredford scale) were smallest in third experiment. The glycerol hydration increased the level of hot environment tolerance.

Key words: sauna training, thermoregulation, body hydration

Introduction

The „sauna training" causes great interest among researchers and coaches because of its wide range of applications in professional sport and biological

[1] Physiology Institute, Academy of Physical Education, Cracow
[2] Department of Physiotherapy

renovation. The presence in sauna causes fast increase of skin temperature followed by growth of internal temperature. The most effective method of heat elimination in humans is sweating and evaporation of water from skin. Another very important system included into thermoregulation is circulatory system. Blood circulating in human body balances the temperature in specific body regions. Blood is also very important intermediator between internal body and skin which is the main place of heat elimination. The decrease of plasma volume followed by dehydration is one of the reasons of decreased fitness and ability to perform intensive efforts after sauna sessions.

The main aim of the work was description of hydration influence on chosen physiological reactions on sauna training.

Material and methods

The experiment was conducted on 10 healthy men age 22 years. Subjects did not used sauna earlier and were not professional athletes. In first experiment subjects did not received any drinks during sauna session. In second experiment subject drunk water warmed to body temperature according to individual needs approx. 600 ml/person, while in third session received the same amount of 4% glycerol solution . In all series subjects were on empty stomach having last meal before $22^{\underline{00}}$ on the day before. Sauna session consisted from 3 repetitions (15 min.) with rests (2 min.) during which subject cooled down with water (20-22°C). The temperature in sauna was equal to 90°C and relative humidity 26%. The following variables were registered: rectal temperature (Tre), heart rate (HR), body weight (BWT) and subjective thermal perceptions. All these variables were registered before, in 5^{th}, 10^{th}, 15th min. of sauna session and immediately after whole series. The heart rate was registered palpably, rectal temperature was measured with the use Ellab electrotermometer (±0.01°C) and body weight with the use of electronic Sartorius weight (±0.01 kg). The thermal stress was measured according to 7 degrees of Bedford scale (Laszczynska 1995).

The blood samples were taken from elbow vein 10 min. before and immediately after sauna session. Hct was evaluated with the use of microhematocrit method while Hb - Drabkin method. The change in plasma

volume ΔPV was calculated from changes in values of Hct and Hb according Dill and Costill formula (1974) in Harrison et al. modification (1982).

$$? PV = 100 \{ (Hb_1 / Hb_2) * [100 - (Hct_2 * 0{,}874)] / [100 - (Hct_1 * 0{,}874)] - 1 \}$$

where: Hb_1, Hct_1 – rest values; Hb_2, Hct_2 – final values

All data were presented as mean values and its standard deviations. The statistical significance of differences was calculated with the of Wilcoxon test.

Results

Series	Variable	Body mass		Heart rate		Rectal temperature		delta PV
		Before	After	Before	After	Before	After	
I	$\bar{x}$	**75,6**	**74,9**	**74,2**	**133,8**	**36,9**	**38**	-7,1
	SD	**3,8**	**3,5**	**14**	**23**	**0,2**	**0,1**	4,5
II	$\bar{x}$	76,1	76,1	**73,2**	**106,2**	**36,9**	**37,8**	0,94
	SD	3,6	3,6	**11,9**	**21,7**	**0,3**	**0,2**	11,4
III	$\bar{x}$	76	75,9	**72,6**	**103,2**	**37**	**37,7**	1,24
	SD	3,6	3,5	**9,6**	**11,9**	**0,2**	**0,2**	9,1

Difference in bold are significant at $p \leq 0.01$

The mean values of diagnosed variables are presented in table 1. The level of body mass decreased significantly in first experiment by 0,78 kg while in second and third there are no changes. The highest increase in the heart rate variable were observed in first experiment. These changes were followed by relative smaller increase in amount of heart beat per minute, but they stayed statistically significant at $p \leq 0.001$. The highest increase in rectal temperature was determined in first experiment when subjects did not received any drinks during sauna session. In second experiment when subject drunk water warmed to body temperature according to individual needs approx. 600 ml/person the increase was smaller by 0,2°C. In third session when subjects received the same amount of 4% glycerol solution the increase in measured variable was the smallest. All of the differences were statistically significant. The highest loss of plasma was detected in first experiment, in second stayed unchanged and in third significantly increased

Discussion

During routine sauna session the average amount of water evaporated from the equals to approx. 400-600 g (Häninnen 1986, Hawkins 1987, Kauppinen and Vuori 1986). The measure of dehydration of human body is decrease of body mass and plasma volume. The average loss of body mass during first experiment were similar to another reports with the male subjects (Szygula et al 1990, Szygula and Jurczak 1993, Leppäluoto et al. 1986a, Väänänen and Leppäluoto 1983), while higher than in female participation (Jezova 1994, Pilch 1995). It may be caused by lower level of water in female body, thicker adipose lay because of what the sweating and evaporation is less intensive and body mass loss smaller (Grucza et al. 1987, Hawkins 1987, Kauppinen and Vuori 1986).

In II and III series there was no body mass loss, because water was received during sauna bath. Smaller increase in II session may suggest that glycerol has hygroscopic properties and causes attenuation of water in organism. If higher temperatures exposition prolongs, then unless the best and most efficient thermoregulatory processes, the heat accumulates in human body. During 20 min. of sauna bath the temperature may rise by 0.4-0.5°C (Häninnen 1986). In present experiment the highest increases were observed in first case, followed by significantly lower in second and third, what may be the result of body hydration and increased immunity to heat circumstances. The skin cells dilation and increase in skin blood circulation are the first reactions to high environment temperature and growing internal body temperature. Skin circulation may increase to 8 l/min. or to 60% of minute heart volume (Stepenson and Kolka 1993). The increase in skin blood circulation causes the growth of skin temperature, what reduces the heat inflow to organism in case of presence in higher external temperatures. In case of increased body temperature increases dispersion of heat to environment (Ernst 1988, Kozlowski 1986, Stephenson and Kolka 1993). The maintenance of increased blood circulation through dilated blood vessels is possible only thanks to increased minute heart volume and redistribution of blood from external body

to periphery (Bulas et al. 1983). The growth of minute heart volume in sauna is caused mainly because of acceleration of heart rate (Luurila 1992) with unchanged or increased in small degree cardiac output (Ernst 1988, Häninen 1986, Kaupinen and Vuori 1986, Kiss et al. 1994, Luurila 1992).

In present experiment the highest increases of heart rate were observed in first experiment. The acquired result to not differ basically from existing data (Ježova et al. 1994, Szygula et al. 1989). The smaller heart rate accelerations observed in experiments with hydration show smaller excitation related to smaller overwarming and body dehydration. The hydration increases plasma volume and improves heart volume (Saris et al. 1999). It may also explain lower heart rate in experiments with body hydration. The differences in heart rate increases may be also related to increased blood plasma volume and decreased peripheral vessels tension what allows to lower the heart in experiments with hydration (Latzka et al. 1998). The dehydration in first experiment caused the blood plasma volume decrease (7,1%) what corresponds with the results of similar research. During increased sweating the fluid loss begins in extracellular area (Stephenson and Kolka 1993), and is followed by intracellular loss visible in blood plasma volume decrease (Harrison 1985, Kubica et al. 1983). General view on subjective thermal sensations shows progressive and relatively smaller increase of negative sensations in sauna session in II and III experiment in comparison to first one.

Conclusions

1. The hydration during heat expositions increases organism tolerance to warm environment.
2. The hydration facilitate the activity of blood circulatory system in sauna, what may be valuable suggestion to coaches and subjects with smaller circulation diseases.

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