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Changes in temperature sensitivity of Indian students in the initial period of adaptation to the conditions of the European North

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Abstract. The article presents the results of the study of temperature sensitivity of Indian students who came to the European North for training. The survey showed an increase in the thresholds of thermal sensitivity in the initial period of adaptation to the conditions of the North in Indian students compared with their peers-the indigenous inhabitants of the European North. There is a decrease in the half-year period of living in the European North of Indian students cold sensitivity of 1.5°C in male group and 1.9°C in female. In addition, in the male group revealed dulling of warm sensitivity by 1.8°C. Among the students of the native inhabitants of the European North (control group), there were no true differences in the temperature sensitivity thresholds between different periods.

1. Introduction

Temperature sensitivity of the human body has a key role in adaptive reactions to changing environmental conditions. The speed of reaction of the thermosensor apparatus influence to all further neurohumoral adjustment, leading the body to a state of adaptation. The delay in the receipt of afferent information about the external temperature caused by any disturbances in the work of thermoreceptors or nerve fibers, by which these impulses follow in the central nervous system, can lead to a delay in adaptive reactions, overheating or hypothermia of the body and as a consequence to the development of various pathological conditions. These disorders can be associated with various neurological diseases, which are thus an indirect cause of violations of the temperature balance of the body. However, in recent years, numerous studies have found significant differences in the functioning of thermoreceptors in healthy people of different nationalities, different ages, as well as people living in different climatic conditions [1, 2]. The level of temperature sensitivity may also be due to individual genetic characteristics associated with polymorphism of genes encoding protein structures of thermoreceptors [3]. It was found that the thresholds of thermal sensations can increase and decrease in various functional states of the body – with physical and psycho-emotional stress [4], under thermal or cold stress, in conditions of normobaric hypoxia [5]. Thus, the temperature sensitivity can be called an individual, highly labile feature of the human body, the effectiveness of which depends on the work of all other body systems.

Temperature conditions are the main characteristic of the climate to which the human body is forced to adapt when changing seasons or changing place of living. Often, such changes occur very quickly and require the operational work of each part in the chain of thermoregulatory reactions of the body, the first of which is a sensitive link represented by thermal and cold receptors. It should be noted that in the period of adaptation, with prolonged exposure to heat or cold, there is "addiction", that is,



adaptation of receptors, dulling their sensitivity [6]. In this case, we can say that the body is more at risk, since information about the increase or decrease in the temperature of the medium in this case will come with a delay, but at the same time in science there are numerous data on the development in such conditions of protective mechanisms at other levels of thermoregulation – for example, changes in the hormonal balance, changes in the types of metabolism [7,8]. But, the "insufficiency" of the receptor apparatus is compensated by different metabolic protective mechanisms. It is known that during urgent adaptation (for example to extremely low temperatures) a specific stress reaction is formed, which is characterized by mobilization of functional systems responsible for adaptation, including the sensory system responsible for the perception of negative environmental factors (in this case, low temperature) [9].

To determine the changes occurring at the receptor level, it is appropriate to investigate people who are at the initial stage of adaptation to the new temperature conditions that the body is facing for the first time.

2. Method of research

The study identifies the key changes in the temperature sensitivity among boys and girls – students-Indians who come to study in the area of the European North of the areas of the hot equatorial climate of South Asia. Among the examined persons 20 girls and 19 boys aged 19-25 years. Russian students permanently residing in the European North (Arkhangelsk region) in the number of 35 people – 17 boys and 18 girls aged 18-23 years-were examined as a control group. All the examined persons had temperature sensitivity thresholds to temperature increase and decrease in the left hand palm at rest in the sitting position in the conditions of temperature comfort. Measurement of thresholds of different types of sensitivity was carried out using a neurosensory analyzer TSA II Analyzer (Israel). During the experiment, the test subjects installed a thermode (temperature sensor-stimulator) on the skin of the left palm. The initial temperature of the thermode was 32°C, which after one minute after installation was perceived by the examined like a neutral. After the beginning of the experiment, the temperature of the thermode began to decrease (or increase) with speed of 0.4°C per second and at the moment of feeling the first cold (or warm) sensation, examinee pressed the mouse button connected to the analyzer, this way stopping further cooling (or heating). In total, for each type of sensitivity, according to the method laid down in the program of the analyzer, a fourfold cold or thermal effect was carried out, by which the average value was determined. To determine the dynamics of the level of temperature sensitivity, measurements were carried out twice - in October for the first time and again six months later in April. During the first measurement (October) Indian students were at the stage of prompt adaptation, during the second measurement – at its initial stage [10]. Thus, the students who came to the European North, for six months were under the influence of atypical for them cold climate, especially intense impact on their body in the winter. As a result, we can assume the formation of functional rearrangements in their body, including those affecting the thermoreception system, changes in which were supposed to be detected in this study.

The control group, consisting of students from the North, also in the interim half-year period was in the cold climate of the winter period, but for them the change in temperature conditions is more familiar because of their long-term residence in the North.

All measurements were carried out in a room with a constant temperature of 22-23°C and humidity of 80%. All subjects were pre-housed at room temperature and were not exposed to cold for two or more hours before the experiment. The results were processed using the program SPSS 21, which determined the normal distribution of indicators for all groups of the examined (Shapiro-Wilk criterion) and the reliability of differences in the mean values between some groups (t-criterion).

3. Results and conclusions

As a result of two measurements of temperature sensitivity thresholds, statistical changes were found in the group of Indian students, both among males and females.

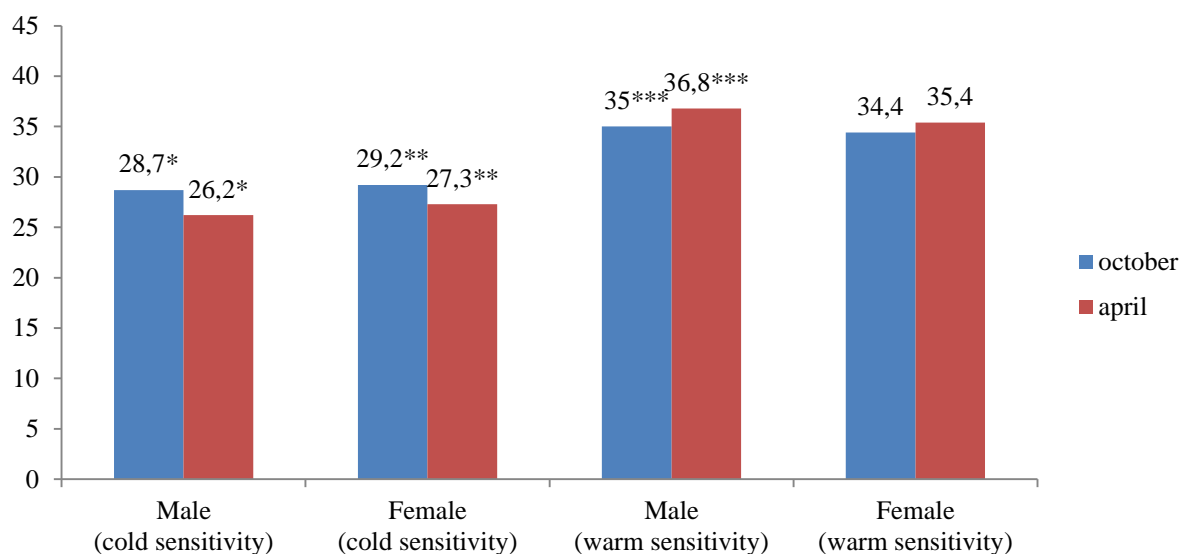


Figure 1. Change of the temperature sensitivity of the hand of Indian students (the difference being statistically significant between measurements * $p < 0.05$; ** $p < 0.01$; *** $p < 0.05$).

In both groups, there was an increase in the threshold of cold sensitivity: in females, the average threshold of sensitivity of cold receptors in the palm during the period of prompt adaptation (in October) was observed at 29.2°C, in April it changed to 27.3°C. In the group of males, the changes were similar to 28.7°C in October to 26.2°C in April. Heat sensitivity thresholds also increased from 35°C to 36.8°C in the male group and from 34.4°C to 35.4°C in the female group.

In the group of students-northerners as a result of statistical processing of the results of significant differences between the values of temperature sensitivity thresholds between the first and second measurements was not revealed. The average thresholds in this group were 28.7°C for cold and 34.3°C for heat sensitivity in female group and 28.5°C and 34.8°C for heat reception in male.

Thus, it can be concluded that the overall increase in the thresholds of temperature reception in Indian students, which may be due to prolonged low-temperature effects on the body (in particular on the hands, usually the most exposed to hypothermia) and as a consequence to the partial adaptation of the thermoreceptor apparatus. It is known that the long-term effect of low temperature in most people, for a long period of time working at low temperatures, there is a dulling sensation of cold, which is replaced with time by anemia of the fingers of the upper extremities and a decrease in the ability to bind small objects. There are known facts of decreasing pain, tactile and temperature sensitivity in humans after chronic cold damage during the period of general cooling [11]. It should be noted that the change in temperature sensitivity thresholds can be caused by epigenetic adaptation mechanisms, which are expressed in changes in the expression of certain genes of heat-sensitive ion channels under the influence of cold, ultimately leading to a decrease in cold sensitivity and simultaneously to an increase in heat production and heat transfer of the body [12]. However, confirmation of such changes in the body of Indian students is possible with the use of thermal imaging equipment, which requires further research.

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References

- [1] Babenko V N, Isakov J T, Alibekova E T, Atambaeva D A, Kobzev V F, Potapova T A,

- Voevoda M I, Aldashev A A 2015 TRPM8 gene Polymorphism in the Kyrgyz population: possible link with high-altitude adaptation *Vavilov journal of genetics and breeding* **19/5** pp 630-637
- [2] Skedung L, El Rawadi C, Arvidsson M, Farcet C, Luengo G S, Breton L, Rutland M W 2018 Mechanisms of tactile sensory detection amongst the elderly *Sci Rep.* 19/8 (1):5303
- [3] Kozyreva T V 2016 The relationship of single nucleotide polymorphism rs11562975 gene of temperature-sensitive ion channel TRPM8 with sensitivity to cold and menthol *Human Physiology* Vol 37 pp 71-76
- [4] Sychev V S and Davydova S S 2017 Skin sensitivity of fingers in boys and girls with different profiles of manual asymmetry *Neuroscience for medicine and psychology: proceedings Of the international interdisciplinary Congress in preparation for the XXIII Congress of the Russian Physiological Society. I. p. Pavlova* p 399
- [5] Divert V E 2008 Peripheral thermoreception in different functional States of the organism autoref. dis. ... *Dr. Biol. Sciences* p 32
- [6] Ivanova T L 1980 Heat exchange and functional state of brushes at General and local cooling of the person. Hygienic aspects of urbanization of Northern and Eastern regions of the USSR pp 75-79
- [7] Zubatkina O V Malakhova M Y and Popov A A 2018 Possible mechanisms of formation of pyruvate blood in northerners. *Bulletin of the Ural medical academic science* Vol 15 pp 176-183
- [8] Wlosinski P E and Panin L E 2014 The power structure, the status of energy metabolism and endocrine status in organized team in the far North *Bulletin of the Ural medical academic science* 2(48) pp 11-15
- [9] Kiseleva T P 2013 General adaptation syndrome *Academic journal of Western Siberia* Vol 9 pp 81-83
- [10] Avtsyn A P Marachev A G 1975 The Manifestation of adaptation and disadaptation among the inhabitants of the Far North *Human physiology* Vol 1 № 4 pp 587-601
- [11] Levina G, Bykov U N, Borisov A S 2015 Diagnosis and treatment of peripheral pain (literature review) *Bulletin of the East Siberian scientific center of the Siberian branch of the Russian Academy of medical Sciences* 101 pp 72-76
- [12] Kozyreva T V and Voronova I P 2014 Involvement of neurogenomic level of regulation in the processes of maintaining the temperature homeostasis of the body in the cold *Vavilov journal of genetics and selection* Vol 18 pp 1100-09