

## HYGIENE

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**Overview.****Analysis of ensuring climate information collection for carrying out social and hygienic monitoring***S. N. Noskov<sup>1,2</sup>, O. V. Mironenko<sup>1,3</sup>, G. B. Yeremin<sup>2</sup>, E. A. Fedorova<sup>1</sup>*

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Earth's climate change and its adverse consequences are a global problem at the international level. On the territory of the Russian Federation, climatic conditions change approximately 2.5 times more intensively than on average on the planet, average annual temperatures are rising in all physical and geographical regions and federal districts. To solve this problem, the Russian Federation has ratified a number of international documents and developed measures to adapt to climate change. To improve social and hygienic monitoring, — dynamics of changes in air temperature, air velocity, relative air humidity, and atmospheric pressure are used as major indicators in climate assessment, bioclimatic indices being their integral assessment indicators. We can state with good reason that the forecast and meteorological factor effects on human body are the most important links in social and hygienic monitoring. Currently, in spite of many years of research, mechanisms, character and significance of this phenomenon remain largely uncertain. Absence of reliably identified consistent patterns restrains from further research to reveal subtle physiological mechanisms causing human body response to climatic changes.

*Keywords:* human environment factors, public health, meteorological factors, meteosensitivity, social and hygienic monitoring.

## Introduction

Climate (from Greek *klima* — tilt) (inclination of Earth surface to the Sun's rays) is a long-term weather regime corresponding to a particular area. It is caused by a combination of atmospheric, space and terrestrial natural factors which form the weather. Division of the globe into climatic zones: hot, warm, temperate, and cold is related to geographical latitude, from 0 до 30°, from 30 to 45, from 45 to 60 and over 60° latitude.

Depending on average annual temperature and geographical location of the area, 7 major climatic zones are distinguished on the globe, 4 of them being basic climatic zones: equatorial, tropical, temperate and polar, and three being transitional: subequatorial, subtropical and subpolar. Temperate, arctic, subarctic and subtropical zones which in their turn are subdivided, as well, prevail in Russia [1].

Earth climate change and its outcomes is a global problem of the international level. According to the Hadley Center for the United Kingdom's Meteorological service, the global warming rate between 1976 and 2020 is 0.18° per decade, and only during this period the global temperature rose by 0.8 °C. According to Rosgidromet (Federal Hydro-meteorology and Environmental Monitoring Service), the average warming rate in Russia is significantly higher than the global one and is 0.51 °C per decade for the same period of 1976–2020<sup>1</sup>.

## Materials and methods

Cause-effect relationships between population health and impact of human environmental factors, as well as risk and damage from the climate change resulting in increased morbidity and mortality levels among increased risk population groups were studied in this research.

Standard and legal documents, which regulate carrying out social and hygienic monitoring, procedures to assess the degree of natural climate factor effects on population health were analyzed, measures to improve survey, assessment and prognosis of pathological condition development among population caused by unfavourable environmental factors were developed.

## Results and discussion

According to the latest edition of the law “On Sanitary Epidemiological Wellbeing of Population” no. 52-ФЗ of March 30, 1999, and to the RF Government Decree no. 60 of February 02, 2006 “On Approval of Regulations on Carrying out of Social and Hygienic Monitoring”, monitoring human environment factors, including natural climatic factors, being one of its components, is one of the tasks of social and hygienic monitoring (SHM), performed by Federal Service for Supervision of Consumer Rights Protection and Human Well-being.

Based on monitoring data, Federal Service for Supervision of Consumer Rights Protection and Human Well-being creates a Federal information Stock for SHM data. It is a database on population health status and human environment, developed on the basis of

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<sup>1</sup> Report on the peculiarities of the climate in the territory of the Russian Federation for 2020. — Moscow, 2021, p. 104.

regular systemic observations, and a set of regulatory legal acts and procedural documents on the issues of analysis, prognosis and identifying of cause-effect relationships between population health status and human environment factor effects on a human<sup>2</sup>.

Currently the Federal Service for Supervision of Consumer Rights Protection and Human Well-being does not carry out monitoring of natural climatic factors in Russia in the framework of SHM.

Control of natural and climatic factors is carried out by local bodies of Rosgidromet (Federal Hydrometeorology and Environmental Monitoring Service). The following indicators are included into SHM: meteorological conditions, degree of temperature inversion manifestations, solar activity, geomagnetic field, ionosphere state, and presence of geopathogenic zones (phenomena)<sup>3</sup>.

In accordance with RF Government Decree no. 372 of July 23, 2004 “On the Federal Service for Hydrometeorology and Environmental Monitoring” Rosgidromet is a Federal executive body performing the functions of providing state services in the field of hydrometeorology and related areas, environment and environmental pollution monitoring, state supervision over the activities impact on meteorological and other geophysical processes. There is a unified state database on the state environment and its pollution<sup>4</sup>.

According to Procedural guidelines MP 2.1.10.0057-12 “Assessment of risk and damage from climatic changes causing morbidity and mortality level increase in high-risk population groups”, meteorological indicators used to assess climate change effect on population health include average daily and maximum indicators of atmospheric air temperature, relative humidity, atmospheric pressure, wind velocity and precipitation amount.

The most prevalent diseases characterized by climatic change sensitivity include:

- respiratory diseases: acute respiratory infections (J00–J22), allergic rhinitis (J30), chronic obstructive pulmonary diseases (J40–J44), bronchial asthma (J45);
- circulatory system diseases: diseases characterized by increased blood pressure (I10–I15), ischemic heart disease (I20–I25), cardiac conduction impairment and arrhythmia (I44–I49), cerebrovascular diseases (I60–I69);
- endocrine system diseases: diabetes mellitus (E10–E14);
- injuries, poisonings and other consequences of external causes: injuries (S00–T14), frostbites (T33–T35), drowning (W69–W70), suicides (X60–X84);
- mental disorders and alcoholic psychoses (F10);
- intestinal infections: salmonellosis (A02), shigellosis (A03) and other intestinal bacterial infections (A04) and poisonings (A05), viral intestinal infections (A08);
- vector-borne diseases: Lyme disease (A69.2), tick-borne viral encephalitis (A84), Dengue fever (A90–A91), West Nile fever (A92.3), yellow fever (A95), malaria (B50–B54), leishmaniasis (B55), African trypanosomiasis (B56), Shagas disease (B57), ochocerciasis (B73), filariasis (B74).

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<sup>2</sup> Federal Law No. 52 “On the Sanitary and Epidemiological Welfare of the Population” dated March 30, 1999.

<sup>3</sup> Methodical recommendations no. 2001/83 “Methodology for conducting social and hygienic monitoring”, 2001.

<sup>4</sup> Decree of the Government of the Russian Federation of July 23, 2004, no. 372 “On the Federal Service for Hydrometeorology and Environmental Monitoring”.

Increased risk population groups for which climatic change health effects are assessed, include:

- children (from 0 to 17);
- elderly persons (60 years and older) and old-aged (75 years and older);
- persons with chronic diseases, suffering from respiratory, circulation nervous, urinary and endocrine system diseases;
- employable age persons, including outdoor workers;
- indigenous peoples.

Assessment of meteorological factor effects on health should be done according to the following indicators:

- population mortality;
- population morbidity by number of persons seeking medical care;
- morbidity by hospital admission data;
- number of population seeking emergency medical aid [2].

Ability of living organisms to respond to weather conditions changes is called meteorodependence. The following quantitative clinical tests are used to assess meteorotropic responses [3]:

- Kerde index ( $I_K$ ) is used to characterize autonomic nervous system responses. Positive values of  $I_K$  are considered to reflect prevalence of tone of sympathetic division of autonomous nervous system, and negative values are specific for vagotonia, i. e. unstable state of blood vessels;
- Rudder's meteorosensitivity test index (G M). Value of G M > 1 corresponds to the presence of meteorotropic manifestations;
- Index of seasonal morbidity and mortality  $G_c = (dI/mI \cdot 365)/N$ , where dI — number of deaths in the i-month of the year being considered; mI — number of days in a month; N — population size.

According to manifestation degree, four types of meteorosensitivity can be classified [4]:

Mo — there is no evident sensitivity to weather regime changes.

M1 — meteorosensitivity is slightly manifested. In unfavourable weather mild responses appear, mainly general complaints (low mood, headache, inertia, weakness, muscle pain, slight sleep disturbances).

M2 — meteorosensitivity is moderately manifested. In unfavourable weather objective disturbances occur (increased blood pressure, sore throat and other symptoms of cold. In cardiovascular disease patients negative ECG deviations, evident decrease of working capacity, occurrence of heart pains).

M3 — high meteorosensitivity. Meteoropathic responses are manifested in severe degree (hypertensive crisis, respiratory impairment, asthma attacks, angina attacks, angina attacks, aggravation of chronic pneumonia). People belonging to this group of meteorosensitivity have got very low adaptation capacity, so they need permanent medical control.

According to the literature data [5] the strongest meteorotropic responses can be seen in blood circulation disease patients: myocardial infarction, hypertension, rheumatism. In some cases percentage of coincidences of aggravations with unfavourable weather types

reaches 72%. On cyclone and thunderstorm days the number of sudden clinical death cases in ischemic disease patients as well as percentage of acute left ventricular insufficiency increases significantly.

Correlation analysis of the role of meteorological factors in cardiovascular disease pathogenesis showed that January weather severity index ( $r = 0.57$ ), weather sultriness ( $r = 0.5$ ), number of humid weather days ( $r = 0.51$ ), gloomy weather frequency ( $r = 0.66$ ), number of no-wind days ( $r = -0.55$ ) are the most significant climatic indicators.

Average daily number of deaths is approximately the same, both on high and low atmospheric pressure days, significant correlations being seen between acute myocardial infarction and the number of days with air temperature difference  $> 60^{\circ}\text{C}$  ( $r = 0.54$ ) and pressure  $> 10$  hPa ( $r = 0.52$ ). Increased rate of hypertension disease attacks, is mainly associated with “spastic” and “hypoxic” weather types; in years with frequent recurrence of days characterized by sharp and significant fluctuations of air temperature and atmospheric pressure (over  $50^{\circ}\text{C}$  and 5–10 hPa) and with greater frequency of “sultry” weather, characterized by low air oxygen concentration, disease incidence rate increases significantly.

Hypertension crises frequency increase associated with weather changes were reported by other authors as well, for example, N. S. Temnikova et al surveyed patients through the entire period of hospital stay (30–60 days), retrospectively studied medical histories of 1801 patients and 24 422 ambulance calls. 54.7% of hypertension patients and 24.3% of myocardial infarction patients were meteosensitive, most unfavourable months being March, April, May, December, February.

In 48.2% of cases meteopathic reactions were observed with a decrease in atmospheric pressure by 5–8 hPa and an increase in relative humidity by 25–30% in frontal cyclonic weather. Arkhipova I. V. revealed a close correlation mainly between hypertension disease and the number of days with significant diurnal fluctuations in atmospheric pressure ( $\geq 8$ –10 hPa) ( $r = 0.84$ ), frequency of sultry weather days with air temperature  $\geq 200$  C and air humidity  $\geq 80\%$  ( $r = 0.5$ ).

It is reported that among rheumatism patients meteosensitivity achieves about 90%. Meteosensitivity of this disease is classical. Significant temperature and atmospheric pressure fluctuations result in unfavourable effect on the course of rheumatism. In the temperate zone an increase in frequency of aggravations is mainly reported in autumn, winter and early spring — during cold and damp seasons.

Research carried out in Yalta Scientific Research Institute of physical treatment methods and climatology named after I. M. Sechenov showed that over 50% of chronic non-specific pulmonary disease (COPD) patients are meteosensitive, and among chronic obstructive bronchitis patients this percentage is 72%. Weather conditions characterized by rapid approach of weather front, atmospheric pressure drop, high humidity, strong wind, cold snap are most unfavourable for meteosensitive COPD patients.

Analyzed the relationship of COPD and bronchial asthma course with weather conditions showed that in warm season meteopathologic response was seen on the average in 20.2% of patients (in 28% of bronchial asthma patients), and in cold season the response was observed on the average in 48% of the patients (and in 78% of bronchial asthma patients).

The COPD course is greatly affected by the entire complex of meteorological factors. Bronchial asthma prevalence has got an evident climatic dependence. Bronchial asthma

incidence is mainly reported in areas where the climate is characterized by a combination of high humidity with high or low air temperatures and with a contrasting weather change.

In addition to direct unfavourable effect the weather can produce an indirect one as well. For example, the higher the air humidity, the greater are the effects of chemical and biological allergens. The self-cleaning ability of atmosphere is of certain significance. Low diffusing capacity of atmosphere reduces the comfort of climatic conditions for respiratory disease patients

When analyzing infectious diseases of upper respiratory tract, many researchers emphasize the significance of unfavourable weather conditions in increasing disease incidence.

Correlation analysis of the role of meteorological factors in the incidence growth of acute infectious diseases of upper respiratory tract showed that the Bodman weather severity index ( $r = 0.8$ ) and duration of low temperature air period ( $r = 0.5$ ) are the most important climatic indices. Seasonal dynamics of respiratory disease incidence is quite evidently manifested in temperate climate zone and is characterized by increased frequency of attacks in spring (March — April) and in autumn (October — November).

Correlating of acute condition incidence of gastric ulcer and other diseases with weather conditions reveals a significant role of the latter and allows over 30 % of acute condition cases to be attributed to weather-related ones indicates to the significance of meteorological factors for chronic gastrointestinal disease children.

According to his findings, from 41 to 63 % of children suffering from these diseases are weather-sensitive. The number of acute conditions of gastric ulcer increases with unfavourable weather and with pronounced meteorological instability accompanied by significant air temperature fluctuations ( $r = 0.55$ ) and high weather severity index ( $r = 0.5$ ).

About 20.3–22 % of all acute conditions in pyelonephritis and 25.1 % in glomerulonephritis are weather-related. According to Grigor'ev, 53.5 % of glomerulonephritis and 40.6 % of pyelonephritis children are meteosensitive. A correlation between renal and urinary tract diseases and winter weather severity index ( $r = 0.58$ ) and frequency of humid weather periods ( $r = 0.5$ ) was identified.

The climate of dry and arid steppes of the Kulunda lowland with long hot and dry summer with very high average air temperatures, low humidity, intense solar radiation induces profuse sweating and can be quite favourable for chronic nephritis.

When analyzing the relationship of frequency of seeking medical aid by mental disorder patients and climatic indicators, significant and reliable correlations were found with weather severity index ( $r = 0.5$ ), frequency of changeable weather with temperature drops in atmospheric air pressure  $> 10$  hPa ( $r = 0.57$ ) and long-term discomfort period in transitional seasons of the year ( $r = 0.6$ ).

When assessing weather and climatic factor effects on pregnancy course and outcome, special importance is attached to storm winds and frontal weather. A direct relationship between the occurrence of pregnancy complications and frequency of weather periods with significant pressure drops ( $r = 0.54$ ).

In the studies by D. A. Chernykh et al. carried out on Krasnoyarsk Territory it was shown that temperature fluctuations (periods of hot and cold weather waves) and mortality jumps related to them, especially caused by cardiovascular and respiratory diseases [6] are significant.

According to E. G. Golovina, various biometeorological indices are used to assess weather conditions from medico-meteorological point of view, such as effective temperature (ET), equivalent effective temperature (EET), normal equivalent effective temperature (NEET), radiation equivalent effective temperature (REET), biologically active temperature (BAT), temperature and humidity index (THI), wind cooling index (WCI), human heat balance equation, Bodman index of climate severity, and from medical point of view, it is advisable to use the wind-cold index (according to Siple), equivalent calm temperature (ECT) heat load index HLI (K. Ya. Kondrat'ev), index of pathogenicity of meteorological information, weather variability index.

Currently about 30 biometeorological indicators are known and used for calculations — indices which are tentatively divided into 7 major groups. The classification was developed by E. G. Golovina and M. A. Trubina and at Russian State Hydrometeorological University, St. Petersburg, and supplemented with the 7<sup>th</sup> group by S. S. Andreev [7; 8]:

1. Temperature and humidity indicators:  
ET — effective temperature of still air;  
DI — discomfort index (USA);  
DY — discomfort index (Japan).
2. Temperature-wind indicators (cold stress indices):  
W (K) — wind-cold index (according to Siple);  
WC — updated wind-cold index (Kanada);  
S — severity score according to Bodman;  
T — weather severity coefficient according to Arnoldi;  
H — wind-cooling index according to Hill;  
So — weather severity coefficient according to Osokin;  
ECT — equivalent calm temperature.
3. Temperature-humidity-wind indicators (for shady spaces):  
ET — equivalent-effective temperature (thermal sensitivity index, taking into account wind effect);  
EET — equivalent-effective temperature;  
NEET — normal equivalent-effective temperature (thermal sensitivity index, taking into account wind effect for a dressed person).
4. Temperature-humidity-wind indicators (taking into account solar radiation):  
REET — radiation equivalent effective temperature, assessed by expert as the most informative index;  
BAT — biologically active temperature;  
Tred — reduced temperature indicator according to Adamenko and Khairulin;  
Qs — net heat balance of human body according to Rusanov;  
C — clothes insulation, unit clo;  
Climate discomfort coefficient according to V.I. Rusanov.
5. Pathogenicity and climate variability indicators:  
I — pathogenicity index of meteorological situation (according to Boksha);  
 $\rho O_2$  — partial oxygen density according to Ovcharova;  
CWM — class of weather of the moment according to Rusanov;  
K — variability index of CWM according to Rusanov;  
BISM according to Belkin;

MHI — meteorological health index according to Bogatkin;

G — thermoregulation mechanism intensity index according to B. A. Aizenshtadt;

N — heat load index according to K. Ya. Kondrat'ev.

6. Indices of climate continentality:

$K_G$  — according to Gorchinskii;

$K_{khr}$ . — according to Khromov.

7. Indices characterizing the state of atmosphere:

$I_i$  — summary index of atmospheric pollution.

In view of keeping favourable living conditions for population and development of required preventive measures, B. B. Prokhorov suggested to determine comfort degree of the area on the basis of analysis of about 30 human environment parameters: duration of periods with different air temperatures, climate continentality, total sum of heating degree/days, soil and water ability to self-purification, biota character, seismicity, permafrost, risk of floods, mudflows, avalanches, prerequisites for diseases and conditions of their manifestations, prevalent pathology among various population groups, presence of factors contributing to or preventing from recovery of patients and etc.

Degree of comfort was suggested to be assessed on a 5-point scale. According to this scale the regions considered are divided into comfortable, precomfortable, hypocomfortable, uncomfortable and extreme ones.

Comfortable areas (the most favourable for human habitation) are the territories where factors which significantly complicate work, life, recreation of people, are absent or are insignificant. Adaptation of newcomer population takes place here quickly and without complications.

Precomfortable areas are territories where negative impact of natural factors on population health is seen for a short time and is slightly manifested. The adjustment of newcomer population is accompanied by a moderate stress of adaptive systems of the body with a tendency to quick compensation.

Hypocomfortable areas are territories within which natural factors complicate normal working conditions, life and recreation conditions of population. Adaptation of newcomer population takes place here with a strong strain of adaptive systems of human body with gradual compensation.

Uncomfortable areas are territories where most of the year natural conditions complicate work, life and recreation of people, and certain natural conditions have a strong negative effect on population health (especially that of old-aged and children).

Adaptation of migrants is accompanied by strong strain of adaptation systems of the body with complicated compensation.

Extreme regions are areas within which natural conditions, practically all year round, sharply complicate work, life, relaxation of people, and parameters of some environmental factors reach values which are critical for health and life. Adaptation of migrants here takes place with very strong stress of adaptation systems, with a tendency to decompensation [8; 9].

E. S. Andreeva et al. suggest calculation of certain biometeorological indicators, as well as determination and interpretation of integral index of climatic comfort (IICC). In particular, at the first stage, a thermal effect on the body is assessed, using such param-



eters, as: equivalent effective temperature (ET), biologically active temperature (BAT), radiation equivalent effective temperature (REET), heat balance of human body (Q).

The second stage of technique implementation involves assessment of degree of pathogenicity of meteorological conditions (I). At the third stage it is supposed to assess potential of atmosphere for its self-purification (КМ). Integral indicator of bioclimatic comfort resulting from the described procedure implementation is suggested to be determined as a sum of scores of bioclimatic assessment resulting from 3 stages.

Suggested integral indicator, which is the sum of points of all three stages of climatic comfort assessment, is universal for any studied area and enables to identify such parameters as: comfort, discomfort and moderate discomfort. At the same time, important effect of meteorological factors on health is taken into account, as well as the possibility of reducing atmospheric pollution due to its self-purification potential [10].

V. V. Vinogradova, taking into account varying climatic conditions on the territory of Russia, suggested to use the Universal thermal comfort index (UTCI). UTCI index reflects equivalent ambient temperature which has the same physiological effect on humans as the actual environment. This indicator was initiated by the Commission of the International Society for Biometeorology [12].

According to S. V. Tkachuk, the most promising in terms of predicting the comfort of weather conditions are the indicators which take into account the effect of accumulation of negative impact of certain conditions. The American HIS index (Heat Stress Index) is one of such indices developed to determine heat load in summer season. The distinctive feature of this index is a consideration of a number of variables, which as well as the major meteorological parameters affect heat perception: wind velocity, cloudiness and solar radiation. Moreover, none of the indices developed earlier takes into account accumulation of negative effect of heat over a certain period, for example, several days [13].

To systematize research and apply it to the needs of economic activity in climatology, the concept of climatic scales is used. The main ones are macro, meso and micro scales. The macroscale is used in meteorology and climatology to study processes and phenomena comparable in size to hemisphere or its large regions (seas, continents). Mesoscale climate changes are usually understood as processes occurring under the effect of a large city or some area of a large lake, river, valley, mountain range, etc.

Each building site and individual objects have their own microscale climate, i. e. — microclimate on their territory and in the immediate vicinity of it. The most significant sanitary and hygienic indicators of the microclimate which affect thermal state, include: air temperature and its relative humidity, air velocity, thermal radiation of human body and surrounding objects, which determine the possibility of heat exchange between the body and the environment, and achievement of thermal balance of the body.

A thermal state in which there is slight stress in thermoregulation is defined as a state of thermal comfort. Therefore, climatic parameters of thermal comfort are used as a hygienic standard for microclimatic conditions. In general, “microclimatic standard” should provide an optimal state of the body which is characterized by an insignificant strain of functional systems. At the same time, hygienic regulation cannot be limited to establishing only optimal parameters for certain factors.

Simultaneously “allowable” limits of their fluctuations must be determined. These limits are set depending on the nature of outdoor activity and physical activity level typical for this activity. According to the degree of influence on a person’s wellbeing and on

his working capacity, microclimatic conditions can be divided into: optimal, allowable, harmful and dangerous (extreme).

Optimum microclimate conditions are characterized by such parameters of microclimate indicators which under their combined effect on a human can provide keeping up of a thermal state of the body. In these conditions a minimum in thermoregulation mechanism strain is seen, whole-body and/or local discomfort heat sensations are absent, which is a prerequisite for maintaining high working capacity.

In an optimal microclimate a comfortable thermal state of human body is provided. Allowable microclimatic conditions are characterized by such parameters of microclimate indicators that under their combined effect on a human can cause such change of a thermal state in which a moderate strain of thermoregulation mechanisms is observed. In this case a slight general and/or local discomfort in heat perception can occur.

Meanwhile, relative thermal stability is preserved, temporary decrease of working capacity can take place, but the health is not impaired. Such microclimate parameters are admissible at which the thermal state of the body can be considered satisfactory.

Harmful microclimatic conditions are microclimate parameters, which under their combined effect on a human can cause changes in the thermal state of the body: pronounced general and/or local uncomfortable sensations of heat, a significant stress in thermoregulation mechanisms, a decrease in working capacity. At the same time, thermal stability of a human body and health preservation are not guaranteed. The degree of harmfulness of microclimate is determined both, by values of its components, and their exposure duration.

Extreme (dangerous) microclimatic conditions are microclimate parameters, human exposure to which even for a short time (less than 1 hour) cause a thermal state change characterized by excessive stress of thermoregulatory mechanisms which can result in health disturbances and death risks. Moreover, extreme indicators can include heatstroke, cold stress and squall wind effects [14].

A retrospective analysis showed that the forecasting institutions of Hydrometeorological Service started providing doctors and public with medical weather forecasts since 1963. Clinical testing of the method for assessing meteosensitivity using medical types of weather was the development of interregional schemes of medical weather characteristics for certain regions of the country. These included central regions of the European territory of Russia, the Black Earth Zone, Leningrad region, the Volga region, the Far East, Crimea, Kyrgyzstan, Uzbekistan, Latvia, Lithuania, etc.

Identifying and prevention of adaptive-meteorotropic syndrome contributed to a decrease in the frequency of complications and relapses of the underlying disease, and increased treatment effectiveness.

Timely consideration of medical weather forecasts enabled medical personnel to perform the prevention of meteorotropic reactions in in-patient, home, and out-patient settings.

Thus, the use of a complex of collective and individual measures on days with weather of type III and IV reduced the frequency of pathological meteorotropic responses in various diseases by 80–90%, contributed to the patient adaptation (if he was sent to a sanatorium) to climatic conditions change and to sharp weather fluctuations.

Diagnostics of increased meteosensitivity state was carried out according to the anamnesis, clinical and meteorological monitoring and the use of diagnostic test indices.

The average observation period enabling to obtain objective information on meteosen-sitivity, is 45–60 days, and should not be less than 3–4 weeks. It is required that 3–4 days with sharp changes in weather were reported during the observation period.

An important principle of clinical and meteorological monitoring is the application of the method of superposition of short-period epochs — an analogue of the method of superposition of epochs of A. L. Chizhevsky for heliosociological studies. The method of superimposing short-period epochs assumes simultaneous observation of a group of sick and healthy persons for 30–45–60 days, which enables to identify their meteosen-sitivity, its severity degree and to determine the type of meteo-tropic reactions [16].

In current conditions characterized by global climate change and growing anthropo-genic pollution of environment, prevention and correction of meteo-pathic responses in healthy and sick people, are becoming increasingly important. To solve this problem new approaches to monitoring meteo-helio-geophysical factors are used, taking into account their information value and evidenced relatedness to changes in the functional state of the human body.

New diagnostic and treatment procedures for early detection and correction of meteo-pathic reactions, especially those relating to cardio cardiorespiratory system, are being de-veloped. Within the framework of these studies, Yu. A. Rakhmanin et al. [17] developed new scientific, organizational and procedural approaches to development and implementation of programs to prevent the adverse effects of global climate change on RF population health.

The work performed evidenced the prospect of creating a mathematical model for the development of increased meteosen-sitivity in response to the influence of unfavour-able meteorological factors, followed by the formation of recommendations for its use in personalized programs of sanatorium-resort treatment of meteo-dependent patients.

E. G. Kameneva [18] identified the most informative physiological indicators and suggested a meteosen-sitivity assessment method in coronary heart disease patients and changes in systolic blood pressure in healthy subjects, clinical application of which con-tributed to the increase of effectiveness of vascular event prevention and development of arterial hypertension in coronary artery disease patients.

Often an increase in overall mortality among acute myocardial infarction patients is reported a few days before meteorological factors start changing; a method of early weather forecasting and informing health authorities for them to take required organiza-tional long-term measures [19].

Results of analysis of regional features of meteorological conditions of urbanized Caucasian midlands made it possible to improve the System of Sanitary Hygienic Moni-toring and develop measures to improve survey, assessment and prognosis of develop-ment of acute pathological condition of cardiovascular system in population, caused by unfavourable environmental environmental factors [20].

Stupishina O. M. et al. suggested and tested a model for early assessment of natural and climatic factor effect on population health [21].

Special emphasis should be given to the contribution of photochemical formation of formaldehyde, which may significantly exceed direct emissions from natural, industrial, mobile and agricultural sources. In winter or on summer nights in cities direct formalde-hyde emission may be more important than those from the secondary sources.

Among the sources of urban atmospheric air pollution by formaldehyde, especially in large cities, vehicle exhaust plays an important role. Formaldehyde concentration in

atmospheric air has got a seasonal and diurnal character and depends on meteorological factors. In daytime and in summer with high temperatures and solar activity, formaldehyde concentration increases greatly [22].

In order to improve social and hygienic monitoring, the determining indicators in climate assessing are dynamics of changes in air temperature, air velocity, relative air humidity, atmospheric pressure, — for the assessment of which bioclimatic indices will be integral indicators. It can be quite reasonably stated that the forecast and assessment of meteorological effects on a human body are the most important links in social and hygienic monitoring.

Currently, in spite of many years of research, — mechanisms, character and significance of this phenomenon remain largely uncertain. The lack of reliably identified patterns restrains further research aimed to reveal subtle physiological mechanisms, which cause human body responses to climatic factor changes. Inconsistencies of findings of numerous studies carried out by domestic and foreign researchers can be explained by natural climatic features of various regions of the world, insufficient number of observations and errors in statistical processing of data obtained.

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