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SPACE WEATHER EFFECTS ON THE FEATURES OF PERSONAL RESPONSE OF VOLUNTEERS IN A MULTIPLE-LATITUDE MONITORING

DOI 10.25789/YMJ.2018.64.26

ABSTRACT

The article presents a comparative analysis of psycho-emotional peculiarities of persons from polar, sub-polar and middle latitudes, taking part in multiple-latitude monitoring, in relation to a psychological sensitivity to heliogeomagnetic factors.

64 relatively healthy persons, males and females, have been examined using the following tests: State-Trait Anxiety Inventory (STAI) (Ch. Spielberg, U. Khanin), E. Heim Test, Psycho-Geometric Test. Reactive anxiety and integral index of heliogeomagnetic activity (Kp-index) have been determined by a two-month phase of monitoring, other tests have been checked once in the beginning of a phase. Group I consisted of persons with maximum coincidences in Kp-index peaks and in reactive anxiety. Group II consisted of persons with no coincidences. It is found that the volunteers from the group I and II, as in northern (polar and sub-polar) as in middle latitudes, had a number of similarities depending on a psychological sensitivity to heliogeophysical factors (tending to analyze problems, emotional suppression, agreeableness, purpose). The findings of the study allow organizing patient-specific preventive methods for psycho-somatic diseases and neuroticisms in relatively healthy persons taking into consideration their psychological sensitivity to changes in heliogeomagnetic activity, and the latitude of their place of living.

Keywords: heliogeomagnetic activity, anxiety, polar, sub-polar and middle latitudes, stress-overcoming behavior.

Introduction. The given research was controlled by a multiple-latitude monitoring of the study of heliogeophysical factors effects on psycho-emotional and somatic (cardiovascular system, primarily) state of inhabitants of auroral (Tiksi), sub-auroral (Yakutsk) and middle latitudes (Saratov). The monitoring is being held simultaneously during two months in fall and/or spring periods (October-November, March-April) – the periods of a maximal activity of heliogeomagnetic factors [5], in groups of volunteers from the given latitudes, with a daily recording for a uniform protocol.

The monitoring started in 2014 and it is a follow-up to the previous unique international project “Heliomed”, which was organized by an interdisciplinary project-team of physics, biologists, informational technologies specialists, psychologists and physicians [1].

A combined research of a psycho-emotional status and of a cardiovascular system condition of volunteers in space weather changes [5].

“Space weather” or “cosmic weather” is a phenomena in an upper atmosphere, in an ionosphere and in the near-Earth environment. Space weather, as well as the weather as a common notion of this word, is characterized by a cycle of calm periods (the minimum of a solar activity cycle) which can be comparable to a stable summer weather, and a cycle of abrupt changes (in high solar activity) which may be analogical to an changeable fall weather. A changeable weather in the near-Earth environment links with

the Earth environment – there are no two days of a kind. So, as a grey rainy day in November differs from a sunny May day, as two days may not be the same from the space weather and its factors point of view [12].

The main targets for heliogeophysical factors are human nervous and cardiovascular systems. During the geomagnetic activity there are: arrhythmia, heart rate changes, BP peaks, blood viscosity and erythrocytes aggregation increases, capillary slow flow, and a number of other pathological changes happen [3, 9].

Alongside with traditional risk factors of cardiovascular pathology developing (smoking, adiposity, hypodynamia, etc.), today there are data about psycho-social risk factors accumulated (anxiety, depression, alexithymia) [4, 6, 8], and data about increased indices of a solar and geomagnetic activity on blood circulation organs diseases [3, 5, 9]. At the same time, complex influence of these factors on physiological and psychological characteristics of healthy people are not enough studied.

Over the last years, there are innovative abilities of registering and analyzing space weather parameters by artificial satellites of the Earth. These data analyze, further studying the effect of the solar and geomagnetic activity parameters on a cardiovascular system and personal psychological features may allow to optimize measures of a primary prevention of cardiovascular diseases leading to a high mortality percent of an adult population on Earth. All these make studying the

effect of heliogeomagnetic factors on a psycho-emotional condition of a healthy person actual.

A detailed studying of personal psychological features of people from polar and middle latitudes from the point of their stress-overcoming behavior differentiated according their spheres and types of personality, with the space weather effect on them, had not been held earlier.

Aim: make a comparative analyze of psycho-emotional features and to determine them in persons living in polar, sub-polar and middle latitudes, and taking part in a multiple-latitude monitoring in 2015, in dependence of a presence of a psychological sensitivity to a changeable geomagnetic state.

Methods of research and objects. Relatively healthy persons took part in the research – males and females (n=64), age - 44, 8 (40,7; 45,2) years. The observation of the volunteers was organized in a spring monitoring phase in 2015, in March and April, in Saratov (middle latitude), Yakutsk (sub-polar latitude), Tiksi (polar latitude).

To achieve the goal the following tests were used:

- State-Trait Anxiety Inventory (STAI) (Ch. Spielberg, U. Khanin) [2, 7];
- E. Heim Test, building a stress-overcoming behavior [11];
- Psycho-Geometric Test [10].

Reactive anxiety of the volunteers according to Spielberg-Khanin had been determined every day during a two-months observation (March-April), the other tests had been given once at the

beginning of the monitoring phase. An integral parameter of geomagnetic activity had been used daily - Kp-index.

Statistical processing of the findings was done by an application program package Statistica 6.0, Microsoft Excel 7.0. for Windows, checking zero hypothesis of conformity with a normal distribution law based on a Shapiro-Wilk criterion, and following use of nonparametric mathematical methods (as the distribution of variables was non-normal). The data are presented as a median (Me) with values of quartile range (25%, 75%) for samples. Reliability of the used statistical estimating was no less than 95%.

Results and discussion. We divided all of the observing persons into two groups depending on coincidence (no less than 60%) in absolute and pinnacled increase of the values of reactive anxiety by Spielberg-Khanin, and Kp-index values. In the group I there were people who had such coincidences – volunteers with a psychological sensitivity to heliogeomagnetic factors changes. In the group II there were volunteers with no coincidences mentioned above – without psychological sensitivity to geomagnetic factors changes.

During the examination of the volunteers living in polar and sub-polar latitudes we established the followings: group I with persons having a psychological sensitivity to changeable heliogeophysical factors consisted of 42,9% (39,2; 43,7) people. In the group II there were 57,1% (52,7; 58,6) persons with no psychological sensitivity.

The results of examination of auroral and sub-auroral inhabitants by the use of E. Heim test are presented below on Pictures 1-3.

From the data on Pic. 1 we can see that in the group II as in the group I adaptive coping-cognitions predominate, which is keeping self-control ($p \leq 0,05$).

As it follows from the data on Pic. 2, the volunteers with a psychological sensitivity to heliogeomagnetic factors changes had chosen adaptive coping-forms more seldom than those one with no sensitivity (in both groups this was optimism), and it's interesting that persons from the group I had chosen mostly non-adaptive coping-behavior – emotion suppression ($p = 0,04$).

As for the choice of behavior coping-responds (Pic. 3), there should be noticed a number of prevailing choice of non-adaptive coping-behavior (retreat) in the group I, and the choice on a par with adaptive (asking for help) and non-adaptive (active escape) coping-behavior in persons from the group II ($p \leq 0,05$).

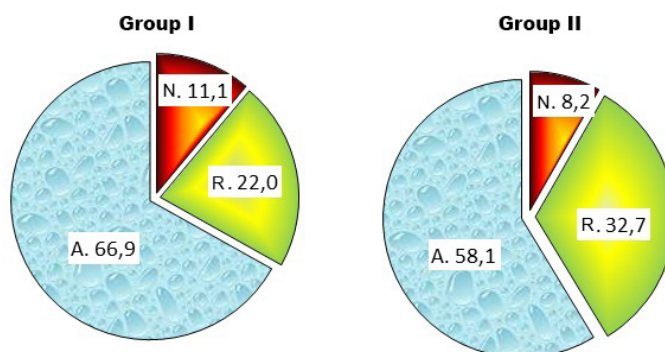
The results of the research with stimu-

lus material of a Psycho-Geometric Test in the observing persons living in northern latitudes are presented on Pic. 4-5.

As we can see from the Pic. 4-5, the volunteers from the both groups living in northern latitudes preferred triangle and refused zigzag ($p \leq 0,05$). Among the inhabitants of middle latitudes taking part in the monitoring, 46,7% (40,6; 47,2) of persons were in the group I, 53,3% (49,3; 54,1) – in the group II.

The peculiarities of building stress-overcoming behavior by E. Heim in the volunteers from Saratov are presented on Pic. 6-8.

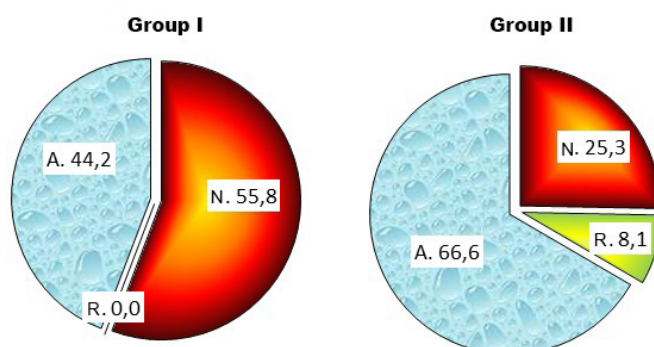
As we can see from the data on Pic. 6, the persons with psychological sensitivity to heliogeomagnetic factors changes, living in middle latitudes, preferred choosing non-adaptive cognitive coping-behavior (dissimulation and submission), the volunteer without sensitivity – adap-



Pic. 1. Distribution of cognitive coping-strategies in inhabitants of northern (polar and sub-polar) latitudes in groups (%).

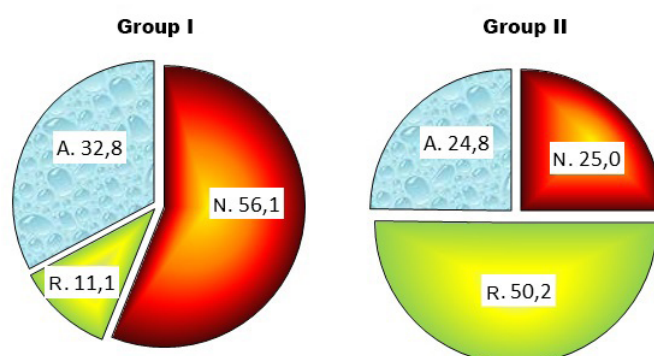
Note. Notions of coping-strategies kinds: A — adaptation, R — relatively adaptation,

N — non-adaptation



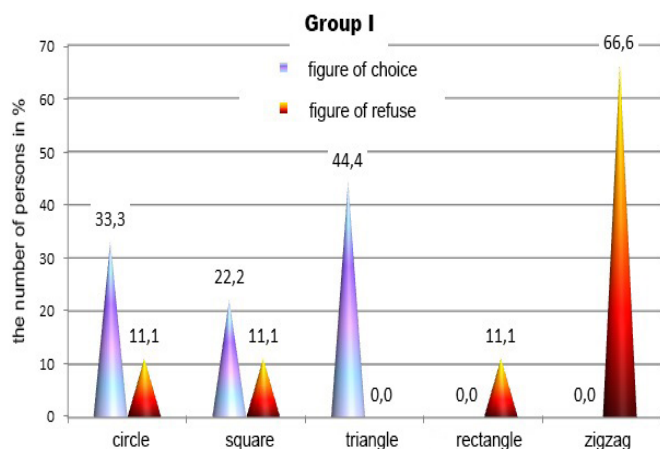
Pic. 2. Distribution of emotional coping-strategies in inhabitants of northern (polar and sub-polar) latitudes in groups (%).

Note. Values of respond types are the same as for the Pic. 1.

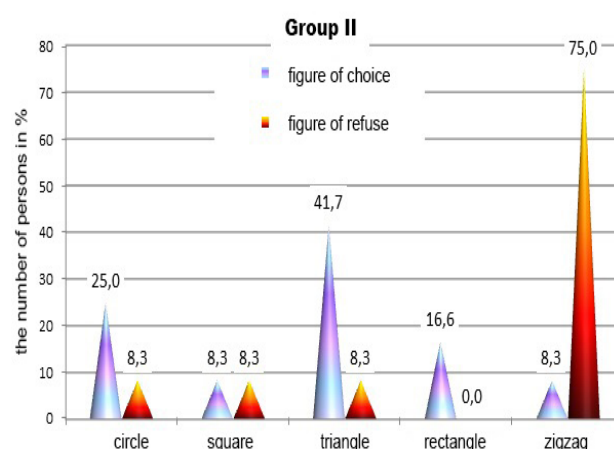


Pic. 3. Distribution of behavior coping-strategies in inhabitants of northern (polar and sub-polar) latitudes in groups (%).

Note. Values of respond types are the same as for the Pic. 1.



Pic. 4. Results of psycho-geometric tests in inhabitants of northern latitudes in the group I (%).



Pic. 5. Results of psycho-geometric tests in inhabitants of northern latitudes in the group II (%).

tive (problem analyzing and establishing own value) ($p \leq 0,05$).

The volunteers from the group I chose adaptive emotional coping-strategies (optimism, protest) of nearly the same frequency as the persons from the group II (latter ones – only optimism). Among non-adaptive coping-strategies the representatives from both groups, living in middle latitudes, preferred emotional suppression and blamed themselves in any troubles, and what's interesting, persons with no psychological sensitivity to heliogeomagnetic factors did that more often ($p < 0,05$).

As we can see from the Pic. 8, in persons with psychological sensitivity to changeable heliogeomagnetic factors, in building their own coping-behavior, adaptation coping-strategies predominated (asking authority figure for help), and the volunteers without sensitivity chose adaptive (ask for help) and non-adaptive (retreat) coping-behavior in the same frequency.

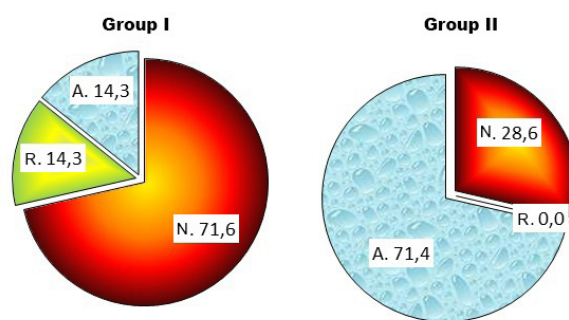
That is interesting to notice that the findings from the volunteers of the group I, living in middle latitude, in work with the stimulus material of the psycho-geometric test, are analogical to the same results from the persons of northern latitudes (group I): they chose triangle and refused zigzag. The representatives of the group

II chose circle and triangle with the same frequency, and refused zigzag and circle ($p \leq 0,05$).

It stands out that on the given stage of the monitoring we established practically the same frequency of episodes of a psychological sensitivity to heliogeophysical activity in persons as from middle as from northern latitudes.

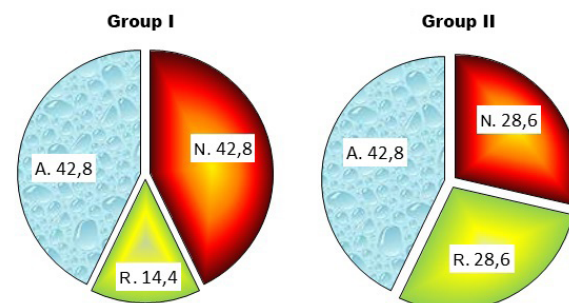
On the base of the findings of a psychological examination, it seems as if inhabitants of polar and sub-polar latitudes, regardless of the presence or absence of a psychological sensitivity to heliogeophysical activity changes, are representatives of a composed manner of behavior, they are serious, organized, highly responsible, tend to analyze problems, they don't get rattled in any situations. At the same time they are optimists, and they are sure as in positive results as in their own possibilities. It stands out that the persons with a psychological sensitivity to heliogeomagnetic factors, comparing to those ones who do not have sensitivity, are more patient and self restrained, have a strong will power, self-esteem, they never ever show off their emotions even if they are ill, and cover all symptoms.

Compared to persons from polar and sub-polar latitudes, between the representatives of the group I



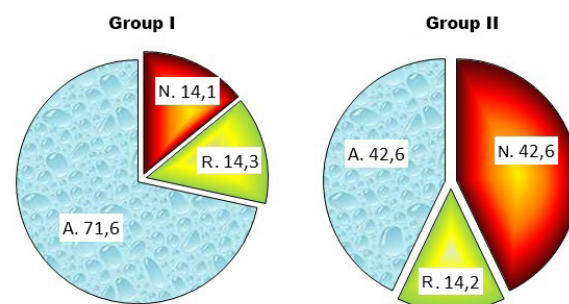
Pic. 6. Distribution of cognitive coping-strategies in inhabitants of middle (Saratov) latitudes in groups (%).

Note. Values of respond types are the same as for the Pic. 1.



Pic. 7. Distribution of emotional coping-strategies in inhabitants of middle (Saratov) latitudes in groups (%).

Note. Values of respond types are the same as for the Pic. 1.



Pic. 8. Distribution of behavior coping-strategies in inhabitants of middle (Saratov) latitudes in groups (%).

Note. Values of respond types are the same as for the Pic. 1.

and II from middle latitudes there is no as much common which is limited by optimism, emotion suppression, submission and asking for help in difficult situation. As for the difference in the groups, we should notice high behavior adaptation in persons with psychological sensitivity to heliogeomagnetic factors, and their less cognitive adaptation, comparing to those who has no such sensitivity. The representatives from the group I more often than those ones from the group II, tended to analyze problems, suppressed emotions, though, protested sometimes, and could dissimulate when they were ill.

Regardless of the latitude, the volunteers with a psychological sensitivity to changeable heliogeomagnetic factors, were kind and purposeful, preferred analyzing cause-and effect relationship of problems, tended to dissimulation and emotion suppression. Those who had no sensitivity were, as a rule, contradictory and tended to ignore problems.

Conclusion. From there, in 2015 during monitoring there had been revealed a coincidence of frequency of presence of psychological sensitivity and non-sensitivity in volunteers among inhabitants of northern and middle latitudes, to changes in geomagnetic activity.

On the base of this research there had been established that among the volunteers who took part in multiple-latitude monitoring had as similarities as differences, taking to account the latitude, psychological sensitivity to heliogeophysical factors. Many similar features are subjected, first of all, by the latitude of living, though, there are some close features in volunteers with psychological sensitivity to heliogeomagnetic activity (tendency to analyze problems, suppress emotions, kindness, focus).

Conflict of interests in the study was not stated.

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INDICATORS OF THE CARDIOVASCULAR SYSTEM IN THE CAUCASIAN RESIDENTS OF MAGADAN REGION DEPENDING ON THE TERM OF RESIDING UNDER CONDITIONS OF RUSSIA' NORTHEAST

DOI 10.25789/YMJ.2018.64.27

ABSTRACT

The climatic conditions of the North have been forcing the human body to use additional social and biological means of protection against the adverse effects of environmental factors. It should be noted that, first of all, the cardiorespiratory system undergoes the influence of these abiotic factors. In this regard, the purpose of the research was to study and identify the characteristics of the cardiovascular system in young male residents of Magadan Region who differ in terms of residence in the northeast of Russia. 1632 young male subjects aged 17 to 21 and permanently residing in the city of Magadan, were examined in 2005–2017 using standard methods for determining cardiovascular parameters. Depending on the length of residing in the region all the subjects were divided into 4 groups. They represented three generations as well as migrant Caucasians who were not born in Magadan Region but came there from the central regions of the country. Residents of the northeast of Russia with short periods of residence in the North demonstrated a state of stress in the cardiovascular system manifested by an increase in systolic pressure, total peripheral vascular resistance, heart rate, and a decrease in the blood stroke volume. At the same time, the representatives of the 3rd generation had better functioning of the system. They were significantly lower in blood pressure (both systolic and diastolic) and the heart rate. In addition, the subjects of this group had minimal cardiac output, which indicated a more economical functioning of the cardiovascular system in the conditions of the northeast of Russia.

Keywords: cardiovascular system, generations of residence in the North, adaptive changes

The territory of Magadan Region that is located in the northeast of Russia (59.33 northern latitude) belongs to the subarctic region (55-66.5 north latitude) according to modern concepts of circumpolar regions [20]. Circumpolar regions create a unique set of negative environmental factors affecting humans, including prolonged and severe cold stress with negative monthly temperatures, which in some regions may drop to -40°C [20]. Living in the conditions of the northeast of Russia can be considered as life with additional functional tension. So the climatic characteristics of the North are defined by researchers as uncomfortable, severe [1], and even extreme [12] as they make significant demands to the human body, forcing it to use additional social and biological means of protection against unfavorable environmental factors [18].

The physiological mechanisms of adaptation changes in the cardiovascular system under northern conditions have been studied fairly well and are presented in numerous works [3, 4, 7, 19]. The results of such studies are aimed at creating the conditions for maintaining health and increasing the life expectancy of people living and working in the arctic and subarctic climatic zones under

unfavorable natural conditions [4]. At the same time, much less attention is paid to the study of adaptive rearrangements in the activity of the cardiovascular system in different periods of residence under the northern conditions.

The circulatory system serves as a marker of the nature of the adaptation processes in the body and is one of the first to reflect a state of stress, exhaustion, and pathology [10]. Acute exposure to cold is associated with a decrease in peripheral blood flow and an increase in metabolic heat production to maintain body temperature. The vasomotor response of the cardiovascular system is mediated by sympathetic activation directed toward peripheral vasoconstriction which results in the body heat loss decrease at the expense of a decrease in peripheral blood flow [16]. This is a necessary term for the functioning of the cardiovascular system since peripheral cold stress due to sympathetically controlled vasoconstriction increases arterial pressure by increasing the peripheral resistance [17]. Of note that chronic vasoconstriction leads to the development of hypertension [15]. At the end of the 20th and beginning of the 21st centuries, the identification and study of the mecha-

nisms of the development of early stages of hypertension, called "near-disease" or "prehypertension" became of special relevance. This condition is more often demonstrated by young men [14; 22]. According to the authors, one of the pre-nosological conditions is the so-called "high normal pressure" of 130-139 / 85-89 mm Hg [23].

Based on the above, the **purpose** of this work was to study the cardiovascular system in young residents of Magadan region differing in terms of residence in Russia' northeast.

Materials and methods. By random sampling, 1,632 young men aged 17 to 21, permanent residents of the Magadan Region, were examined. Depending on the term of residence in the territory of Magadan Region all the examinees were divided into 4 groups. The I group ($n = 62$) included migrant-Caucasians moved here from the central regions of the country and characterized by a short period of residence in the North (average 7.1 ± 1.3 years). We designated this group as the "zero generation". The II group included those born in Magadan Region in the 1st generation from among Caucasians but whose parents were migrants ($n = 924$). The III group included young people born