

# Effect of Heliogeomagnetic Disturbances on the Functional State of the Brain of Older Women During Mental Stress



Allakhverdiev AR\* and Allakhverdieva AA

Department of Physiology, Institute of Physiology, Baku

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\*Corresponding author: Allakhverdiev AR, Department of Physiology, Institute of Physiology, na AI Karaev of National Academy of Science of Azerbaijan, Baku

## Abstract

**Introduction** In the present work personalized and the total group analysis of the bioelectric activity of brain (EEG) of almost healthy females of 50-60 years old in tranquil days and the days of weak geomagnetic perturbations were carried out. Computer programs Neuron-Spectrum NET analyzed 10 second EEG segments of both hemispheres with a definition of frequency-amplitude characteristics and index of the frontal, central, parietal, occipital and temporal areas in the state of quiet wakefulness with closed eyes and when counting in the mind. The state of counting in the mind was created by presenting to tested people with closed eyes solutions of arithmetic tasks. Discussion and conclusion The study revealed that the restructuring of the structural organization of the EEG observed during mental activity in calm days and days of magnetic storms indicates a shift in the balance of the synchronizing and desynchronizing mechanisms of nonspecific brain systems towards strengthening bottom-up influences of the activating link. At the same time in tranquil days activation processes in a range of high-frequency beta spectrum are of local character, affecting the frontal and temporal areas, in the days of the geomagnetic disturbances activation is diffuse and affects both low-frequency and high-frequency spectra of beta-band EEG. Diffuse reduction of index and slowing its theta rhythm frequency in the days of magnetic storms, in the contrast of the increase of theta rhythm index in tranquil days indicate of less extent of successful solution of the task.

**Keywords:** Elektroencefalography; Frequency-amplitude; Index analysis; Mental activity; Women

**Abbreviations:** EEG- Elektroencefalography

## Introduction

Questions related to the study of the influence of environmental factors on the physiological systems of the human body [1,2] and especially on brain activity attracted and continue to attract the attention of researcher's various scientific areas. Among these factors, a special role is given to disturbances of the Earth's geomagnetic field that occur during periods of increasing solar activity. During maximum activity on the Sun, flashes occur, accompanied by the release of charged particles into the atmosphere, affecting the planet's magnetic field and causing a change in its characteristics. Weak and strong geomagnetic disturbances are distinguished depending on the strength of the flow and the degree of change in the Earth's magnetic field. The human brain, with electrical activity produced by neurons and the resulting electric and magnetic fields, is a screen that responds to changes in the Earth's magnetic environment. A number of researchers point to the relationship between the functional state

of the human brain and geomagnetic activity [3] and the emerging clinical and physiological reactions on the part of the brain when changing the geomagnetic environment [4]. At the same time, in the available literature, information about the age-gender aspects of the problem and the effect of magnetic storms on the activity of the brain in various functional states is scarce. In the continuum of functional states of the brain, the solution of arithmetic problems is considered as a state of intense wakefulness [5,6]. Which differs from the rest state by the structural organization of the frequency-amplitude components of brain electrical activity (electroencefalogram EEG). Considering peace as a state of readiness for action, and stressful as the implementation of mental activity, by a comparative analysis of their EEG, one can also characterize the states themselves and the peculiarities of the restructuring of the structures of bioelectric activity, reflecting the adaptive capabilities of the brain. In this work, in order to elucidate

the nature of the rearrangements of the structural organization of the bioelectrical activity of the brain in response to mental stress on calm and geomagnetically disturbed days, personified studies of the structural organization of the EEG of women 50-60 years old.

## Methodology

The survey involved women aged 50-60 years (15 women). The Electrical activity of the brain (EEG) was recorded from the frontal, central, parietal, occipital anterior temporal, middle temporal and posterior temporal regions of the right and left hemispheres on computer encephalograph according to the international scheme 10-20% , on days with calm (KP = 1-2) and weakly perturbed geomagnetic conditions (KP = 4). The elimination of the influence of the variability of individual characteristics on the research results was achieved by conducting personalized studies. The forecast of the Heli geomagnetic situation in the survey region (Baku) was presented by the Shamakhi Astrophysical Observatory of the National Academy of Sciences of Azerbaijan. The cognitive load (mental count) was created by presenting subjects with arithmetic problems. Each subject was presented with the same set of tasks. We processed non-artifact EEG segments (10 seconds) in a state of relaxed wakefulness with eyes closed and counted in the mind according to the Neuron-Spectrum-NET programs of Neurosoft (Russia). Frequency-amplitude and index indicators for delta, theta, alpha, beta-1 (low-frequency) and beta-2 (fast-frequency) EEG rhythms were analyzed. Further, using the Microsoft Excel program, a comparative analysis of the EEG characteristics was carried out when solving arithmetic problems with a rest state, for days with KP = 1-2 and KP = 4.

## Discussion

To reflect the dynamics of changes in EEG characteristics when giving computational operations to subjects in the mind, we conducted a comparative analysis of the data obtained, which consists of the difference in the values between the state of the account in the mind and the state of rest. The most significant changes were the index and frequency characteristics of theta, beta-1 and beta-2 rhythms. In geomagnetic-calm days, the account in the mind marks a diffuse increase in the theta index, with some emphasis in the temporal areas. In the days of perturbation of the geomagnetic situation, the picture is different - there is a dynamic to the decrease in the percentage representation of theta-rhythm. On quiet days there is a decrease in the beta-1 index - rhythm, mainly in the temporal regions. In the days of weak geomagnetic disturbances there is a diffuse increase in the index of low-frequency beta-1 - rhythm. On quiet days, the increase in the beta-2 rhythm index was observed mainly in the frontal and right temporal regions, and in the days of weak geomagnetic disturbances, an increase in the percentage representation of fast-frequency beta-2 rhythm was observed in all cortical regions. Frequency characteristics of rhythms also reflect different dynamics when moving to a state of account in the

mind, depending on the geomagnetic environment. Thus, in quiet days, when moving from a state of rest to solving an arithmetic problem, there was an increase in beta-2-rhythm frequency and in the days of geomagnetic perturbation there was an increase in the frequency of both low-frequency and high-frequency beta rhythms. The data obtained as a result of research allow us to come to the following conclusions. Observed in the process of mental activity, changes in the structural organization of the EEG, both on calm and geomagnetically disturbed days, indicate a shift in the synchronizing and desynchronizing mechanisms of non-specific brain systems in the direction of strengthening the ascending effects of the activating link. Moreover, on days with a quiet geomagnetic situation at the level of the cerebral cortex, local activation processes are traced in the high-frequency beta spectrum, affecting the frontal and temporal regions. On days with disturbed geomagnetic conditions, diffuse activation is observed, including both the low-frequency and high-frequency spectra of the beta range. Along with this, on calm days in the process of mental activity there is a diffuse increase in the theta rhythm index. In the days of geomagnetic disturbance, mental stress is accompanied by a decrease in the index and a decrease in the frequency of the theta rhythm in all areas. Given the literary evidence, it can be assumed that the increase in mental activity of the percentage representation of theta-rhythm, apparently reflects the optimal structure of the EEG for the success of the job, the decrease in the same theta index perturbation of the heliogeomagnetic environment, indicates less well-established ratios of characteristics of brain activity.

## Conclusion

Thus, the results of personalized studies of the bioelectrical activity of the brain of practically healthy women aged 50-60, suggest that on days of weak disturbance of the geomagnetic situation, in comparison with calm days, a less optimal version of the existing structure of cortical activity in the process of mental activity is necessary to achieve the goals.

## References

1. Samsonov SN, Strekalovskaya AA, Malysheva LA, Petrova PG, Zakharova FA (2016) The connection of geomagnetic disturbance with the state of the human cardiovascular system at high latitudes during the growth phase of the 11-year cycle of solar activity. *Yakutsk Medical Journal* 2 (54): 52-54.
2. Azcárate T, Mendoza B, Levi JR (2016) Influence of geomagnetic activity and atmospheric pressure on human arterial pressure during the solar cycle 24. *Advances in Space Research* 58 (10): 2116-2125.
3. Novik OB, Smirnov FA (2013) A geomagnetic storm reduces the coherence of electrical oscillations of the brain when working on a computer in 2013. *BIOPHYSICS* 3: 554-560.
4. Rozhkov VP, Trifonov MI, Bekshaev SS, Belisheva NK, Pryanichnikov SV, et al. (2016) Assessing the influence of geomagnetic and solar activity on the bioelectric processes of the human brain using structural functions. *Russian Physiological Journal named after Sechenov* 102 (12): 1479-1494.

5. Polikanova IS, Sergeev AV (2014) The effect of long-term cognitive load on the EEG parameters. National Psychological Journal №1: 86-94.
6. Marutina TM, Kondakov IM (2004) Psychophysiology. Textbook for universities - Moscow: MGPPU: 183.



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