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THE GEOMAGNETIC VARIATIONS DEPENDENCE OF ADAPTATION OF THE NORTHERN CHILDREN TO THE MIDDLE-LATITUDE

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One of the natural factors of risk to human health is the geomagnetic disturbances that violates the temporal sequence of information signals synchronizing biological rhythms with environment (Presman AS, 1968; Dubrov, 1974; Moiseeva, Lyubitski, 1986). Physiological effects of the geomagnetic field (GMF) variations were demonstrated on the diverse systems of the human body (Belisheva et al., 1994; Belisheva, Merkushev, 1999; Belisheva, Konradov, 2005; Belisheva et al., 2007). It is believed that the geomagnetic disturbances are not the cause of the specific diseases, but they aggravate the existing functional impairment on reason of the imbalance of the regulative systems in the body (Kaznacheev, 1980; Soroko, 1985; Shepovalnikov, Soroko, 1992). According to the hypothesis about the physiological mechanisms of the influence of the geomagnetic field (GMF), the increase of the geomagnetic activity (GMA) acts on the central nervous system (CNS). By the result of such impact on the CNS, the compensatory physiological processes are transforming and the sensitivity to the perception of unwanted external agents is reduced (Presman AS, 1968; Soroko, 1985; Moiseeva, Lyubitski, 1986).

The analysis of the qualitative and quantitative characteristics of geomagnetic variations, their "dose" dependence of the brain functional state showed that the stable state of the human brain is determinated by the periodic oscillations of the GMF field in a certain amplitude-frequency range. Break of a structure of the GMF variations can be responsible for unstable state of the brain and the corresponding psycho-emotional reactions (Belisheva et al., 1995). It was shown that parameters of interplanetary media associated with the low level of the GMA were closely related with the indices of the unstable emotional state: anxiety, depression, hysteria, psychosis and etc. (Belisheva, Kachanova, 2002).

The physiological processes could be activated or inhibited according to amplitude-frequency range of the GMF variations, and, in the case of the essential disturbance of the functional state of human body, the GMF activity may provoke desynchronosis and consequently failure of adaptation. Thus, in result of the variations of the GMF tension, the temporal sequence of the environmental information signals can be broken and lead to the functional state of human body which is characterized by a mismatch between the functional abilities and requirements to functional activity that predisposes to the appearance of the pathological states (Soroko, 1985; Moiseeva, Lyubitski, 1986; Tkachev et al, 1992).

The purpose of the study was to assess the features of the Northern children adaptation to the middle latitudes under variations of GMF.

Materials and Methods: The study of the Northern children adaptation to the middle latitudes was carried out on the basis of the Wellness Centre "Ekovit" of the Kola Science Centre RAS (Aleksandrovka-Don Pawlowski Voronezh region). Adaptational abilities were assessed by using of the device "Omega M", based on the analysis of biological rhythms of the human body, obtained by measurement of electro cardio signal in a wide range of frequencies. The method is based on a new informational technology of the analysis of bio- rhythmical processes by using "fractal neurodynamics." System analysis included four modes: analysis of heart rhythm variability - the performance appraisal of autonomic regulation by the statistical methods, temporal and spectral analysis of heart rhythm variability; Neurodynamic analysis - assessment of central regulation of the endocrine system and the methods of neurodynamic analysis of biological rhythms; mapping of the brain biorhythms - psycho physiological assessment of the examinees by methods of phase analysis and mapping of biological rhythms of the brain; fractal analysis - assessment of the degree of the harmonization of biorhythms of the body and determine the immune status by the information about of the fractal analysis. The indicators of psycho physiological state included: IVB (Index of the vegetative balance) - indicates the ratio between the activity of the sympathetic and parasympathetic nervous systems (IVB = Amo (mode amplitude) / Δx); IRPA (index of the adequacy of regulatory processes) - which shows the correlation between the activity of the parasympathetic system and leading-functioning sinus node (IRPA = AMo / Mo); IVR (vegetative rhythm) - indicates the vegetative balance in terms of the activity of the independent regulative contour (IVR = 1/Mo * Δx): under higher activity, ie IVR, under smaller value of the, the vegetative balance shifts towards predominance of the parasympathetic autonomic nervous system; ID (index of the tension of regulatory systems) - shows the degree of centralization of the control over the heart rhythm (ID = AMo / 2 * Δx * Mo);

We have also used the integral indicators which allow make a rapid diagnosis of the mental and the emotional state of the human body (expressed in % relatively normal state). These indicators are referred to as: A - level of adaptation, B - an indicator of autonomic regulation, C - an indicator of central control, D - psycho-emotional state.

Under values of these indices above 50% (fixed point of normal state) – the psycho physiological state and the level of adaptation are considered as a high, and under values lower than 50% - one is low.

Results: Evaluation of the personal values of the adaptation level in children group showed that the adaptation reserves of the children examinees varied from 49.6% to 74.6%. That is mean a different adaptive potential in children group (Table 1). We found, that adaptive possibilities of some children were too a low. The same pattern in indicators of functional state can be seen on the examples of the autonomic and central regulation, psycho-emotional state, as well as a combined indicator of psychophysiological state. Values of the psycho physiological indicators in group of examinees are evidence of a relatively low adaptive capacity of the Northern children.

The low adaptive potential and the high level of tension of the regulatory systems in the body of the Northern children are confirmed by the average values ID =171.35 ± 26.05 and IRPA index =51.15 ± 4.74, relative units (relatively normal range 35-145 and 15-50, respectively). In some case the personal index of vegetative balance (IVB) was equal 391.4, relative units (35-145) that indicates premorbidity state.

Table 1. Psychophysiological characteristics and indicators (relative units) of the adaptation features of the Northern children to the middle latitudes

The average values for the sample	M ±m	Min.	Max.	Std. dev.	Norm.
A - level of adaptation	62.7±2.3	49.58	74.65	7.21	60-100
B - an indicator of autonomic regulation	67.8±3.5	50.35	88.11	11.16	60-100
C - an indicator of central control	61.04±2.5	46.03	68.03	8.00	60-100
D - psycho-emotional state	63.1±2.1	50.35	70.22	6.73	60-100
integral indicator of the state of	63.4±2.7	46.30	74.63	8.53	60-100
IVB - Index vegetative balance	171.4±26.1	94.46	391.37	82.37	35-145
IVR - vegetative rhythm	0.36±0.01	0.32	0.392	0.02	0.25-0.6
IRPA - a measure of the adequacy of regulatory processes	51.2±4.7	34.11	88.20	14.99	15-50
ID - index of tension of regulatory systems	137.1±29.8	60.84	394.43	94.35	10-100

To analyze the dynamics of adaptation of the Northern children to the conditions in the mid-latitude the daily monitoring of psycho-physiological state of examinees was conducted. For this analysis, the all examinees were divided on two groups, depending on the amplitude of the oscillations of the index of the tension of regulatory systems (ID): in the first group the ID fluctuations have a slow amplitude, in the second group - a higher (Fig. 1)

Distribution of the mean ID of in the first group shows regulation of the heart rhythm by the moderate prevalence of the sympathetic tone, associated with a particular strain of the adaptation mechanisms and with adequate response of the autonomic nervous system to the conditions in the middle latitude (Fig. 1, bottom curve, 1). The high variability of the values of ID in the second group (Fig. 1, upper curve, 2) shows the presence of the opposing influences of the autonomous and central regulation of the heart rhythm as well as the humoral-metabolic effects.

In general, the index ID in the first group of the examinees is significantly higher than in the normal range, and, on certain days it significantly increased (7 and 11 August). This means that the complete adaptation to the conditions of middle latitude in this group of children does not occur, on the contrary, the index ID increases toward the end of the stay on vacation. In the second group the index ID, practically does not change during the holyday period, and it remains in the normal range.

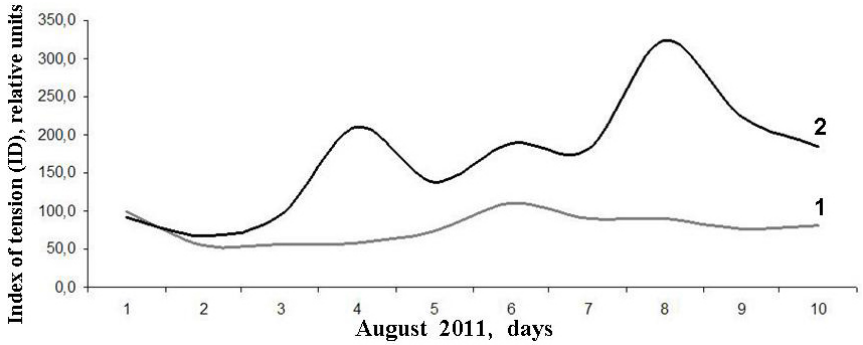

Fig. 1. Dynamics of stress index (ID) in the two groups of subjects. On the horizontal axis - the days of the study, the relevant dates of the registration parameters (from 4 to 13 August 2011), the vertical axis - the value ID, arbitrary units.

To identify the cause of the variability of the index ID the link between indices of the adaptation (A), the autonomic regulation (B) and geomagnetic activity were assessed. We found the increase of the mean A and B in the group of examinees when the GMF activity increased.

Coefficients correlation between indices A, B and interplanetary magnetic field (IMF) magnitude (r=0,72 and r=0,84, p≤ 0.05, respectively) show, that under the increase of the IMF magnitude, as indicator of GMF activity, adaptation of Northern children to environment of the middle latitude increases (Fig 2).

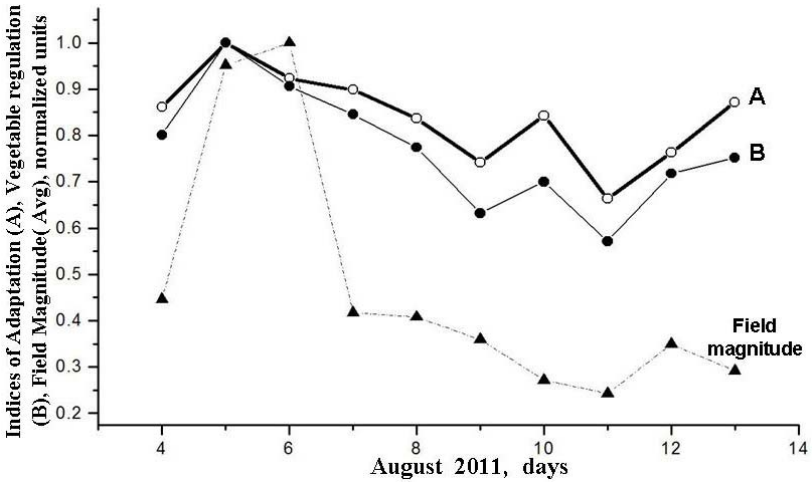

Fig. 2. Coefficients correlation between indices A (level of adaptation), B (level of adaptation) and interplanetary magnetic field (IMF)

Thus, our results shown a lack of complete adaptation of Northern children to the environment of the middle latitude during investigated span. However, the adaptation of the children body from the North increases under the increase of GMF activity. This means, that the body of children living in high latitudes, needs in a certain "dose" stimulus, such as variation of GMF, which are usual environmental agent in high latitude, where they are more intensity and occur more often, than in the middle latitude.

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