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Research Article

**METHODOLOGICAL ASPECT OF FORMING THE SYSTEM
OF INDICATORS IN MEDICAL ECOLOGY****Anna V. Gordeeva^{1*}, Leila Au. Akhtyamova², Irina D. Sitdikova¹, Lyudmila I.
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ul. Kremlin, 18, Kazan, Russia² Kazan State Medical University, Ulitsa Butlerova, 49, Kazan, Tatarstan, Russia, 420012³ "The Postgraduate Doctor's Training Institute" of Health Care Ministry of the Chuvash
Republic, Chuvashia**Abstract:**

The environment and the ecological state of a large industrial city form an unfavorable condition and adversely affect the health of the citizens. A number of enterprises, in the course of their operation, produce a significant amount of substances polluting the environment of living massifs.

This paper assesses the man-caused impacts of industrial enterprises on the level of air and water pollution in the village located 1,0 km from a large industrial enterprise. The assessment was carried out by a personal interview with the residents of the village, as well as by the method of assessing the risk to the health of the population.

The studies have revealed the maximum permissible values of divinyl and hexavalent chromium. Combined effect of these chemicals orally may result in abnormalities in the cardiovascular and circulation systems.

The paper assesses the risk of exposure of the village citizens to harmful substances in accordance with the guidelines for assessing the health risks of the population when exposed to chemicals polluting the environment (P 2.1.10.1920-040). Identification of the hazard source, assessment of exposure, assessment of exposure-response relationship, risk characteristics were carried out.

The quantitative characteristic of multienvironmental risk allows us to develop optimal management decisions to reduce it based on an assessment of all contacting environments and ways of entering, taking into account their shared contribution to human exposure levels.

Keywords: *ecology of industrial regions, non-cancer risk assessment, air quality, individual and population risk, hazard ratio.*

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INTRODUCTION:

Scientific and technological progress called upon mankind to carry out the growth of scientific knowledge, to make a large number of discoveries and increase productivity in industry. The negative side of technological progress is the technogenic impact on the biosphere. Over the last decades, the adverse impact on the biosphere has reached a global level, while the compensating resources of the biosphere tend to zero. This ecological situation directly affects the health of the human body. The most important causes of health disorders are air and water pollution [1].

Initially, the method of questionnaire screening was used to monitor the environmental contamination of the region. The method of questionnaire screening provided high reliability, as well as gave the opportunity to obtain the results of the survey among a hard-to-reach target group [2]. Further, the identified problem zone was subjected to an assessment and analysis of the health risk of the residents of the village due to the exposure of chemicals released to the environment by industrial enterprises, which were conducted in accordance with the guidelines for assessing the health risks of the population exposed to chemical pollution (P 2.1.10.1920-040).

The objective of the research was to study the technogenic impacts on the settlement located 1.0 km from a large chemical enterprise, which makes it possible to assess the degree of influence of industrial enterprises on the elements of the natural complex and residents of a certain region in order to create a favorable habitat for the population, as well as assess an aggregate risk and calculate hazard indices.

METHODS:

To study the problem, a regionalized, quota sample was used. The sample size was 800 people. For the study, a personal interview method was used with the formalized questionnaire of the residents of the given microdistrict. A conversation followed a specific plan (questionnaire) with direct contact with the respondent. The questionnaire included 3 blocks of questions: block 1 - water consumption and quality, block 2 - satisfaction with air quality in the field of operating enterprises, block 3 - personal indicators (body weight, time and frequency of presence in the study area, etc.).

Children's opinion was obtained through their parents interviewed in pre-school educational institutions (kindergartens / nurseries) for respondents from 1 to 7 years old, as well as in secondary schools by

directly asking children aged 7 to 17 years. The survey of the adult population aged 18 to 80 years was carried out by a personal interview at their place of residence (in the apartments).

The processing of the questionnaires was revealed that the citizens of the village are particularly concerned about the quality of the air, and there is an extraneous smell. Based on these data, the risk of exposure to harmful substances in the air was assessed in accordance with the guidelines for assessing the health risks of the public exposed to chemical pollution (P 2.1.10.1920-040). Identification of the hazard source, assessment of exposure, assessment of exposure-response relationship, risk characteristics were carried out [3].

Calculation of individual carcinogenic risk was made by multiplying the magnitude of the carcinogenic potential factor by the average daily intake area of the substance over the entire life span. Having the value of individual lifelong risk, the population risk was calculated, taking into account the total carcinogenic risk for one route of administration.

The hazard index is the product of the actual concentration of the substance in the air and the reference concentration of the substance (RfC).

If the hazard ratio is equal to or less than 1.0, the risk of harmful effects is considered to be extremely small, with the increase in the hazard factor the probability of development of harmful effects increases [10]. The health risk exists if the hazard ratio is greater than 1.0. The hazard factor makes it possible to calculate the risk of developing non-carcinogenic effects.

The data obtained as a result of the research were statistically processed by standard methods on a PC using standard programs: STATISTICA 8.0, MicrosoftExcel, with parametric and nonparametric statistics methods [8].

RESULTS:

Questions of *Block 1* are aimed at identifying the level of quality of water consumed, according to the residents of the study area. The parameters of determining the quality of water were the presence of smell, taste, color, turbidity, as well as the respondents were given the option "nothing bothers". The results of the survey showed that 83% of the villagers are satisfied with the quality of water.

Further, a survey was conducted on the consumed types of water with food (water used for cooking and drinking), which also serves as an indicator of water

quality. The study revealed that the residents use only tap water. Significant differences in the structure of consumption and quality of water on weekdays and weekends are not revealed.

Block 2 included the questions to reveal satisfaction of inhabitants with quality of air. The presence of odors from working industrial enterprises at different times of the day, presence of odors from industrial enterprises inside and near the house, as well as the degree of odor stability at various times of the day were investigated.

The smell of gas (38.6%), the smell of phenol (22.8%), poultry droppings (10.9%), chemicals and household chemical waste (7.9%) prevail in the studied village.

When detecting sources of air pollution and unpleasant smells by the majority of respondents, industrial emissions (65.4%) were recognized as the main source of smells, and 15.0% of inhabitants of the district recognized the dump as the source of smell. The remaining industrial facilities and sources of air pollution in these areas scored less than 3%.

The investigated parameters of *Block 2* showed that the quality of the air in the village is low. Based on these data, this issue requires detailed research and determination of the level of individual carcinogenic risk, population risk of air pollution, as well as the coefficient and index of the hazard of certain substances.

The total individual carcinogenic risk of carcinogens entering from the ambient air corresponds to the level of the maximum permissible risk (the upper limit of an acceptable risk). These levels are subject to constant monitoring [5].

The values of population risk in the village are $2.19 \cdot 10^{-2}$. The results of the assessment of chronic non-carcinogenic risk show that the values of the hazard coefficients of ethylene concentration at the border of the residential building of the settlement approach their reference (safe) concentration (0.88).

Calculations of ethylene hazard indices indicate the likelihood of developing various chronic effects. The hazard index up to 1.63 - subject to the background, up to 1.58 - without taking into account the background, speaks about the effect on the cardiovascular system, the hazard index up to 1.51 - subject to the background, up to 1.48 - without taking into account the background – on the circulation system, hazard index up to 1.36 - subject to the

background, up to 1.28 - excluding background – on the immune system in the southern part of the village.

There is also the possibility of developing chronic effects on the part of the respiratory system, where the hazard index is up to 1.34 and the central nervous system, where the hazard index is up to 1.14: respiratory organs - due to a mixture of hydrocarbons C1-C5 in pentane (contribution - 24.38 %), the central nervous system - due to benzene (contribution - 46.28%), the permissible level - 1.0. The probability of development of chronic effects from the central nervous system and respiratory organs according to the hazard index is 0.97 and 1.0, that is, does not exceed 1.0. The main contribution to the formation of total hazard indices is made by industrial emissions and amounts to 92.33-98%.

The action plans should provide for the reduction of ethylene emissions, which will reduce the risk of developing the abnormalities of cardiovascular system, circulation system, immune system to an acceptable level, that is, the concentration of substances should be at or below RfC.

Furthermore, calculations of hazard indices indicate the permissible probability of development of chronic effects on the part of the reproductive system, where the hazard index is up to 0.68, the development of the organism with the hazard index up to 0.53, for the liver – up to 0.23, for the kidneys – up to 0.18, eyes – up to 0.08, and hormonal system – up to 0.0003.

DISCUSSION:

The results of the questionnaire screening showed that the investigated parameters of *Block 1* do not require detailed research, the residents of the district are completely satisfied with the quality of water. The investigated parameters of *Block 1* showed that the quality of the air in the village is low. Based on these data, this issue requires detailed research and determination of the level of individual carcinogenic risk, population risk of air pollution, as well as the coefficient and index of the hazard of certain substances.

The results of the study revealed that the smell of gas is the most common. The air of the investigated settlement includes such substances as divinyl (with a characteristic smell of gas) and hexavalent chromium. When inhaled, these substances directly come into contact with the surface of the lungs, this ensures the rapid spread of harmful substances in the body. Poor air quality can cause angina, allergies, asthma, skin diseases, diseases of the musculoskeletal system, impaired blood circulation of the brain. The

combined effect of chemicals by oral administration may cause irregularities in the cardiovascular system and the blood system due to nitrates and nitrites. Residents of the village are recommended to equip their houses with ventilation and air-conditioning systems, ozonation systems and air humidification [4]. This will reduce the adverse effect of air containing industrial impurities and gases on the condition of the residents' body.

The combined effect of chemical substances on the skin leads to a low probability of pathology of the central nervous system, circulation system, kidneys, liver, and the hormonal system.

SUMMARY:

- 1) The main contribution to the formation of total hazard indices is made by industrial emissions, which amounts to 92.33-98%.
- 2) Air quality directly affects the state and health of the human body, therefore, the risk assessment of the effects of air pollution on the inhabitants of the village is always relevant.
- 3) The method of questionnaire screening allows identifying the factors most actively affecting the body of residents among the population of a certain area with minimal resources.
- 4) Based on the monitoring data, knowing the values of concentrations of urban air pollutants and having chemical concentration data, it is possible to forecast potential concentrations and values and make proposals for risk management.
- 5) In the studied village, a combined effect of these chemicals orally may result in abnormalities in the cardiovascular and circulation systems due to nitrates and nitrites. The probability of development of pathology of the central nervous system, developmental processes, kidneys, liver, reproductive system, hormonal system, immune system, biochemical changes, mucous membranes is low.
- 6) The action plans should provide for the reduction of ethylene emissions, which will reduce the risk of developing the abnormalities of cardiovascular system, circulation system, immune system to an acceptable level, that is, the concentration of substances should be at or below RfC.
- 7) Residents of the village are advised to install a forced ventilation using air purification in their houses.

CONCLUSIONS:

This study made it possible to identify the most acute environmental problems in the investigated settlement, as well as assess the man-caused impacts of industrial enterprises on the elements of the natural complex and residents of a certain region.

A number of enterprises in the course of their operation produce a significant amount of substances polluting the environment of residential areas.

The studies revealed that the total individual carcinogenic risk of carcinogens entering from the ambient air corresponds to the level of the maximum permissible risk (the upper limit of an acceptable risk); these indicators are subject to constant monitoring. It is recommended to take extra measures to clean the air in the residential buildings.

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