Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw, Poland 00-773
Tel: +48 226 0 227 03
Email: editorial_office@rsglobal.pl

JOURNAL	International Journal of Innovative Technologies in Social Science
p-ISSN	2544-9338
e-ISSN	2544-9435
PUBLISHER	RS Global Sp. z O.O., Poland

ARTICLE TITLE	A STUDY OF THE EFFECT OF SAUNA ON THE OXYGEN TRANSPORT FUNCTION OF YOUNG ATHLETES ENGAGED IN HANDBALL SPORT
AUTHOR(S)	Hokuma Mammadova Eyvaz, Tarlan Mammadova Nasir
ARTICLE INFO	Hokuma Mammadova Eyvaz, Tarlan Mammadova Nasir. (2023) A Study of the Effect of Sauna on the Oxygen Transport Function of Young Athletes Engaged in Handball Sport. *International Journal of Innovative Technologies in Social Science*. 3(39). doi: 10.31435/rsglobal_ijitss/30092023/8063
DOI	https://doi.org/10.31435/rsglobal_ijitss/30092023/8063
RECEIVED	21 August 2023
ACCEPTED	28 September 2023
PUBLISHED	30 September 2023

A STUDY OF THE EFFECT OF SAUNA ON THE OXYGEN TRANSPORT FUNCTION OF YOUNG ATHLETES ENGAGED IN HANDBALL SPORT

Hokuma Mammadova Eyvaz
Teacher, Department of Game Sports, Azerbaijan State Academy of Physical Education and Sport
ORCID ID: 0000-0003-2512-9903

Tarlan Mammadova Nasir
Assistant professor substitute, Department of Game Sports, Azerbaijan State Academy of Physical Education and Sport
ORCID ID: 0009-0001-3780-8041

DOI: https://doi.org/10.31435/rsglobal_ijitss/30092023/8063

ARTICLE INFO

Received 21 August 2023
Accepted 28 September 2023
Published 30 September 2023

KEYWORDS

Young Handball Player, Oxygen, Lipid Peroxidation, Antioxidants, Sauna, Prooxidants.

ABSTRACT

The effect of sauna on blood oxygen transport function, lipid peroxidation, prooxidant-antioxidant balance in athletes aged 17-21 engaged in handball sport was studied in the article. Persons involved in the hot air sauna were exposed once a week (20 procedures) for a period of four months. The sauna procedure (at 85-90°C, 10-15% humidity) consisted of two parts: 5 and 10 minutes. In young handball athletes, after taking a dry air bath, an increase in pO_2, which is the development of respiratory alkolosis, and a decrease in the combination of hemoglobin and oxygen in venous blood increased the amount of oxygen transported to tissues. After a one-time exposure to the sauna, the development of oxidative stess accelerated (intensification of free radical processes, weakening of antioxidant defenses), and at the end of the course it began to decline. The observed increase in the formation of nitric oxide can play an important role in the modification of oxygen-dependent processes in the body.

Citation: Hokuma Mammadova Eyvaz, Tarlan Mammadova Nasir. (2023) A Study of the Effect of Sauna on the Oxygen Transport Function of Young Athletes Engaged in Handball Sport. *International Journal of Innovative Technologies in Social Science*. 3(39). doi: 10.31435/rsglobal_ijitss/30092023/8063

Introduction.

As is known, a dry air bath for athletes is widely used in sports practice as a therapeutic and prophylactic procedure. In addition to having an effective effect on increasing physical and mental work capacity, this restorative means helps to intensify the recovery processes in the body, eliminate stressful tensions caused by professional activity, regulate blood circulation, expand functional capabilities and increase immune resistance. It should be noted that the bath puts an additional burden on the body, especially the cardiovascular and respiratory systems (Ragino, 2015, p. 128)

It has been determined that in the literature, there are individual scientific data on the effect of the dry air bath on the acid-base balance of the blood, the gas content of the blood, and the prooxidant-antioxidant balance. One hour after taking the sauna procedure, a gradual increase in the tension of pO_2 in the blood and saturation of hemoglobin with oxygen is observed. This can also be assessed with the help of oximetric studies carried out immediately after the sauna. The development of oxidative stress

based on the increase in the concentration of hypoxanthine and xanthine in blood plasma was also determined (Zinchuk & Zhadko, 2018, p. 230).

Experiments conducted on animals to study the effect of high ambient temperature on the mechanism of blood oxygen transport function have shown that depending on the real temperature value, pH and CO2 concentration, the tendency of oxygen to combine with hemoglobin decreases, accordingly, there is a shift of the curve to the right, which reflects the state of oxyhemoglobin dissociation (Kamyshnikov, 2012, p. 35). During hyperthermia, the strengthening of lipid peroxidation process and the weakening of the activity of the antioxidant system were found. It has also been established that there is a close mutual functional relationship between the tendency of oxygen to combine with hemoglobin and activation of free radical oxidation of lipids in tissues. It was found that the direction and degree of change in the process of peroxidation of lipids and the activity of the antioxidant system in such cases depend on the state of oxygen-forming properties of blood. However, the effect of using a dry-air bath on the state of oxygen-dependent processes has not been sufficiently studied. Based on the above, the main goal of our work was to assess the effect of sauna effect on oxygen transport function and prooxidant-antioxidant balance in young handball players (Zinchuk & Zhadko, 2018, p. 57).

The effect of sauna on blood oxygen transport function and prooxidant-antioxidant balance was studied in 17-21-year-old athletes (handball players). The effect of heat on the body was determined once a week for 4 months (20 procedures). The sauna procedure (temperature 85-90^{o} C, humidity 10-15%) consisted of two exposures (5 and 10 minutes). During the interval between expositions, the persons subjected to the inspection were at room temperature for 5 minutes (21-22^{o} C).

The normal distribution of the obtained results was evaluated according to Shapiro-Wilk test. Results with normal distribution presented as: mean values, ±-mean squared errors. Student's t-test was used for statistical calculation of differences. The distribution of results that differ from normal indicators is given as follows: median (25% -75%); in this case, Vilcoxon's two-sample test was used to find the statistical value of the differences.

Research results.

After the first procedure of the sauna, the body temperature in the persons subjected to the inspection increased to 2.55^{o} C ($p<0.001$). After the last procedure, it was 2.6^{o} C ($p<0.003$). If at the beginning of the course the body mass decreased to 0.89% ($p<0.002$), then at the end of the course this decrease was 0.76% ($p<0.003$). The results reflecting the oxygen transport function of blood are presented in Table 1.

Table 1. Influence of sauna on parameters of oxygen transport function of blood in young athletes engaged in handball sport.

Indicator	Beginning of the course			End of the course		
	sauna		Vilcoxon's criterion	sauna		Vilcoxon's criterion
	before (n=6)	after (n=6)		before (n=6)	after (n=6)	
1	2	3	4	5	6	7
pO_2, mm.c.st	28.00 (24.50-32.00)	65.00* (54.50-68.00)	0,001	29.00 (27.00-37.00)	51.00* (36.00-57.00)	0,004
CvO_2, ml/l blood	9.05 (8.35-12.10)	21.15* (1940-23.70)	0,001	950 (800-12.90)	17.20* (13.70-17.50)	0,003
Hb, q\l	140.50 (134.00-15150)	166.50* (154.00-185.00)	0,001	35.00 (118.00-142.00)	144.00* (137.00-147.00)	0,003
SO_2, %	47.10 (41.05-61.00)	94.50* (92.55-95.55)	0.001	49.00 (43.60-69.20)	87.90* (66.40-90.60)	0,004
KE, ml/1 blood	19.25 (18.75-21.10)	22.60* (21.00-25.05)	0,001	18.36 (16.05-19.31)	19.58* (18.63-19.93)	0,003
Met.Hb, %	0.90 (0.60-1.05)	1.10* (100-1.20)	0,003	1.00 (030-1.20)	1.20* (1.20-1.20)	0,005

Table 1. Continuation.

1	2	3	4	5	6	7
$P50_{real,}$ mm.c.st	26.60 (25.95-27.24)	29.68* (28.96-30.65)	0,001	27.20 (26.80-28.28)	30.57* (30.03-31.15)	0,002
$P50_{stand.,}$ mm.c.st	26.44 (26.03-27.51)	27.96* (27.70-28.7)	0,001	27.10 (26.76-28.30)	28.37* (27.33-29.28)	0,002
pCO_2, mm.c.st	52.95 (49.50-57.75)	38.80* (27.50-40.45)	0,001	52.40 (43.90-59.00)	39.80* (38.30-42.000	0,010
Ph, unit	7.354 (7.342-7.37)	7.442* (7.424-7.45)	0,001	7.350 (7.318-7.398)	7.432* (7.412-7.439)	0,005
ABE, mM/l	3.55 (3.00-5.45)	2.90* (2.20-360)	0,003	3.80 (2.10-4.30)	2.90* (1.80-3.10)	0,006
HCO_3, mM/1	30.20 (28.90-31.00)	26.70* (25.65-27.15)	0,001	29.90 (28.20-30.600	26.90* (25.80-27.10)	0,002
$TCO_{2,}$ mM/1	32.05 (30.50-32.50)	27.80* (26.85-28.40)	0,001	31.50 (29.50-32.40)	28.00* (27.20-28.40)	0,002
SBE, mM/l	4.00 (3.15-6.10)	2.30* (130-2.95)	0,001	3.60 (2.60-4.50)	2.40* (1.00-2.70)	0,005
SBC, m M /1	26.65 (26.00-27.55)	26.95* (26.25-27.50)	0,889	26.70 (24.90-27.20)	26.20* (24.50-27.00)	0,005
T, ^0C	36.30 (36.05-36.45)	38.85* (38.60-39.50)	0,001	36.3 (36.10-36.40)	38.9* (3880-3920)	0,003

Note:* - Statistical difference relative to the initial level ($P < 0,005$)

The most important aspect of the effect of the sauna on the body of young athletes engaged in handball sports is that breathing with hot air has a positive effect on reflector development in respiratory adaptation. Hot air changes the amount of blood flowing in the vessels, protects the body's internal temperature from rising above the norm and homeostasis from being disturbed. In studies, the nature of the change in the acid-base ratio of the blood is reflected in the development of respiratory alkalosis. The increase in body temperature when breathing in a sauna with hot air can be explained by the decrease in the level of carbon dioxide in the blood as a result of the increase in hyperventilation of the lungs. An increase in body temperature by 2-3º C leads to an increase in lung ventilation. A decrease in the concentration of CO_2 in the blood leads to a change in the pH in an alkaline direction. Accumulation of incompletely oxidized metabolites in the blood, depletion of physiological mechanisms for restoring acid-base balance, and development of metabolic acidosis occur. As can be seen from the obtained results, hyperventilation causes the acceleration of carbon dioxide removal from the body and the shift of pH in the alkaline direction. However, it is possible to put forward the idea of a decrease in the level of bicarbonates, real and standard residues of bases, and compensation of respiratory alkalosis to some extent by metabolic acidifying processes.

The parameters of the oxygen transport function of the blood indicate the presence of symptoms of hypoxia in those who were examined before taking sauna procedures. This is most likely due to the fact that blood is taken from the peripheral collecting veins. It should also be noted that the degree of tension of pO_2 in the blood in practice, the saturation of blood with oxygen, has a high value compared to the initial indicators, is due to a number of factors. As is known, hyperventilation of the body develops in hot weather conditions, oxygen demand rises significantly. The process is also facilitated by increased sweat secretion under the influence of heat stress and, in connection with this, increased hemoglobin concentration. In studies, rectal temperature increases up to 39.5º C in test subjects, pH shifts towards alkalinity, pO_2 increases, and venous blood pCO_2 decreases. However, in this case, a sharp increase in lung ventilation is not observed. This suggests that auxiliary factors are involved in increasing blood oxygen tension. Redistribution of circulating blood occurs when the body is affected by the high temperature of the external environment. As a result, peripheral blood circulation is strengthened, and the amount of blood collected in internal organs is reduced. There is an increase in the amount of oxygen

transported to the peripheral organs. A decrease in the concentration of oxygen coming to some tissues accelerates the development of tissue hypoxia due to the metabolites accumulated in those tissues. Based on the above, we can say that hyperventilation of the lungs, the distribution of blood with less oxygen to the visceral organs, an excess of exchange products in the blood and other factors associated with this lead to an increase in pO_2 in venous blood.

Table № 2. Influence of sauna on the process of peroxidation of lipids and factors of antioxidant protection system in young athletes engaged in handball sport.

Indicator		Beginning of the course			End of the course			
		sauna		Vilcoxon's criterion	sauna		Vilcoxon's criterion	t-criterion
		before (n=6)	after (n=6)		before (n=6)	after (n=6)		
Diene conjugants, v/ml	Plasma	1.20 (1.04-1.46)	1.60* (1.26-1.9)	0,016	1.44 (0.76-1.56)	1.42 (1.34-1.60)	0,534	—
	Erythrocytes	14.44 (11.16-15.360)	18.24* (16.56-19.32)	0.002	10.80 (8.76-12.12)	11.04 (8.88-13.20)	0,790	—
Malon-dealdehidim kM/l	Plasma	1.86 (154-2.63)	2.76* (1.92-3.78)	0.028	2.23 +-1.41	2.31-+1.32		0.639
	Erythrocytes	26.92 (18.97-28.46)	35.13* (29.48-38.46)	0.002	26.15 (15.13-26.67)	27.95* (21.79-91.02)	0,010	—
Schiff bases, v/ml	Plasma	152.30 (203.36-257.06)	211.19* 186.50-224.00	0.039	136.76 (55.42-247.57)	263.80* (119.12-218.87)	0,003	—
	Erythrocytes	27.28 (26.66-29.34)	379.61* 341.60-428.27	0,004	22.36+-2.31	2321+-284	0,859	0,064
α-tocopherol, mkM/l	Plasma	244.76 (203.36-257.06)	25.15* (20.69-26.67)	0,001	252.31 (28.39-375.52)	1.98.74 (48.74-334.81)	0,016	—
	Erythrocytes	6.58 (6.12-7.26)	5.60* (5.47-5.91)	0,002	6.86 (5.58-7.33)	6.23* (4.68-6.70)		
Catalase, mM H_2O_2/1dəq/q Hb								

Note:* - Statistical difference in relation to the initial level (P < 0,005).

This also has its place in our studies in strengthening physiological processes after sauna procedures. The increase in body temperature in a bath with dry air and the ineffectiveness of heat

transport depend on the activation of oxidative reactions. When considering the results of the research, it is clear that the prooxidant-antioxidant parameters are equal, that the processes of free radicalization are enhanced, and the antioxidant protection after the sauna goes down. These changes are due to insufficient oxygen transported to internal organs and weakening of oxidation processes. The discrepancy between the transport of oxygen and its consumption by cells leads to the activation of the process of lipid peroxidation. After the course of thermal procedures, changes in the oxygen transport function of the blood and the process of peroxidation of lipids are more common than with one-time effects.

The combination of oxygen with hemoglobin is exothermic and, conversely, dissociation of oxyhemoglobin are endothermic reactions. Rising blood temperature reduces the tendency of hemoglobin to combine with oxygen. Such a nature of the interaction of the combination of hemoglobin with oxygen is characteristic for the interactions of most types of hemoglobin with oxygen, and to evaluate this tendency, it is important to take into account the temperature of the blood (in most cases, it is determined at 37º C - standard temperature). In this case, it is also important to take into account the temperature gradient of the body, since at the price of p50 there may be a decrease in this size from 36.5 to 8.7 mm c.st (at temperatures of 42^0 C and 15^0 C, respectively). The decrease in the tendency of hemoglobin to combine with oxygen is one of the important factors in the process of compensating for the lack of oxygen. Because the role of this factor is especially great in various pathological conditions and during adjustment of the process of adaptation to hypoxia.

REFERENCES

1. Inzhevatkin E.V., Savchenko A.A., Albrant A.I., Nefedov V.P. Study of metabolic changes in the liver of rats in the dynamics of the recovery period after hyperthermic exposure // Questions of medicinal chemistry. 2010.
2. Kamyshnikov V.S. Handbook of clinical and biochemical laboratory diagnostics. Minsk, 2012.
3. Ragino Yu.I. Application of new biochemical methods for assessing the oxidative-antioxidant potential of low-density lipoproteins // Clinical and laboratory diagnostics. 2015.
4. Solonin Yu.G., Katsyuba E.A. Thermoregulation and blood circulation in adults with short-term extreme temperature effects // Human physiology. 2016.
5. Zinchuk V.V. Zhadko D.D. Sauna effect on blood oxygen transport function and pro–oxidant -antioxidant balance in untrained individuals // Human physiology. 2018.
6. Zinchuk V.V., Borisyuk M.V. The role of oxygen-binding properties of blood in maintaining the pro-oxidant-antioxidant balance of the body // Successes of physiological sciences. 2019.
7. Ahmadova N.A. – Somato-functional variability of the body of students in the conditions of application of differentiated physical culture technologies: Abstract. dis. can. med. sci. Tyumen, 2019.