ГИГИЕНА

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Assessment of the population health risk under the impact of climatic factors in the territory of St Petersburg

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In recent years, climate change has been considered as one of the leading factors affecting the health of the population, one of the conditions for the implementation of this concept for specific risk factors in St Petersburg is the development and use of adequate methods. In this work, as a methodological basis for assessing the state of health of the population, taking into account climatic conditions, the methodology of MR 2.1.10.0057-12 "The state of health of the population in connection with the state of the environment and living conditions of the population. Assessing the risk and damage from climate change affecting the increase in morbidity and mortality in high-risk population groups. Guidelines" was used. The presence of statistically significant correlations between the effective air temperature in St Petersburg and the primary incidence of diabetes mellitus in people older than working age has been established (Spearman rank correlation coefficient −0.829, $p = 0.042$); primary incidence of acute respiratory infections of the upper respiratory tract in children 0–14 years old (Spearman rank correlation coefficient −0.886, $p = 0.019$); primary incidence of chronic obstructive pulmonary disease in children 15–17 years (Spearman rank correlation coefficient −0.943, $p = 0.005$). The presence of established direct and inverse statistically significant correlations can be explained logically based on modern ideas about the impact of climatic parameters on human health, however, in this case, the logical connection seems doubtful due to the highest deviation of the average annual air temperature from the norm in 2020 and the pandemic of a new coronavirus infection COVID-19. Therefore, a decrease in morbidity (in the case of a negative correlation) can be explained by a reduction in planned medical care.

Keywords: morbidity, population, public health risk assessment, climate, St Petersburg.

Introduction

Over the past decades, the unprecedented high rate of global warming and climate change has raised concerns. It has been established that human economic activity has a significant impact on the climate. These climate changes are diverse and are manifested in changes in the frequency and intensity of climatic anomalies and extreme weather events. Expected climate change will inevitably affect the lives of people in all regions of the planet, and in some of them will become a tangible threat to the well-being of the population.

In recent years, climate change has been regarded as one of the leading factors influencing public health. There is both a direct impact due to an increase in the number of days with abnormally high and/or low temperatures, floods, storms, typhoons, and an indirect one, mediated by the influence of environmental or socio-economic factors (an increase in the area of drylands, a decrease in the volume of high-quality drinking water, etc.). The impact of climate change in cities is combined with the adverse impact on the health of the population of polluted atmospheric air.

According to WHO estimates, in Europe, climate change annually causes from 1 to 10 % of deaths among older age groups, and in the world — more than 150 thousand additional deaths and 5.5 million years of disability per year. This represents 0.3 % of total deaths and 0.4 % of total years of disability, respectively. By 2050, a further increase in the number of deaths associated with climate warming is expected by another 1.0–1.5 %. The economic damage from additional mortality as a result of climate change in the world fluctuates in a wide range — from 6 to 88 billion dollars a year.

In accordance with the Climate Doctrine of the Russian Federation, the negative consequences of the expected climate change for the Russian Federation include an increase in health risks (increase in the level of morbidity and mortality) of the population. Assessment of risks and related losses are considered as the most important components in the development and planning of measures for adaptation to climate change. Quantitative risk assessment allows you to estimate the approximate magnitude of specific consequences (illness and premature death) under different scenarios [1–8].

The main risk factors associated with climate change are high temperatures, extreme weather events, the spread of infectious diseases, malnutrition, etc. "Waves" of heat and cold are considered as one of the priority factors of climate change affecting the increase in the level of morbidity and mortality in the population of the Russian Federation [9–14].

Materials and methods

The methodological basis of the work is the scientific concept of assessing and managing risks to the health of the population living in ecologically unfavorable areas, which has found wide application in healthcare practice. One of the conditions for the implementation of this concept for specific risk factors in St Petersburg is the development of adequate methods for hazard identification, exposure assessment, assessment of the dose-effect relationship and risk characterization with an analysis of its uncertainties. Since in the case under consideration, risk is understood as the probability of occurrence of harm and its severity as a result of exposure to environmental pollution, the assessment of the socio-economic consequences associated with them based on the use of modern evidence-based methodology is a necessary step in planning a general policy in the field of environmental management and health. In the course of this work, the following methods were used:

— *hygienic methods*, including the collection, analysis and generalization of the results of laboratory and instrumental studies and measurements of atmospheric air quality and climate parameters in the city of St Petersburg, affecting the health of living people;

— *epidemiological methods for analyzing the incidence of the population;*

— *statistical methods* for processing the data obtained, including the use of statistical tools to identify the correlation between various environmental factors, their man-made pollution and the state of public health, as well as take into account the contribution of social and professional factors to the formation of the state of public health; generally accepted statistical methods were used using a personal computer with installed Microsoft software products (Microsoft Excel) and the IBM SPSS Statistic v.22 application program, which created a database on morbidity for 2015–2020, calculated health risk and correlation analysis;

— *prognostic methods* — calculation methods that make it possible to obtain predicted values of the potential risk to public health from the impact of climatic factors and air pollution in populated areas.

Methodology for assessing the state of health of the population, taking into account climatic conditions

As a methodological basis for assessing the state of health of the population, taking into account climatic conditions, the methodology MR 2.1.10.0057-12 "The state of health of the population in connection with the state of the environment and living conditions of the population was used. Assessing the risk and damage from climate change affecting the increase in morbidity and mortality in high-risk population groups. Guideline" [15].

When collecting and evaluating meteorological data, the following methodological approaches were used.

For the simultaneous assessment of air temperature and humidity, the effective air temperature was used, which was calculated by the formula:

$$\text{Tapp} = -2.653 + 0.994 \text{ x } (\text{Tair}) + 0.0153 \text{ x } (\text{Tdewpt})^2, \quad (1)$$

where: Tapp — effective temperature; Tair — air temperature; Tdewpt — dew point.

The dew point was calculated from the relative humidity information using the formula:

$$T_d = \frac{b\gamma(T,RH)}{a-\gamma(T,RH)}, \quad (2)$$

where gamma is calculated by the formula:

$$\gamma(T,RH) = \frac{a \times T}{b \times T} + \ln(RH/100), \quad (3)$$

where: T — air temperature; RH — relative humidity; a, b — constants equal to 17.271 and 237.7 respectively.

When collecting and analyzing data in the framework of this work, the following classes of diseases were taken into account in accordance with MR 2.1.10.0057-12 [15]:

— intestinal infections (A00–A09);

— diseases of the endocrine system: diabetes mellitus (E10–E14);

— mental and behavioral disorders: substance use-related mental and behavioral disorders (F10–F19);

— respiratory diseases: J00–J06 (acute respiratory infections of the upper respiratory tract), J09–J18 (flu and pneumonia), J20–J22 (other acute respiratory infections of the lower respiratory tract), J30.1 (allergic rhinitis caused by plant pollen), J40–J47 (chronic lower respiratory diseases: chronic bronchitis, emphysema, other chronic obstructive pulmonary disease, asthma, status asthmaticus);

— diseases of the circulatory system: diseases characterized by high blood pressure (I10–I15), coronary artery disease (I20–I25), conduction and rhythm disturbances (I44–I48), cerebrovascular diseases (I60–I69);

— injuries, poisoning and some other consequences of external causes (S00–T98).

Primary morbidity of the population was studied by priority classes of diseases and individual nosological forms (the number of newly diagnosed cases of the disease per 100,000 of the population of the corresponding age group. Based on the data obtained, a correlation analysis was carried out (the nonparametric coefficient was calculated Spearman rank correlation coefficient indicating the significance of the correlation) between effective air temperature and health indicators among priority indicators among high-risk population groups.

Sources of information

In accordance with the terms of reference of this work, the collection and analysis of the necessary information was carried out, which, for ease of processing, was grouped into the following blocks:

1. Data on climatic indicators in St Petersburg for the period from 2015 to 2020.
2. The results of monitoring the quality of atmospheric air in populated areas in St Petersburg for the period 2015 to 2020.
3. Data on the incidence of the population with various pathologies.

To obtain the above information, available statistical and scientific information was used (Table 1) [16–22].

Table 1. **Sources of information used in the report for the analysis of population morbidity and pollution of environmental objects**

No.	Information	Source of information
1	Data on climate indicators in St Petersburg for the period from 2015 to 2020	a) Letter of the Federal State Budgetary Institution "North-Western UGMS" no. 11/1-2017–2010 dated 11/24/2021; b) Reports on the environmental situation in St Petersburg for the period from 2013 to 2020
2	Statistical data on the incidence of the population of St Petersburg for the period from 2015 to 2020	a) Form no. 12 "Information on the number of diseases registered in patients living in the service area of a medical organization"; b) Form no. 14 "Information on the activities of a unit of a medical organization providing medical care in a hospital"
3	Information on the population of St Petersburg by individual age groups for 2015–2020	Statistical bulletins of the Office of the Federal State Statistics Service for St Petersburg and the Leningrad Region (Age and sex composition of the population of St Petersburg as of January 1)
4	The results of monitoring the quality of atmospheric air in populated areas in St Petersburg for the period 2015 to 2020	Reports on the environmental situation in St Petersburg for the period from 2013 to 2020

Characteristics of climatic conditions in St Petersburg for 2015–2020

The climate of St Petersburg is moderate and humid, transitional from continental to maritime. This region is characterized by a frequent change of air masses, largely due to cyclonic activity. In summer, western and north-western winds prevail, in winter — western and south-western ones.

The average air temperature in St Petersburg according to observations for 2015–2020 is +5.9 °C. The coldest month in the city is February with an average temperature of –5.7 °C, in January –5.5 °C. The warmest month is July, its average daily temperature is +18.7 °C (Table 2).

Table 2. **Climatic information based on averaged observational data of the St Petersburg meteorological station for 2015–2020**

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Air temperature, °C	–5.7	–5.5	–1.2	4.8	11.4	15.9	18.7	16.9	11.8	5.9	0.6	–3.2	5.9
Relative humidity, %	86	84	77	69	63	67	71	75	80	82	86	87	77
Rainfall, mm	43	34	36	35	42	66	82	83	63	64	58	51	657
Wind speed, m/s	2.5	2.3	2.3	2.2	2.0	1.9	1.8	1.8	1.9	2.3	2.6	2.6	2.2

Table 3. **Climatic information based on averaged observational data of the St Petersburg meteorological station for 2015–2020**

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Oblique-ness
2015	−2.7	−0.6	2.6	5.1	11.8	15.9	16.9	18.3	14	5.6	3.1	2.1	7.7	2.7
2016	−11.2	0	1	6.3	14.7	16.4	19	17.2	12.9	5	−1.8	−1.2	6.5	1.5
2017	−3.9	−3.5	1.3	2.8	9.4	13.6	16.5	17.4	12.5	5.6	2.3	0.4	6.2	1.2
2018	−2.9	−7.7	−4.4	6	15.1	16.2	20.9	19.2	14.5	7.3	2.8	−3.2	7	2
2019	−6.5	−0.5	0	7.3	12.1	18.7	16.6	17	12.2	6.1	1.9	1.8	7.2	2.2
2020	1.5	0.6	2.2	4.2	10	19.1	17.6	17.2	14.3	9.1	3.9	−0.7	8.3	3.3

Using formulas (1)–(3), the effective air temperature in St Petersburg for 2015–2020 was calculated, which was later used in correlation analysis and in establishing cause-and-effect relationships:

Year	2015	2016	2017	2018	2019	2020
Effective temperature. °C	5.2	3.9	3.6	4.5	4.7	5.9

The highest temperature recorded in St Petersburg for the entire observation period is +37.1 °C (August 7, 2010), and the lowest is −35.9 °C (January 11, 1883).

To perform this work, we used the average annual air temperature data in St Petersburg for 2015–2020 (Table 3).

The state of health of the population of St Petersburg in 2015–2020

Data on the primary morbidity of the population of St Petersburg (for individual age groups from among the risk groups) for priority classes of diseases and individual nosological forms are presented in Table 4.

Over the 6-year period, among the priority classes of diseases and nosological forms potentially associated with the impact of climate, there is no significant dynamics of indicators or a significant decrease in the incidence in 2020. The exceptions are pneumonia, diseases characterized by high blood pressure and coronary heart disease among people older than working age, as well as diabetes mellitus (mainly type I) among children aged 0 to 14 years: according to nosological forms, a significant increase was registered in 2020 primary morbidity, especially in relation to pneumonia among people older than working age.

Table 4. **Primary morbidity of the population of St Petersburg for 2015–2020 (per 100,000 persons of corresponding age)**

Nosological forms	2015	2016	2017	2018	2019	2020
Intestinal infections (children 0–14 years old)	3100.7	3028.0	2611.0	2541.5	2713.2	1757.3
Intestinal infections (children 15–17 years old)	1063.8	1244.6	1127.2	1222.9	1281.7	917.8
Intestinal infections (older than working age)	298.5	225.4	208.2	256.4	196.2	134.6
Diabetes mellitus (children 0–14 years old)	30.3	33.7	33.1	29.9	42.5	51.5
Diabetes mellitus (children 15–17 years old)	32.2	43.4	30.4	76.1	62.3	72.6
Diabetes mellitus (older than working age)	597.2	718.9	723.6	530.9	513.8	435.5
Mental and behavioral disorders associated with the use of psychoactive substances (children 0–14 years old)	9.7	12.6	10.5	14.0	8.2	6.1
Mental and behavioral disorders associated with the use of psychoactive substances (children 15–17 years old)	312.3	281.9	257.6	288.7	223.0	199.1
Mental and behavioral disorders associated with the use of psychoactive substances (older than working age)	17.0	17.8	9.6	6.9	7.4	6.0
Diseases characterized by high blood pressure (children 0–14 years old)	12.2	5.2	7.2	6.6	40.7	19.0
Diseases characterized by high blood pressure (children 15–17 years old)	208.9	168.8	149.1	108.5	188.5	146.0
Diseases characterized by high blood pressure (older than working age)	1927.3	2099.9	1538.3	1292.3	1638.9	2157.5
Ischemic heart disease (children 0–14 years old)	0	0	0	0	0	0
Ischemic heart disease (children 15–17 years old)	0	0	0	0	0	0
Ischemic heart disease (older than working age)	1956.7	1716.7	1348.0	1292.8	1294.3	1649.2
Cerebrovascular diseases (children 0–14 years old)	0.4	1.1	0.3	0.3	0.5	0
Cerebrovascular diseases (children 15–17 years old)	0	0	0.9	0.9	0.8	0.8
Cerebrovascular diseases (older than working age)	1276.2	1500.7	1377.2	1251.6	1305.6	1143.3

Continuation of the Table 4

Nosological forms	2015	2016	2017	2018	2019	2020
Acute respiratory infections of the upper respiratory tract (children 0–14 years old)	131 334.1	146 317.6	144 374.8	142 187.7	142 866.1	120 748.8
Acute respiratory infections of the upper respiratory tract (children 15–17 years old)	79 839.9	87 310.5	87 415.7	88 120.4	89 842.0	85 920.1
Acute respiratory infections of the upper respiratory tract (older than working age)	16 859.8	18 742.3	19 302.1	21 525.8	18 674.5	21 782.1
Influenza (children 0–14 years old)	40.5	122.1	41.2	50.5	34.8	31.7
Influenza (children 15–17 years old)	64.4	104.7	74.5	79.6	12.6	47.3
Influenza (older than working age)	7.3	34.4	7.2	4.6	5.0	2.7
Pneumonia (children 0–14 years old)	493.2	630.4	642.9	626.8	585.4	379.9
Pneumonia (children 15–17 years old)	288.9	301.7	437.1	507.3	504.1	301.9
Pneumonia (older than working age)	505.8	507.4	420.8	381.0	291.0	1578.8
Other acute respiratory infections of the lower respiratory tract (children 0–14 years old)	3265.8	3870.4	3435.7	3824.9	3853.6	3087.9
Other acute respiratory infections of the lower respiratory tract (children 15–17 years old)	1257.0	1272.0	1509.1	1754.7	1738.7	1622.7
Other acute respiratory infections of the lower respiratory tract (older than working age)	2170.2	3304.8	3172.0	3543.7	2845.8	2944.7
Allergic rhinitis (children 0–14 years old)	247.3	319.4	256.3	225.1	255.0	323.2
Allergic rhinitis (children 15–17 years old)	365.0	344.2	310.1	314.9	430.9	357.3
Allergic rhinitis (older than working age)	5.0	13.0	6.6	10.2	10.4	8.5
Chronic bronchitis. emphysema (children 0–14 years old)	6.5	10.3	3.4	30.5	8.2	4.4
Chronic bronchitis. emphysema (children 15–17 years old)	152.2	89.6	25.8	24.5	25.2	15.5
Chronic bronchitis. emphysema (older than working age)	666.3	374.6	319.5	399.3	305.9	168.7
Other chronic obstructive pulmonary disease (children 0–14 years old)	18.9	22.1	13.9	20.8	16.3	11.2
Other chronic obstructive pulmonary disease (children 15–17 years old)	3.9	15.1	9.2	7.0	4.2	3.3

Nosological forms	2015	2016	2017	2018	2019	2020
Other chronic obstructive pulmonary disease (older than working age)	93.3	115.5	78.4	73.5	77.6	81.8
Asthma. status asthmaticus (children 0–14 years old)	289.0	305.5	181.7	149.2	208.0	119.5
Asthma. status asthmaticus (children 15–17 years old)	384.5	507.3	277.0	426.0	290.3	180.3
Asthma. status asthmaticus (older than working age)	124.2	148.6	81.2	87.9	100.0	113.7
Injuries. poisoning and some other consequences of external causes (children 0–14 years old)	15 063.3	14 213.3	14 522.3	14 468.4	14 693.5	12 752.2
Injuries. poisoning and some other consequences of external causes (children 15–17 years old)	25 172.5	26 772.6	24 755.5	25 855.9	25 580.1	16 848.9
Injuries. poisoning and some other consequences of external causes (older than working age)	11 030.4	11 061.2	10 464.1	10 518.8	10 582.8	9619.9

Analysis of cause-and-effect relationships of climatic conditions and public health

The results of the correlation analysis between the change in 2015–2020 effective air temperature in St Petersburg and the dynamics of primary morbidity are presented in Table 5.

Table 5. **Correlation between effective air temperature and primary morbidity of the population of St Petersburg in 2015–2020**

Nosological forms	Correlation coefficient	Value (2–sided)	n
Intestinal infections (children 0–14 years old)	–0.143	0.787	6
Intestinal infections (children 15–17 years old)	–0.486	0.329	6
Intestinal infections (older than working age)	–0.2	0.704	6
Diabetes mellitus (children 0–14 years old)	0.371	0.468	6
Diabetes mellitus (children 15–17 years old)	0.429	0.397	6
Diabetes mellitus (older than working age)	–0.829	0.042	6
Mental and behavioral disorders associated with the use of psychoactive substances (children 0–14 years old)	–0.714	0.111	6
Mental and behavioral disorders associated with the use of psychoactive substances (children 15–17 years old)	–0.2	0.704	6
Mental and behavioral disorders associated with the use of psychoactive substances (older than working age)	–0.486	0.329	6

Continuation of the Table 5

Nosological forms	Correlation coefficient	Value (2–sided)	n
Diseases characterized by high blood pressure (children 0–14 years old)	0.657	0.156	6
Diseases characterized by high blood pressure (children 15–17 years old)	0.143	0.787	6
Diseases characterized by high blood pressure (older than working age)	0.543	0.266	6
Ischemic heart disease (children 0–14 years old)	–	–	6
Ischemic heart disease (children 15–17 years old)	–	–	6
Ischemic heart disease (older than working age)	0.257	0.623	6
Cerebrovascular diseases (children 0–14 years old)	–0.371	0.468	6
Cerebrovascular diseases (children 15–17 years old)	–0.464	0.354	6
Cerebrovascular disease (older than working age)	–0.771	0.072	6
Acute respiratory infections of the upper respiratory tract (children 0–14 years old)	–0.886	0.019	6
Acute respiratory infections of the upper respiratory tract (children 15–17 years old)	–0.429	0.397	6
Acute respiratory infections of the upper respiratory tract (older than working age)	0.029	0.957	6
Influenza (children 0–14 years old)	–0.771	0.072	6
Influenza (children 15–17 years old)	–0.657	0.156	6
Influenza (older than working age)	–0.486	0.329	6
Pneumonia (children 0–14 years old)	–1.000	–	6
Pneumonia (children 15–17 years old)	–0.257	0.623	6
Pneumonia (older than working age)	0.314	0.544	6
Other acute respiratory infections of the lower respiratory tract (children 0–14 years old)	–0.6	0.208	6
Other acute respiratory infections of the lower respiratory tract (children 15–17 years old)	0.029	0.957	6
Other acute respiratory infections of the lower respiratory tract (older than working age)	–0.6	0.208	6
Allergic rhinitis (children 0–14 years old)	0.086	0.872	6
Allergic rhinitis (children 15–17 years old)	0.714	0.111	6
Allergic rhinitis (older than working age)	–0.257	0.623	6
Chronic bronchitis, emphysema (children 0–14 years old)	–0.086	0.872	6
Chronic bronchitis, emphysema (children 15–17 years old)	–0.314	0.544	6

Nosological forms	Correlation coefficient	Value (2–sided)	n
Chronic bronchitis, emphysema (older than working age)	–0.2	0.704	6
Other chronic obstructive pulmonary disease (children 0–14 years old)	–0.371	0.468	6
Other chronic obstructive pulmonary disease (children 15–17 years old)	–0.943	0.005	6
Other chronic obstructive pulmonary disease (older than working age)	0.086	0.872	6
Asthma, status asthmaticus (children 0–14 years old)	–0.314	0.544	6
Asthma, status asthmaticus (children 15–17 years old)	–0.371	0.468	6
Asthma, status asthmaticus (older than working age)	0.371	0.468	6
Injuries, poisoning and some other consequences of external causes (children 0–14 years old)	–0.029	0.957	6
Injuries, poisoning and some other consequences of external causes (children 15–17 years old)	–0.429	0.397	6
Injuries, poisoning and some other consequences of external causes (older than working age)	–0.2	0.704	6

The discussion of the results

As a result of the analysis, the presence of statistically significant correlations between the effective air temperature in St Petersburg and:

1) primary incidence of diabetes mellitus in persons older than working age (Spearman rank correlation coefficient –0.829, $p = 0.042$);

2) primary incidence of acute respiratory infections of the upper respiratory tract in children 0–14 years old (Spearman rank correlation coefficient –0.886, $p = 0.019$);

3) primary incidence of chronic obstructive pulmonary disease in children aged 15–17 years (Spearman rank correlation coefficient –0.943, $p = 0.005$).

The presence of established direct and inverse statistically significant correlations can be explained logically based on modern ideas about the impact of climatic parameters on human health, however, in this case, the logical connection seems doubtful due to the highest deviation of the average annual air temperature from the norm in 2020 and the pandemic of a new coronavirus infection COVID-19. Therefore, a decrease in morbidity (in the case of a negative correlation) can be explained by a reduction in planned medical care.

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Оценка риска здоровью населения при воздействии климатических факторов на территории Санкт-Петербурга

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В последние годы изменение климата рассматривается как один из ведущих факторов, оказывающих влияние на здоровье населения. В рамках этой концепции в Санкт-Петербурге разрабатываются и используются адекватные с точки зрения специфических факторов риска методики. В данной работе в качестве методической основы для оценки состояния здоровья населения с учетом климатических условий использовалась методология МР 2.1.10.0057-12 «Состояние здоровья населения в связи с состоянием окружающей среды и условиями проживания населения. Оценка риска и ущерба от климатических изменений, влияющих на повышение уровня заболеваемости в группах населения повышенного риска. Методические рекомендации». Установлено наличие статистически значимых корреляций между эффективной температурой воздуха в Санкт-Петербурге и первичной заболеваемостью сахарным диабетом лиц старше трудоспособного возраста (коэффициент ранговой корреляции Спирмена −0,829, $p = 0{,}042$); первичной заболеваемостью острыми респираторными инфекциями верхних дыхательных путей детей 0–14 лет (коэффициент ранговой корреляции Спирмена −0,886, $p = 0{,}019$); первичной заболеваемостью хронической обструктивной легочной болезнью детей 15–17 лет (коэффициент ранговой корреляции Спирмена −0,943, $p = 0{,}005$). Наличие установленных прямых и обратных статистически значимых корреляций может быть объяснено логически исходя из современных представлений о влиянии климатических параметров на здоровье человека, однако в данном случае логическая связь представляется сомнительной в связи с наиболее высоким отклонением среднегодовой температуры воздуха от нормы в 2020 г. и пандемией новой коронавирусной инфекции COVID-19. Таким образом, снижение заболеваемости в случае отрицательной корреляции может быть объяснено сокращением плановой медицинской помощи.

Ключевые слова: заболеваемость, население, оценка риска для здоровья населения, климат, Санкт-Петербург.

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