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On the Physiological Effect of the Tskaltsminda-Ureki Magneto-Electrical Anomaly

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ABSTRACT

Before the industrial era the natural electro-magnetic background was formed by so called space weather and radioactive dissolution process taking place inside the Earth. Nowadays, due to sustainably increasing anthropogenic load, a process of overall change is observed in the parameters of the environment we live in. The process takes place all over the Earth, especially in areas of dense urbanization, where negative sociological and physiological influences of the technical progress on the global population as well as on individual groups of people are especially felt. This global problem has many aspects and among them is the study of adaptation ability of the population living in the conditions of unnatural changes of the electromagnetic background, the essential element of which is a comparative analysis of background diseases of population, for example, it is already well known that the correlation effect of geomagnetic storms, which is one of the global impact of rapid change in the space weather, has an influence on the deterioration of the health state in population with cardiovascular pathologies. In our opinion, revealing physiological mechanism of this correlation, together with the effects of the processes taking place on the surface of the sun, requires to study physiological effects of the locally variable natural electromagnetic background caused by the influence of geomagnetic anomalies on the Earth. In this regard a comparative analysis of the preliminary medical data of the aboriginal population of the resort area of Tskaltsminda-Ureki local geomagnetic anomaly zone and the population of Telavi region, which is a calmer area in geomagnetic point of view, appears deeply interesting. According to the obtained results the combination of the characteristics of the Tskaltsminda-Ureki geomagnetic anomaly area with the cosmic factors characteristic of the sea coast, probably has a positive influence on the population. According to extrapolation of this conclusion we can generally speak on positive therapeutic effect on the people, who make short-term visits to the Tskaltsminda-Ureki resort zone for recreation and treating purposes.

Keywords: *Magneto-electrical anomaly, physiological effect, Tskaltsminda-Ureki resort.*

Preamble. We may imagine the Earth as a homogenous sphere, on the surface of which perturbations of its own magnetic field (so called "geomagnetic dynamo") induction permanently takes place. This effect is caused by various geological and cosmic mechanisms, which provide conditions for local, regional and global geomagnetic anomalies. Therefore, generally, the magnetic field of the Earth is a superposition of normal and anomalous magnetic fields. Except rare cases the intensity of the first, i.e. the regular component of geomagnetic field considerably exceeds the intensity of the other. The exception is some big anomalies, the geological structures of which are provided by the existence of vast fragments of iron ores. The field of a homogenously magnetized sphere plus continental scale anomalous field (e.g., magnetic fields in polar areas) is called the normal, i.e. the main magnetic field of the Earth. This field is characterized by so called normal

gradients of geomagnetic field in dipole approximation, for example, East Europe is characterized by normal horizontal component gradient $\approx [2-7]$ nT/km.

Significant deviation from normal geomagnetic field refers to existence of regional or local geomagnetic anomaly. Their classification is to some extent conditional and is firstly evaluated according to the area of the anomaly. Therefore, the value of the regional magnetic anomaly of Georgia is commensurable to the local magnetic anomaly characteristic of Russia. Thus, the local magnetic anomaly in Georgia corresponds to micro anomalies in Russia, Kazakhstan or Canada, i.e., any country that coves a vast territory. The value and orographic properties of a magnetic anomaly depend on the degree of rock magnetization, which is determined by physical properties of rocks. Therefore, as a rule, magnetic anomalies are caused by existence of fragments of rocks with different magnetic absorption. The magnetic field of the Earth is characterized by so called century movement, i.e., normal geomagnetic field induction in a given space point varies along time that is associated with magnetic pole drift as well as the variation of the "geomagnetic dynamo" parameters inside the Earth. Besides the century movement, which has its characteristic value $\approx [20 \div 140]$ nT and characteristic time interval – several decades, geomagnetic field shows short-term variations that are caused by external, i.e., cosmic factors. These variations are expressed as sporadic magnetic storms and regular annual, diurnal and short-term (from seconds to 2-10 minutes) periodic oscillations with intensities /1-10/ nT.

It is known that the natural low frequency electromagnetic background is formed by various type waves generated in the near-Earth cosmic space. The intensity and conditions of distributing over the Earth surface of these waves depend on the geomagnetic activity. In calm and less perturbed conditions the self-oscillation frequency spectrum of the Earth magnetosphere, the gigantic magnetic layer, is clearly manifested practically without any distortion. Individual modes constituent of integral wave spectrum of the geomagnetic field variation on the Earth are separated as regular and irregular geomagnetic pulsations and ultra low frequency (ULF) and very low frequency (VLF) electromagnetic oscillations. It is known that geomagnetic pulsation frequency spectrum is composed of six basic regular pulsations Pc1 – Pc6 and each of them has a frequency interval with its maximum probable value characteristic of the given latitude line, for example, appearance of regular short-term pulsations, which belong to Pc1- Pc3, is more probable in low and medium latitudes than in high latitudes. Besides, distribution of the shortest-term Pc1 regular geomagnetic pulsations from the ionospheric levels to the Earth surface in calm conditions is maximally probable in the sea coastline area, where the wave-conductive system Ionosphere-Earth is especially effective [1].

Unlike geomagnetic pulsations, which can be considered as manifestation of magneto-hydrodynamic self-oscillations of magnetosphere resonator, the source of generation of very low or ultra low electromagnetic waves is kinetic effect, which develops as a result of cyclotron instability of the plasma medium inside the magnetosphere. Activity of magnetospheric resonator may be caused due to a rapid change of solar wind pressure, i.e., a global mechanical impulse, whereas in inner magnetospheric plasma it is sufficient to satisfy certain criteria for activation of cyclotron oscillations. Usually, it occurs in some radiation belt of the plasma reservoir of the magnetosphere, e.g., ionosphere. The same phenomenon can serve as a generator of electromagnetic waves. However, as it turned out, appearance of ULF (VLF) waves inside the magnetosphere is rarer than activation of geomagnetic pulsations. Moreover, very low frequency electromagnetic radiation is usually modulated by short-term geomagnetic pulsations [1].

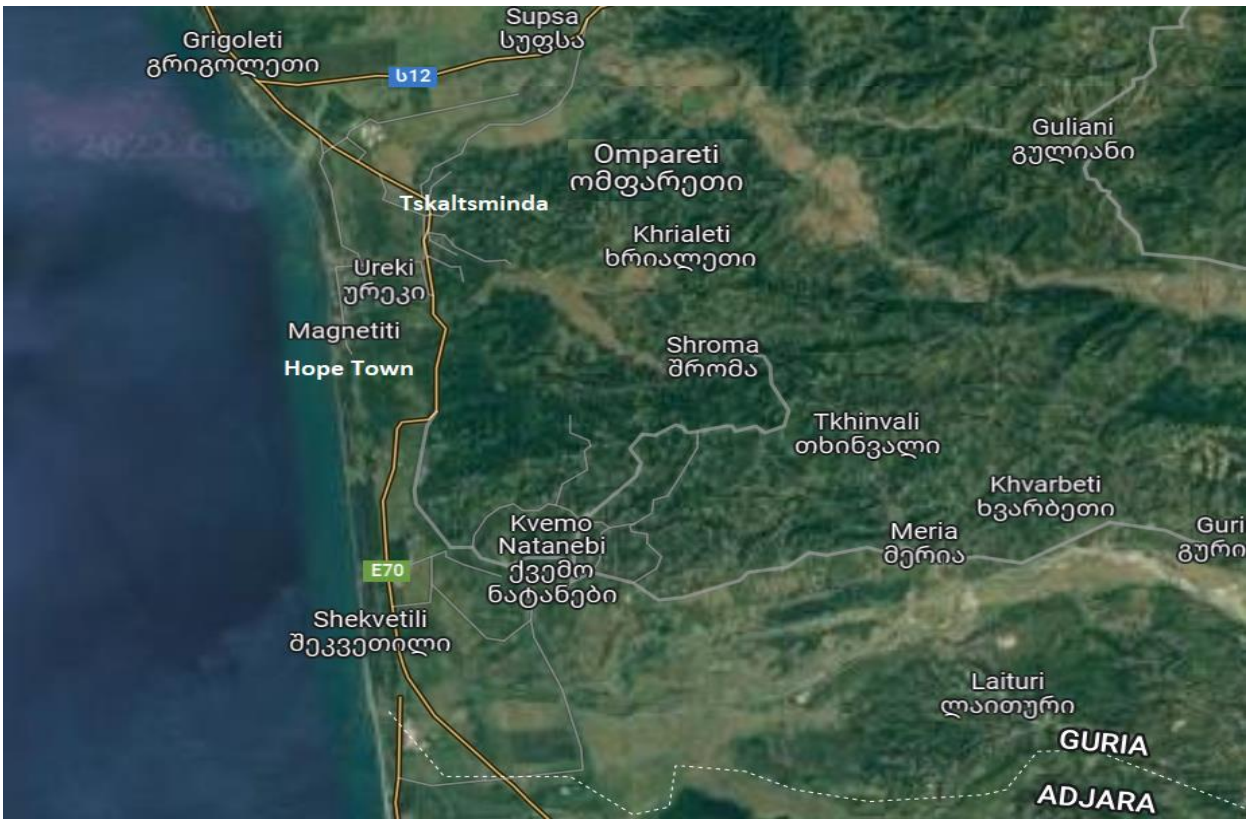
It is known that a certain interval of low frequency magnetospheric electromagnetic radiation spectrum /200-30000/ is practically compatible with the frequency diapason characteristic of human auditory perception

[2]. It is also interesting that the minimum of frequency spectrum of these waves only by half an order exceeds the frequency of industrial electromagnetic wave, which is 50 Hz. Therefore, we may consider that due to the influence of technological electromagnetic field with industrial frequency, the population actually has to be in environment similar to the one, where the inhabitants permanently live in the conditions with high probability that cosmic ULF and VLF radiation reaches the Earth surface. It is noteworthy that like Pc1-Pc2 geomagnetic pulsations, in the magnetospheric ULF and VLF electromagnetic wave spectrum as well, there are such oscillations, the frequencies of which coincide with some human endogenic rhythm. It is acceptable that by means of auditory sensors or via central nerve system they make influence on human organism. Therefore, we may consider that like geomagnetic pulsation, ULF and VLF electromagnetic waves may have a triggering function of vital processes taking place inside the human body [3].

The regional geomagnetic anomaly in Guria. On the territory of Georgia the value of normal geomagnetic field anomaly perturbation has the following classification: 1. weak magnetic anomaly, i.e., deviation from the main characteristic geomagnetic field induction value in interval by [100-500] nT; 2. medium magnetic anomaly – deviation by more than [500-1000] nT; 3. strong magnetic anomaly – deviation by more than 1000 nT. It is noteworthy that deviation from normal field may be both increasing as well as decreasing. In case deviation is positive the magnetic field induction expression takes place and when otherwise then depression is observed. On the territory of Georgia there have been revealed several such anomalies, among which are the regional geomagnetic anomalies of Adjara and Guria. The Tskaltsminda-Ureki-Ompareti local geomagnetic anomaly is a constituent part of the latter and it was for the first time discovered and studied by Prof. Mikheil Nodia. In the 30s of the past century he was heading several long-term geophysical expeditions with the purpose to prospect oil ores in Ompareti. The general results of the expedition were further proved by a large-scale geomagnetic aerial survey organized by the Oil Production Agency of the former USSR in 60-70s. It is natural that there had been no instrumental measurement data on the geomagnetic field of the mountain part of Adjara-Guria before the expedition lead by M. Nodia. Therefore, he had only historical information on the existence of iron and metal mines in Guria, namely in the areas of Chonchkhati dating back to the early era to the late medieval times. Similar information was about Mountainous Adjara, where weapon manufacture was well developed in some gorges. Naturally, it could not have been possible without having local metallurgical raw materials. Besides the historical data there was also a visible sign of high concentration of magnetite in the mountain rocks washed off by the river Supsa and it was visible all over the valley of the river Supsa from the very source to the estuary. Therefore, the first expedition, taking into account the geomagnetic equipment accuracy of that time, made a maximally detailed plan of the areas of the Supsa estuary and some territory of the sea coastline from Kobuleti to Grigoleti. During the first expedition only single, the vertical component of geomagnetic field was measured and further the horizontal component was also added. Due to the big size and insufficient stability during working process in field of so called Schmidt magnetic scales, a magnetometer of that time, a task of geomagnetic planning was very labour-intesive and required quite a substantial amount of time. In spite of that the Schmidt magnetometer accuracy appeared sufficient for quite clearly distinguishing the anomalous values of the geomagnetic field it turned out that the value characteristic of the magnetic anomaly exceeded the threshold of the equipment sensitivity approximately by at least two orders and more: ±10 nT. They mainly used the longitudinal profiling method with an interval of 100 m., though, in those areas, where it was possible to close rectangular frames, i.e., construct the main element of the grid method, Mikheil Nodia used the opportunity everywhere. Despite that, due to objective reasons mainly associated with swampiness of the coastline, the area of the territory

planned by the grid method turned out to be much less than that of the territory planned by longitudinal profiling method [4-6]. It is noteworthy that except rare cases in modern conditions it is practically impossible to repeat the geomagnetic profiles constructed by M. Nodia by modern equipment due to the population increase and building of different urban constructions, among them significant industrial structures, e.g., the Supsa Terminal in the Tskaltsminda-Ureki-Ompareti zone.

The local magneto-electrical anomaly in Tskaltsminda-Ureki. A long-term geomagnetic expedition organized by Institute of Geophysics on this territory began in 1991 and lasted during 1999-2006. During the expedition process a detailed planning of the local magnetic anomaly territories of Tskaltsminda-Ureki (nowadays "Hope Town") and Ompareti was conducted by areal grid method with interval 10 m (Pic.1).



Pic.1. The local magneto-electrical anomaly in Tskaltsminda-Ureki.

As a result of the boundary originated due to the urban changes the micro anomaly of Ompareti was considered as an individual segment of the main local geomagnetic anomaly. They used field magnetometer M-203, by which the absolute vector value $\boldsymbol{T}$ of the magnetic field induction of the Earth is measured. Besides determining the topological image of the geomagnetic field in the Tskaltsminda-Ureki zone, in order to reveal the deep geologic structure of the territory, at the last stage of the expedition a detailed electrometric survey by means of vertical sighting method was also conducted. It appeared that the central area of the geomagnetic anomaly (so called "Hope Town") is characterized with particular inhomogeneity in electric resistance that probably must have been caused due to large fragments of iron-bearing rocks in the sea coastline zone. Such a structure, taking into account sea water leakage into the porous medium, must be in high probability causing a permanent effect of electric polarization and physical phenomena associated with it. Therefore, we consider that this area is anomalous in regard to not only geomagnetic but also geo-electrical point of view. Consequently, the anomaly must be called a local magneto-geo-electrical anomaly. It is characterized with low

absolute intensity, though clear gradients of geomagnetic field together with variable geo-electrical field are also observed. Thus, all the above mentioned together with healthy climatic characteristics, apparently condition particular ecology of this zone. There is a joint activity of several natural factors, namely: sand rich in magnetite, taken down by the river Supsa from the mountains of Guria and Adjara to the porous medium of the beach area; leakage (hydration) of sea water into the coastline; possibility of magneto-hydro-dynamic (MHD) effect generation, as a result of which systematic generation of bound and free polarized charges becomes possible. Under the influence of the variable electrical field generated in such inhomogeneously polarized environment an effect of large-scale (integral) dipole electrical and magnetic moments may arise in the anomaly area. In the area, probably, relaxation of free charges may take place as a result of closing of telluric current circuit generated due to seismic processes developed under the sea in the anomalous zone. In such conditions very low frequency (VLF) surface electromagnetic radiation may generate in the anomaly area. Its characteristic frequency diapason, according to the measures of the anomalous area, must probably be /103-106/ Hz. It is not excluded that in certain cases VLF electromagnetic radiation can be so strong that it may cause local perturbation in the thermo-dynamical and electrical parameters of the atmosphere [7, 8].

The medico-biological aspect. The purpose of comparative analysis of background health data of population living at different places is to verify normal and pathological endemic criteria. In conditions of increasing technogenic load on the environment this issue is considered as a significant aspect of ecological problem for the mankind [9]. It is natural that in this regard, populations in big cities live in particular conditions, which are distinctly different from the usual natural conditions in pre-industrial era. However, population of some certain places might have been under same conditions as in big cities. In regards to electromagnetic background of the Tskaltsminda-Ureki magneto-geo-electrical anomaly zone, which is under high urban load, belongs to the list of such places. Probably, the unique geophysical characteristics determining its value as of a resort, make certain influence on the parameters characteristic of the health of the aborigine population.

It is known that the intensity of the signal that induces parametric resonance phenomenon, i.e., the trigger amplitude, does not have any real meaning. In the case of a living organism the parameter of the activation factor, e.g., electromagnetic wave, which is to coincide with some cyclic function characteristic of organism, is wave signal frequency [2, 10]. As a result of stochastic resonance inside a human body, desynchronization of internal biological rhythms may take place in order to reduce them to a single basic frequency. According to one of hypothesis, such an effect may turn out destructive for the human body, which is diseased or under stress. This is proved by the result obtained after statistical analysis of great number of medical data, which shows tight correlation between global magnetic storms and increased frequency of myocardial infarction, also cerebrovascular accident and lethal ends caused by them [10]. It is logical to assume that such correlation may take place due to anomalous changes in rhythmic process determining the living process of human body, like heart-beating and breathing frequencies. It is noteworthy that the frequencies characteristic of Pc1 - Pc2 geomagnetic pulsations /1 – 0.1/ Hz are in the frequency variation diapason of these very vital characteristics. Pc1 pulsations are sometimes observed in calm geomagnetic conditions, though they almost always accompany global geomagnetic storms, when negative conclusions of cardiovascular diseases are especially increased. Therefore, it is assumed that such type of pulsations may cause stochastic resonance effect in a human body [10]. It is noteworthy that in formation of natural electromagnetic background, besides geomagnetic pulsations, ULF and VLF electromagnetic waves with much higher frequency spectrum than pulsations have a great role and these waves are often modulated by geomagnetic pulsations.

The question whether natural geomagnetic radiation from environment is a permanent negative influence factor for the human body has two existential aspects: medico-physiological and social. Generally, the justice of such assumption must be proved by numerous and versatile research results. In our opinion one of certain cases of such assumption may be manifested by the comparative image based on comparative statistical analysis of the local medical information conducted by us. For this purpose we used the data of the Statistics Agency of Georgia on the Tskaltsminda-Ureki zone and highly populated Telavi region, which is geographically considerably distant and distinguished with its natural conditions from the former. At the same time, at both places, besides the statistical analysis of the preliminary medical information from the healthcare board, a sampling survey by a method of filling out a special questionnaire was conducted on the population. The results revealed quite complete general information involving both male and female aborigine population of all age groups. Namely, there were individual data from 200 residents in 2006 in Ureki. Similarly, by maintaining the correctness of the research method a sampling survey was carried out on the population of Telavi region. Further the results were reconciled with the data of medical archives. Finally, the database of both places included quite wide groups of individuals: Ureki -869 residents, Telavi – 42 789 residents.

Within the framework of the research special interest was taken on separation of the population with health problems within the aborigine residents without referring to degree of disease (low, medium, high). According to methodic the sum of individuals having any type of health problems was equal to 100%. The next step was determining the shares of the diseases, initiation or deterioration of which, with high probability, might associate with triggering effect of geomagnetic pulsations or very low frequency electromagnetic radiation. The diseases were classified in four groups: endocrine diseases, diseases of nervous and sensory system, cardiovascular diseases and respiratory system diseases. The comparative statistical analysis showed significant difference only in the correlation data of endocrine system diseases:

Diseases in the Tskaltsminda-Ureki zone:
- Endocrine system – 6.6 %
- Nervous system and sensory organs – 4.5 %
- Cardiovascular system – 15 %
- Respiratory organs – 13 %

Diseases in Telavi region:
- Endocrine system – 35 %
- Nervous system and sensory organs – 4.5 %
- Cardiovascular system – 15 %
- Respiratory organs – 20 %

At the same time, we used the correlation characteristics of the same disease groups for comparison for entire Georgia:
- Endocrine system – 8.76 %
- Nervous system and sensory organs – 10.29 %
- Cardiovascular system – 20 %
- Respiratory organs – 20.93 %

The obtained results clearly show that correlation statistical indicators of all groups determined according to all three databases, excluding one disease group, are similar. Namely, it turned out that the inhabitants of the magneto-geo-electrical anomaly zone of Tskaltsminda-Ureki, in regards to endocrine diseases are in a considerably better state than the population of Telavi region with calmer natural electromagnetic background. This result appeared to be unexpected as far as according to the opinion

distributed within the circle of medics any kind of electromagnetic radiation, like high-frequency (penetrating radiation) as well as ULF and VLF electromagnetic waves, must have extremely negative influence on functioning of cardiovascular and endocrine systems of human body.

Conclusion.

As a result of carrying out a many-year complex expedition, quite a vast complete database of observations was established by Institute of Geophysics. On the basis of interpretation of these data a theoretical model of the local magneto-geo-electrical anomaly of Tskaltsminda-Ureki, the physical image corresponding of which covers the whole resort zone between the estuaries of the rivers Supsa and Natanebi including the territories of Shekvetili and the camping area, was constructed [7, 8]. According to the model the area of the anomalous geophysical parameters are probably distributed also in the direction of the sea, where in early era a paleo-estuary of the river Supsa was located.

In the viewpoint of fundamental researches of human physiology, taking into account general characteristics of medical information and conditionality of individual data it would be probably reasonable to carry out long-term physiological and epidemiological monitoring of the constitution parameters and functional indicators, especially cardiovascular system as one of the main determinants of adaptation potentials of human organism among valid groups of the aboriginal healthy population of the resort zone.

Such local studies may reveal the physiological effect of permanent influence caused by apparent inhomogeneity of the geomagnetic field.

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წყალწმინდა-ურეკის მაგნიტო-ელექტრული ანომალიის ფიზიოლოგიურ ეფექტთან დაკავშირებით

ზ. კერესელიძე, მ. ლომოური, მ. ჩხიტუნიძე, ნ. ჟონჟოლაძე

რეზიუმე

ინდუსტრიულ ეპოქამდე ბუნებრივ ელექტრომაგნიტურ ფონს აყალიბებდა ე.წ. კოსმოსური ამინდი და რადიოაქტიური დაშლის პროცესი, მიმიდინარე დედამიწის შიგნით. დღეს, სისტემატურად მზარდი ანტროპოგენული დატვირთვის გამო ადგილი აქვს ადამიანების საცხოვრებელი გარემოს პარამეტრების საყოველთაო ცვლილებებს. ეს პროცესი ეხება მთელ დედამიწას, პირველ რიგში მაღალი ურბანიზაციის მქონე არეებს, სადაც განსაკუთრებით საგრძნობია ტექნიკური პროგრესის უარყოფითი სოციოლოგიურ-ფიზიოლოგიური გავლენა როგორც გლობალურად მთელ მოსახლეობაზე, ასევე ადამიანთა ცალკეულ ჯგუფებზე. ამ გლობალურ პრობლემას მრავალი ასპექტი გააჩნია, რომელთა შორის არის ელექტრომაგნიტური ფონის არაბუნებრივი ცვლილებების პირობებში მცხოვრებთა ადაპტაციური უნარების გამოკვლევა, რომლის მნიშვნელოვანი ელემენტია მოსახლეობის ფონური დაავადებიანობის შედარებითი ანალიზი. მაგალითად, უკვე საკმაოდ კარგად არის ცნობილი კოსმოსური ამინდის მკვეთრი ცვლილების ერთერთი გლობალური გამოვლინების, გეომაგნიტური ქარიშხლების კორელაციური ეფექტი გულ-სისხლძარღვთა პათოლოგიის მქონე ადამიანების ჯანმრთელობის მდგომარეობის გაუარესებას შორის. მიგვაჩნია, რომ ამ კავშირის ფიზიოლოგიური მექანიზმების გამოვლენა, მზეზე მიმდინარე პროცესების ეფექტების განხილვასთან ერთად, მოითხოვს აგრეთვე დედამიწაზე გეომაგნიტური ანომალიების გავლენით გამოწვეული ლოკალურად ცვლადი ბუნებრივი ელექტრომაგნიტური ფონის ფიზიოლოგიური ეფექტების შესწავლას. ამ თვალსაზრისით საინტერესო აღმოჩნდა წყალწმინდა-ურეკის ლოკალური გეომაგნიტური ანომალიის საკურორტო ზონაში მცხოვრები აბორიგენული მოსახლეობისა და გეომაგნიტური თვალსაზრისით უფრო წყნარ პირობებში მცხოვრები თელავის რაიონის მოსახლეობის პირველადი სამედიცინო მონაცემების შედარებითი ანალიზი. მიღებული სურათის თანახმად, ურეკი-წყალწმინდის გეომაგნიტური ანომალიის გარემოს მახასიათებლების კომბინაცია ზღვის სანაპიროსათვის დამახასიათებელ კოსმოსურ ფაქტორებთან, სავარაუდოდ, საკმაოდ

კეთილისმყოფელ გავლენას ახდენს აქ მცხოვრებ ადამიანებზე. ასეთი დასკვნის ექსტრაპოლაციიდან გამომდინარე, შეიძლება ზოგადად აიხსნას დადებითი თერაპიული ეფექტი იმ ადამიანებშიც, რომლებიც წყალწმინდა-ურეკის საკურორტო ზონაში მოკლევადიანად იმყოფებიან დასვენებისა და მკუნალობის მიზნით.

О связи с физиологическом эффектом магнито-электрической аномалии Цкалцминда-Уреки

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Резюме

До индустриальной эры естественный электромагнитный фон формировался так называемой космической погодой и процессом радиоактивного распада, происходящим внутри Земли. В настоящее время в связи с неуклонно возрастающей антропогенной нагрузкой наблюдается процесс общего изменения параметров окружающей среды, в которой мы живем. Этот процесс затрагивает всю землю, в первую очередь районы с высокой урбанизацией, где особенно существенно негативное социологическое и физиологическое воздействие технического прогресса как в глобальном масштабе на все население, так и на отдельные группы людей. Эта глобальная проблема имеет множество аспектов и среди них изучение адаптационных возможностей населения, проживающего в условиях неестественных изменений электромагнитного фона, неотъемлемым элементом которого является сравнительный анализ фоновых заболеваний населения, например, Уже хорошо известно, что корреляционный эффект геомагнитных бурь, являющийся одним из глобальных последствий быстрой смены космической погоды, оказывает влияние на ухудшение состояния здоровья населения с сердечно-сосудистыми патологиями. По нашему мнению, выявление физиологического механизма этой связи, наряду с влиянием процессов, происходящих на поверхности Солнца, требует изучения физиологических эффектов локально изменчивого природного электромагнитного фона, обусловленного влиянием геомагнитных аномалий на Земле. В связи с этим большой интерес представляет сравнительный анализ предварительных медицинских данных аборигенного населения курортной зоны Цкалцминда-Урекинской локальной геомагнитной аномальной зоны и населения более спокойного в геомагнитном отношении района Телави. Согласно полученным результатам, сочетание характеристик Цкалцминда-Урекской области геомагнитной аномалии с космическими факторами, характерными для морского побережья, вероятно, оказывает положительное влияние на население. Экстраполируя этот вывод, можно в целом говорить о положительном терапевтическом воздействии на людей, совершающих кратковременные посещения курортной зоны Цхалцминда-Уреки с лечебно-оздоровительными целями.