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INFLUENCE OF GEOMAGNETIC DISTURBANCE ON THE PSYCHOLOGICAL STATE OF THE INHABITANTS OF THE NORTH

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ABSTRACT — THE AIM of the work was to determine the influence of geomagnetic disturbance on the psychoemotional status of residents of polar and Subpolar latitudes. **MATERIALS AND METHODS.** 44 male and female volunteers with an average age of 49.2 (41.7; 55.4) years, living in auroral and sub – auroral latitudes were examined using tests of Ch. Spielberger-Yu. Hanin, E. Khaimah and psychosomatic techniques. The daily CR index (Computed Radiography) was used as an integral indicator of geomagnetic disturbance. **RESULTS.** The volunteers were divided into two groups: psychologically sensitive to changes in space weather (I) and-not having such sensitivity (II) (based on the presence or absence of certain coincidences of the peak values of reactive anxiety and the CR index). The groups had an equal number of persons. It was found that the most problematic area of stress-overcoming behavior in both groups was behavioral, the most effective for group I — cognitive, for group II — emotional sphere. Individuals with psychological sensitivity to geomagnetic disturbances were significantly more anxious than those who did not have this sensitivity. **CONCLUSION.** Thus, despite the fact that all the inhabitants of the Northern latitudes observed by us were not sufficiently effective in constructing the actual stress-overcoming behavior, the risk of developing psychosomatic diseases was higher in the owners of psychological sensitivity to geomagnetic disturbance, taking into account their tendency to suppress emotions and significantly higher anxiety.

KEYWORDS — polar and subpolar latitudes, anxiety, psychological sensitivity, geomagnetic disturbance, multi-latitude monitoring, stress-overcoming behavior.

INTRODUCTION

Changes in space weather, which characterizes the state of near-earth space, are associated with processes occurring in the biosphere [10, 13]. Geomagnetic disturbance (GMD) as an external stress factor causes an increase in the processes of hemostasis, lipid peroxidation, a decrease in the production of nitric oxide, the level of immune protection, disorders of carbohydrate and lipid metabolism, the circadian rhythm of melatonin release, which, in turn, leads to an increase in blood pressure, increased thrombosis, increased insulin secretion and insulin resistance index [5, 6, 11]. The cardiovascular and nervous systems are most sensitive to the influence of heliogeophysical factors [8]. It is shown that the number of affective disorders, psychoses and psychosomatoses increases on the days of GMV [12, 15]. In auroral and subauroral latitudes, the characteristics of changes in geomagnetic factors differ significantly from the average latitudes. Under these conditions, their impact on Biosystems increases and the frequency and intensity of GMD changes in the wide frequency range increases [2, 12, 16]. Due to these circumstances the assessment of the psychophysiological status of people living in high latitudes is an urgent topic for determining the nature of the impact of space weather on human health.

The aim of the study

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MATERIALS AND METHODS

As the territorial localization of this investigation, the village of Tiksi (auroral latitude) and Yakutsk (sub-auroral latitude), which in the spring of 2017 was held the next stage of the multi-latitude monitoring Geliomed-2, the aim of which is to study the impact of GMD on the nervous and cardiovascular system [7]. Among the relatively healthy volunteers, the number of which was 44 people, male persons predominated with 30 males and 14 females. The average age of the examined persons was 49.2 (41.7; 55.4) years. During March and April 2017, each volunteer was assessed daily for reactive anxiety levels by Ch. Spielberger–

Yu. Khanin [3]. Before the start of the monitoring phase, the persons under our supervision passed the test of A. Haym on the construction of stress-overcoming behavior with division by spheres (cognitive, emotional, behavioral) [14], the projective psychogeometric test by S. Delinger [1] and the second part of the questionnaire by Ch. Spielberger–Yu. Hanin to determine the levels of personal anxiety [3]. The choice of this combination of tests is explained in detail in one of our previous publications [4].

To assess the activity of space weather factors, the daily GMD — CR index was used—an index determined daily during a given observation period.

All participants in this work signed a voluntary informed consent.

Statistical processing of obtained results was performed using software package Statistica 6.0 and testing the null hypothesis on their normal distribution on the basis of calculation of the Shapiro-Wilk test and subsequent nonparametric and multivariate methods. The groups were compared using the Mann-Whitney U-test. The data were analyzed in the form of $M \pm \sigma$ for the mean and in the form of median (Me) with quartile range values (25%, 75%) for the samples. The reliability of the statistical estimates used was assumed to be at least 95%.

RESULTS

In the course of comparing the values of the Kr index and reactive anxiety indicators by Ch. Spielberger–Yu. Khanin, all the inhabitants of the subpolar latitudes involved in this stage of the project, were divided into two groups. The first group (14 males and 8 females) included respondents who had more than 66.7% of the peak values of these indicators in the dynamics of daily monitoring (psychologically sensitive to GMD), and the second group (16 males and 6 females) included those who had less or no matches (psychologically insensitive to GMD) [7]. Each group included 50% of the volunteers. Results of testing to determine the values of personal anxiety according to Ch. Spielberger–Yu. Hanin for individuals living in auroral and sub-auroral latitudes are shown in Fig. 1.

The data presented in Fig. 1 show that in the groups there was a significant difference between the average indicators of personal anxiety ($p < 0.05$). In group I, anxiety as a disposition was close to a high level, while in group II, the level of personal anxiety was moderate.

When performing the test of A. Heim constructed for a stress-overcoming behavior with division by spheres, the results were obtained, illustrated in Fig. 2–4.

According to the data in Fig. 2 the volunteers with psychological sensitivity to changes in GMD

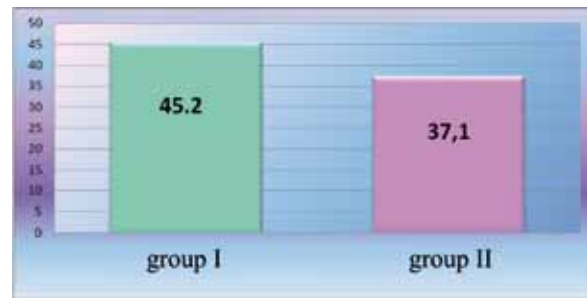


Fig. 1. Averaged values of trait anxiety in the groups (in points)

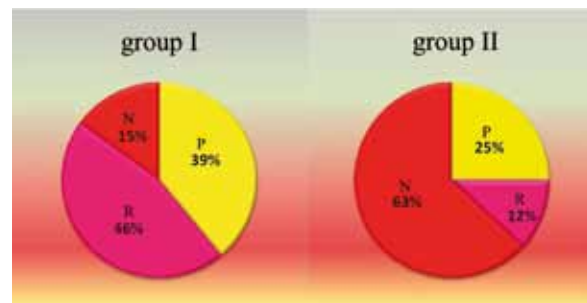


Fig. 2. Distribution of coping-cognitions in the groups of volunteers

Note: Definitions for the types of coping-strategies: P — productive, R — relatively productive, N — non-productive

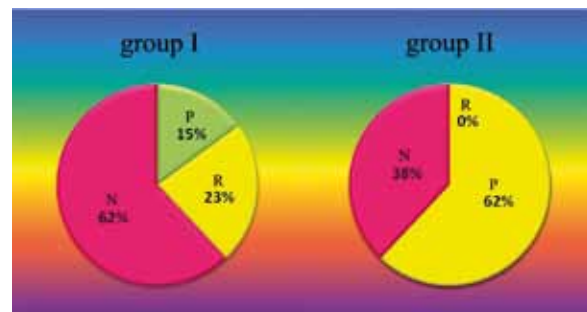


Fig. 3. Distribution of emotional coping forms in the groups.

Note: Definitions for the types of coping-strategies: P — productive, R — relatively productive, N — non-productive

(group I) chose productive coping cognitions almost twice as often as unproductive ones; and those who did not have this sensitivity (group II) — on the contrary (unproductive more often than productive), in the same ratio ($p < 0.05$). The detailed analysis of the cognitive sphere in the groups revealed that the vast majority of people in group I chose to maintain self-control among the productive coping forms while the volunteers in group II preferred ignoring among the unproductive coping reactions.

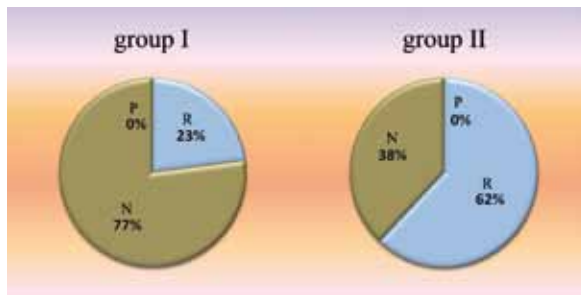


Fig. 4. Distribution of behavioral coping-forms in the groups of volunteers

Note: Definitions for the types of coping-strategies: P — productive, R — relatively productive, N — non-productive

The data illustrated in Fig. 3 show that the monitoring participants included in group I preferred non-productive forms of emotional coping strategies, namely, suppression of emotions, and the persons who made up group II chose productive emotional coping reactions: they were optimistic ($p < 0.05$).

The data in Fig. 4 show us the following: the volunteers from both groups did not build their proper coping behavior effectively enough, preferring non-constructive forms (in group II — mainly active avoidance, and in group I — active avoidance and retreat, on a parity basis), while the choice of productive coping forms was completely absent. Note that the proportion of non-constructive coping styles in group I was almost twice as high as in group II ($p < 0.05$).

When psychogeometric testing of volunteers with both psychological sensitivity to changes in GMV and without such sensitivity, the following was found: persons from group I gave equal preference to a triangle and a circle (27%, respectively), denying the zigzag (55%), and representatives of group II, preferring a square to other geometric shapes (37%), as well as persons from group I, rejected the zigzag (88%, $p \leq 0.05$).

DISCUSSION

We noticed that at this stage of the Heliomed-2 project (spring 2017), among the volunteers living in high latitudes, the amount of those with and without psychological sensitivity to GMV was the same.

It was shown that individuals, who are psychologically sensitive to the effects of heliogeomagnetic factors, under stress conditions, were effective only in the cognitive sphere of stress-overcoming behavior, in contrast to the behavioral and emotional spheres. In conflict situations, they focused not so much on analyzing the problems that arose, but on suppressing their emotions and maintaining self-control, while actively avoiding open struggle with hostile circumstan-

ces or retreating before them (i.e., they were completely ineffective at coping with stress). People from Group I perceived a wide range of situations as threatening, were afraid of changes and conflicts, were sociable and friendly, but, at the same time, they could periodically be restrained, concentrated and purposeful. The presence of polar intrapsychic traits, a tendency to suppress emotions and increased anxiety of carriers of psychological sensitivity to the action of heliogeomagnetic factors allowed them to be attributed to the group of increased risk of neurosis and psychosomatic diseases [9, 17].

Volunteers who did not have psychological sensitivity to changing GMV were most effective in the emotional sphere of stress-overcoming behavior and least effective in behavioral, and the cognitive coping sphere occupied an intermediate position. The representatives of group II were moderately anxious, optimistic, hardworking, conservative, reserved and pedantic, preferring individual activities. However, in exclusive situations, they ignored problems or actively avoided them without even trying to deal with them.

CONCLUSION

Thus, despite the fact that all the inhabitants of the Northern latitudes observed by us were not sufficiently effective in constructing their stress-overcoming behavior, the risk of developing psychosomatic diseases was higher in the owners of psychological sensitivity to geomagnetic disturbance, taking into account their tendency to suppress emotions and significantly higher anxiety.

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