Technosphere safety of West Siberian region and protection of human health in aspects of biogeochemical living conditions and man-made development of region

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Annotation. The development of gas and oil resources, mineral deposits of the northern regions of Russia requires a long stay in the West Siberian region. Therefore, the conditions formed in the place of residence have a direct effect on the medical-demographic, socio-hygienic indicators, and the state of health of the population. Water and soil of the Tyumen region are characterized by a significant imbalance of mineral substances. The peculiarity of the soils of the Tyumen region is their relatively high acidity, high content of organic substances and high washability, which ensures a low content of mineral substances in the upper soil layer. The peculiarity of the main water resources is the fluctuation of acidity - mainly from 4.5 to 8.5, which also provides high mobility of chemical compounds. A significant negative contribution to this imbalance is also made by environmental pollution as a result of the active development of northern resources. Chemical imbalances in the environment adversely affect the health status of the population of Western Siberia. In the Tyumen region, there is an excess of the average Russian indicators of the incidence of respiratory organs, digestive organs, musculoskeletal system, and in the south of the region - the circulatory system.

1. Relevance
The main reasons for the emerging tense situation in the state of health of the population, ceteris paribus, with most other regions of Russia are the combination of, first, the climatic and geographical features, and second, the intensity of the anthropogenic environmental load. At the same time, in addition to the direct influence of climatic and geographical conditions on human health, there is an indirect effect, consisting of lifestyle, nature of food, water consumed, social protection of the population, etc. [1-7].

The development of the study of biogeochemical provinces implies the development of biogeochemical endemic diseases associated with environmental features (air, water, soil). That is, endemic diseases are diseases that are permanently fixed on a geographically limited area and are causally related to its biogeochemical, climatic, and geographic factors, man-made features [8,9]. It should be noted that the animal and plant world is also inextricably linked with the geochemical environment, while obtaining available chemicals from it, is able to have its own chemical
composition in accordance with the composition of this environment. Thus, both the anthropogenic impact on the environment associated with industrial oil and gas development in the North and the natural conditions associated with the regional characteristics of the nature of the soil and water can have a direct, as well as indirect effect on the health of the population of the Tyumen region.

2. Objective
To give a hygienic characteristic of the main elements that form biogeochemical conditions characteristic of the Tyumen region. To substantiate the dependence of the chemical composition of soil and water on soil-forming elements and geochemical conditions. Identify the conditions of anthropogenic impact on the environment of the Tyumen North. To study the relationship of biogeochemical conditions and the results of technogenic development of the region with the state of health of the population of the region.

The scientific novelty of the research consists in an expanded analysis of the relationship between natural conditions and the results of anthropogenic effects on medico-demographic, socio-hygienic indicators, and the state of human health.

The theoretical significance lies in the development of a unified concept of understanding the relationship of the natural and anthropogenic nature of the impact on human health.

The practical significance lies in the practical implementation in the form of recommendations of a preventive nature, aimed at eliminating (leveling) the adverse effects of xenobiotics in the conditions of man-made pressure on a specific territory - the Tyumen region. These recommendations will also have universal values, which can reduce technogenic risk in other environmentally disadvantaged areas.

3. Materials and methods
Materials and methods. For the environmental and hygienic assessment of the xenobiotic load on the population of the Tyumen region, a comprehensive analysis of environmental pollution by standard methods was carried out. In the future, statistical processing was carried out [10]. The data provided by the Department of Subsoil Use and Ecology of the Tyumen Region [11–13] were used as benchmark marks.

The state of public health was assessed on the basis of annual reports on the state of public health, submitted by the Department of Health of the Tyumen Region. Field studies were carried out on the basis of Tyumen Industrial University (TIU), the laboratory of the Department of Technosphere Safety, Tyumen State Medical University (TyumGMU).

4. The results of the study and their discussion
For the northern regions - in the Yamalo-Nenets Autonomous District and the Khanty-Mansi Autonomous Area - the soil of forest landscapes with some common features is typical: in the surface layer of soil there are many humic substances, as well as litter products with incomplete decomposition. This contributes to the formation of acidic soils rich in organic substances, which are capable of firmly adsorbing many mineral substances involved in the metabolic processes of the human body (zinc, manganese, copper, nickel, etc.). A number of mineral elements (zirconium, chromium, vanadium), on the contrary, can quickly leach out of the soil-forming rock, which under the conditions of systematically washed soils does not allow them to accumulate sufficiently in these rocks. Acid sandy, sandy, sod-podzolic, peaty-swaumpy soils are characteristic of the taiga-forest zone of the Tyumen region. They reveal an insufficient content: iodine - up to 80%, copper - up to 70%, molybdenum - up to 55%, zinc and boron - up to 49%. There is an insufficient content of potassium, calcium, cobalt, phosphorus - up to 73% of all analyzed samples. Excess strontium content was found in 15% of samples (especially in floodplains).

Thus, it becomes clear that under the natural conditions of the Tyumen region there is an imbalance (shortage or excess) of mineral substances in the environment — soil, water, and food — according to the principle of food chains. All mineral substances in one degree or another affect the metabolic
processes occurring in the human body, and, consequently, can determine its health, cause morbidity, affect medical and socio-demographic indicators.

Peat soils cause a lack of cobalt and copper in the body, while there is a weakening of oxidative processes and, as a result, inhibition of the synthesis of vitamin B12. This is accompanied by B12 hypovitaminosis and contributes to the development of endemic anemia.

It is known that in soil-forming rocks, fluctuations in the average content of such microelements that are important from a biological point of view as cobalt, zinc, and copper differ by a factor of 2000, 170, and 68, respectively. Relations of a similar nature are also observed in ground waters [14,15]. At the same time, water is also a major factor in the redistribution and migration of chemicals.

An imbalance in the environment of macro-and micronutrients of natural origin can be the cause of: conditions involving thyroid gland dysfunction and, therefore, disruption of many metabolic processes in the body; increased incidence of the cardiovascular system, pathology of the nervous, musculoskeletal systems, gastrointestinal tract [16].

The incidence rates of hypertension in the sub region are consistently higher than the average for Russia by 40-45%, coronary heart disease - by 5-15%. Over the past 7 years, the incidence of the circulatory system has increased by more than 25%. At the same time, cardiovascular diseases, especially coronary heart disease, are the leading diseases in industrialized regions.

The structure of the incidence is presented in table 1.

**Table 1. The structure of the incidence of the population of the Tyumen region 2017**

| Classes of diseases          | Tyumen Region | South of Region | KhMAO | YaNAO | RUSSIA |
|-----------------------------|---------------|-----------------|-------|-------|--------|
| Indicator on 1000 population | 1529,6        | 1533.4          | 1487,6| 1568,6| 1261,1 |
| %                           | 100           | 100             | 100   | 100   | 100    |
| Respiratory diseases        | 435,9         | 397,9           | 451,8 | 494,4 | 350,4  |
| %                           | 28,5          | 25,9            | 30,4  | 31,5  | 27,8   |
| Diseases of the digestive organs | 134,9        | 130,0           | 151,8 | 102,1 | 103,5  |
| %                           | 8,8           | 8,5             | 10,2  | 6,5   | 8,2    |
| Diseases of the musculoskeletal system | 118,0       | 126,6           | 115,6 | 101,7 | 81,1   |
| %                           | 7,7           | 8,3             | 7,8   | 6,5   | 6,4    |
| Circulatory system diseases | 104,9         | 168,2           | 56,8  | 67,1  | 131,0  |
| %                           | 6,9           | 11,0            | 3,8   | 4,3   | 10,4   |

The health of the population is the main medico-ecological indicator of the well-being of the territory. The level of health is not fixed directly, and data on the pain of the population are used to quantify its level, bearing in mind that the higher the level of health, the lower the pain of the population (Table 2).

**Table 2. General morbidity per 1000 population of the Tyumen region.**

| Territories        | 1994  | 1995  | 1996  | 2016  | 2017  | 2018* |
|--------------------|-------|-------|-------|-------|-------|-------|
| Tyumen Region      | 1069,0| 1103,6| 1208,8| 1280,4| 1408,9| 1529,6|
| South of Region    | 1093,1| 1101,8| 1321,6| 1335,2| 1416,8| 1533,4|
| KhMAO              | 1037,0| 1082,8| 1120,0| 1226,4| 1385,6| 1487,6|
| YaNAO              | 1076,6| 1164,7| 1144,1| 1281,1| 1451,7| 1568,6|
| RUSSIA             | 1113,0| 1150,3| 1132,8| 1191,1| 1261,1|       |
From table 2 it can be seen that the morbidity of the population in recent years does not decrease, but increases. As in previous years, there are still differences in indicators. Soreness between the south of the region and the northern territories. The level of pain in the respiratory organs in the sub region is 13% lower than in the Khanty-Mansiysk Autonomous Okrug and 24% lower than in the YaNAO. The index of pain in the circulatory system in the south of the region is 3 times higher than in the Khanty-Mansiysk Autonomous Okrug and 2.5 times higher than in the YaNAO. The level of diseases of the digestive system in KhMAO is 16% higher than in the south of the region. In terms of injuries and poisoning, the indicators of the northern territories are higher than in the south of the region - Khanty-Mansiysk Autonomous Okrug 1.9 times, YaNAO 1.6 times.

This suggests that anthropogenic pressure occurs in all administrative entities of the Tyumen region.

The data of the present laboratory observations carried out at the bases of the leading universities of Tyumen for polluters of water bodies for drinking purposes in Tyumen for 2017 are presented in tables 3.

**Table 3. Indicators and criteria for the risk of pollution of water bodies for drinking purposes in Tyumen.**

| Agent                | Maximum permissible concentration | Hazard indicator | Hazard Class | $C_{MPC}$ | Rating | Risk | Rating of Risk |
|----------------------|----------------------------------|------------------|--------------|-----------|--------|------|----------------|
| Oil products         | 0,1 organoleptic                 | 4                | 1,083        | 9         | 0,85   | 5    |                |
| Sulfates             | 500 organoleptic                 | 4                | 1,165        | 8         | 1      | 1    |                |
| Chlorides            | 350 organoleptic                 | 4                | 1,4214       | 5         | 1      | 1    |                |
| Hydroxybenzene       | 0,001 organoleptic               | 4                | 1,25         | 7         | 0,42   | 7    |                |
| Nitrates             | 45 sanitary toxicological        | 3                | 1,48         | 4         | 0,99   | 2    |                |
| Polymers active      | 0,5 sanitary toxicological       | 2                | 2,584        | 3         | 0,89   | 4    |                |
| substance Iron       | 0,3 organoleptic                 | 3                | 3,28         | 2         | 0,82   | 6    |                |
| Aluminum             | 0,2 organoleptic                 | 3                | 4,184        | 1         | 0,97   | 3    |                |
| Nitrites             | 3,3 sanitary toxicological       | 2                | 1,394        | 6         | 1      | 1    |                |

Table 3 presents the data of the main substances that exceed the permissible normative values polluting water bodies of the city of Tyumen. Based on the obtained values, it can be stated that the leading pollutants (in descending order) on the organoleptic basis are: aluminum - exceeding the MPC by 4.18 times, iron - exceeding the MPC by 3.28 times, chlorides - 1.4 times, hydroxybenzene - 1.3 times, sulfates - 1.17 times and petroleum products - 1.1 times. Similar gradation of ranking places of substances limited by sanitary-toxicological indicator showed that the highest values of the MPC exceedances are observed for surfactants - by 2.59 times, nitrates - by 1.48 times and nitrites - by 1.4 times. The ranking of the exceeding by the main pollutants of the maximum permissible values allows to distinguish the main pollutants. The ranking of the risks of specific negative effects from the presence of pollutants in water reveals the most dangerous xenobiotics that can cause the incidence of the population. It is noteworthy that substances that are not leading to exceed regulatory criteria may be decisive components of the development of specific effects.

Anthropogenic pressure in the form of environmental pollution with xenobiotics inevitably adversely affects the health of the population.
5. Conclusions

1. In the Tyumen region there are significant fluctuations of mineral substances in the environment due to natural factors. The imbalance of these compounds in drinking water, food and the internal environment of a person adversely affects human health.

2. Pollution of soil and water bodies by pollutants as a result of the development of the resources of the North also adversely affects the main indicators of the well-being of the population of a social, medical and demographic nature.

3. A thorough correlation study of these facts is required for the development of algorithms for eliminating these adverse factors.

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