



## **Investigation of Health Risks and Their Prevention in the Rapid Climate Changes and the Rise of Pollution of the Atmosphere in the Mountain Region of the North Caucasus**

Alexander Babyakin (1), Igor Polozkov (2), Georgy Golitsyn (3), Natalia Efimenko (1), Liubov Zherlitsina (1), Nina Povolotskaya (1), Irina Senik (3), Elena Chalaya (1), Maria Artamonova (3), and Fedor Pogarski (3)

(1) "Pyatigorsk Research Institute of Curortology" of the Federal Medical and Biological Agency of Russian Federation, Pyatigorsk, Stavropol region, Russia, (2) Federal Medical and Biological Agency of Russian Federation, Moscow, Russia, (3) Obukhov Institute of Atmospheric Physics of the Russian Academy of Sciences, Moscow, Russia

The current global climate change is determined by changes in the structure of weather conditions, whose impact on the health of various regions of the planet has not been studied sufficiently. To study this effect on the low-altitude mountains resort of Kislovodsk (southern Russia) multi-factor assessment of the impact of the environment on human health is carried out. There were taking in account atmosphere condition, atmospheric aerosol pollution relationship with atmospheric circulation, the level of pollution matching with different types of weather, and, on the base of analysis of meteopathic reactions (MPR), the extent of their biotropism was revealed.

Two sides of weather-climatic influences - specific and nonspecific - are interconnected. They manifest themselves differently in humans with different levels of regulation of vital activity and the adaptive capacity of the organism to the complex environmental effects. This complicates the precise physiological basis of quantitative criteria for the prediction of "biotropic" (adverse) weathers. Nevertheless, clinical observations have shown the existence of the "limiting" physiological bound on the size of medical-meteorological modules (MMM).

The reactions of the organism to unfavorable weather factors on the results of a questionnaire monitoring surveillance of patients treated in clinics of Federal State Institution "Pyatigorsk State Research Institute of Curortology, FMBA of Russia" (PSRIC), in comparison with clinical data, have identified various MPR of the organism, the clinical manifestation of which depends on age, sex of the patient, the availability of principal and attendant pathology, reactivity, etc. Analysis of the results of clinical observation, cases of medical aid appealability to the station an ambulance at the sudden ill health, as well as the uptake of advice of sick people among immigrants during their short stay at the resort, and the local population, allowed the first approximation to clarify the criteria for "pathogenicity" of various weather conditions and the factors of air pollution. These criteria were put in a new technology of the Medical Weather Forecast (MWF).

In this technology it is proposed to use the integrated Weather Pathogenicity Index (WPI), which is calculated as a weighted average of biotropism indices of various MMM, which include: the dynamics and day to day variability of temperature, pressure and humidity, wind speed, weight content of oxygen and natural air ions in the surface atmosphere, cloudiness, atmospheric phenomena, geomagnetic activity, the ultraviolet index (by UVB solar radiation), the integrated illumination by the sun, the heat conditions of the human. For each of the MMM the five physiological grades of the effects of weather on human adaptation to weather of magnitude and dynamics of WPI are marked out: indifferent, weak, moderate, harsh and overly harsh, according to which the degree of "pathogenicity" of the weather is estimating. Pathogenicity is indicated by quantitative number of medical types of weather (I - a very good weather, II - good weather, III - adverse weather, and IV - a particularly adverse weather). According to the forms of the pressure relief on the sea level, 850 hPa, and 500 hPa, the nature of atmospheric stratification and the presence of atmospheric fronts in the medical types of weather the type of atmospheric circulation is evaluating (anticyclonic - "A", cyclonic - "B", frontal - "C"), which defines a subtype of weather and the possible nature of meteopathia (hypotensive, hypoxic, spastic, etc.).

Innovations of the new technology are associated with the introduction of a methodology for the preparation of MWF the modified classifiers to determine the gradation of biotropism degree for various MMM, confirmed by the results of comprehensive empirical medical and climatic studies using dynamic and synoptic weather forecasting

making by Hydrometeocenter of Russia and forecast of atmospheric pollution making by Obukhov Institute of Atmospheric Physics RAS.

The average weighted WPI forms the basis of weather type number, synoptic weather forecast allows you to define a subtype of the weather. This classification is used in the system of MWF in the resorts of Caucasian Mineral Waters (mountainous region of Northern Caucasus), making for the purpose of timely warnings of medical personnel of medical institutions to strengthen health surveillance and, if necessary, conduct prevention of MPR.

MPR to changing weather conditions are most manifest in connection with resettlement of patients from their places of permanent residence to the unusual climatic conditions of the resort. In this regard, in order to enhance the spa rehabilitation of meteosensitive patients with coronary artery disease at PSRIC a physiological method was developed for early and routine prophylaxis of maladaptive pathological and, above all, MPR using the method of transcranial electric-pulse meso-diencephalic modulation by MDMK-4 apparatus with a frontooccipital location of the electrodes. Clinical manifestation of the MPR in adverse weather conditions in patients with coronary artery disease, hypertension with dysadaptation syndrome is characterized by frequent recurrences of angina, rhythm disorders, cerebral symptoms, vascular crisis, violations in the field of psycho-emotional area and other disorders. These meteopathies are eliminated with high efficiency using the MDMK-4 apparatus in individually selected modes at the planned rate of prophylaxis for 10 procedures. In order to urgent MPR prevention the procedures can be used situationally. The high preventive and curative effects of transcranial electric-pulse meso-diencephalic modulation of the MDMK-4 apparatus is shown by positive dynamics of the clinical status of patients, including data on the MPR test survey, the Kerdem vegetative index, rheoencephalography indicators, electrocardiography, neurovascular reactivity, Holter monitoring of blood pressure and ECG.

For children with respiratory diseases PSRIC developed a number of effective methods to increase organism resistance to the effects of environmental factors through the use of artificial microclimate chambers and methods of climatic treatment.

Thus, a comprehensive study has expanded our understanding of the impact of the environment on human health, to refine the criteria of selected biotropic situations related to the influence of atmospheric pollution, to improve the efficiency of the MWF system in mountain resorts of the North Caucasus, to develop ways to prevent meteopathies of patients with cardio-vascular and respiratory systems.

The investigation was fulfilled in the frames of Program of Presidium of the Russian Academy of Sciences "Basic Sciences – for Medicine" and RFBR grant No. 07-05-12069-ofi\_a.