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Research Article

**THE HAZARD INDEX AS A PROGNOSTIC VECTOR OF THE  
HEALTH STATUS OF THE POPULATION****Margarita R. Gabidullina<sup>1\*</sup>, Irina D. Sitdikova<sup>1</sup>, Elmira N. Mingazova<sup>3</sup>, Kseniia O. Firsova<sup>2</sup>, Natalia A. Makarova<sup>2</sup>, Lyubov A. Balabanova<sup>4</sup>, Ksenia I. Biktimirova<sup>2</sup>**<sup>1</sup>Kazan Federal University, Kremlyovskaya St, 18, Kazan, Russia, 420008<sup>2</sup>Kazan State Medical University, Ulitsa Butlerova, 49, Kazan, Russia, 420012<sup>3</sup>National scientific Research Institute of Public Health named after N.A. Semashko, Moscow, Russia<sup>4</sup>Office of Rospotrebnadzor in the Republic of Tatarstan, Kazan, Russia**Abstract:**

*This paper discusses the current issue of the relationship between the deterioration of the ecological state of the environment and the increased impact of carcinogenic risk factors on the organism of the population in a particular area. Therefore, the authors of this paper found it necessary to study and assess the state of the environment of a certain area where the industrial plant is located. According to the results of this study, it is important to assess the risk factors for cancer development among the population of the given territory. Having collected the necessary material on this issue and systematized it, we conducted an analysis of the number of oncological diseases of the population over the past 12 years. Based on the obtained data, the degree of influence of harmful environmental factors, including production carcinogens, on the level of cancer morbidity was determined, which led to the idea of conducting promotion activities in schools, colleges, universities (for example - questioning about smoking, drinking alcohol and drugs) and in mass media. We had to work out proposals to improve the ecological situation in the city and prevent oncological diseases among the population. After analyzing the statistical data provided by the oncological service, a conclusion was made on the need for constant monitoring of the health of the population receiving increased doses of radiation, including measures for the early detection of malignant tumors. In addition, primary prevention measures should be implemented to eliminate the impact on these people of other known chemical and physical carcinogens, namely smoking, occupational carcinogens, and the use of X-ray diagnostic methods. The require a special diet to be developed that reduces the risk of malignant tumors. Such measures of primary and secondary prevention can lead to a significant reduction in morbidity and mortality from cancer among people exposed to ionizing radiation.*

**Keywords:** modern technogenesis, public health, hazard index, risk measurement, carcinogenic risk.**Corresponding author:****Margarita R. Gabidullina,**

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**INTRODUCTION:**

The environment and man are two interrelated and interdependent units. For a long time, scientists have discovered a correlation between environmental pollution and the incidence of oncological diseases. The human environment can have a direct and indirect impact with immediate or remote effects on his health. A steady increase in the content of toxic chemicals in the atmosphere, lithosphere and hydrosphere of the Earth affects many components of human life: first of all, his health, the quality of agricultural products, yields, quality of drinking water, atmospheric air and the state of the ozone layer [1]. Oxides of carbon, sulfur, nitrogen, hydrocarbon, lead compounds and dust have the most aggressive effect on the human body, being one of the most significant carcinogenic factors of development of malignant neoplasms. In direct proportion to the deterioration of the state of the environment, the incidence of cancers is increasing, and, according to WHO statistics, was the fourth leading cause of death in the world in 2017. The level of exposure to risk factors and the threat of development of cancer depends on the territorial characteristics of conditions and lifestyle [2].

The study of the state of the environment in the area studied, the systematization of the material and a thorough assessment of carcinogenic risk factors will be the basis for developing proposals for improving the ecological situation in the territory and creating a set of preventive measures to prevent the emergence of tumors. In case of a high degree of threat of the increased incidence of oncological diseases, there will be a need to monitor the health status of the population in the area and take measures for early detection of oncology.

The study was conducted in the area located close to a large industrial petrochemical enterprise, which has a strong negative impact on air, soil and water in the study areas. Another important point of the study was to determine the time that the population of the district spent in the place of residence, the dynamics and structure of migration, and an assessment of the risk factors for oncological diseases.

The total area of the studied region is about 7000 hectares, the population is over 110 thousand people, 40% of which are under 30 years old, including 2/3 of the territory occupied by the private sector.

The basis of the economy of the region is represented by 12 industrial enterprises. The district locates 513 enterprises of the consumer market, including: trade (shopping complexes, supermarkets, shops, catering); consumer services; pharmacies and pharmacy points;

as well as markets.

Objective of the research: Identification of the peculiarities of the impact of air and water of various levels of contamination on the organism of residents of the district located within a 3 km radius from the industrial enterprise; assessment of risk factors for malignant tumors.

**METHODS:**

The study used the following methods: socio-genetic, chemical, sociological, environmental and statistical. The subject of the study is the state of health of the population under anthropogenic and technogenic pressure.

The object of the study is the adult and children population living within a 3 km radius from the industrial petrochemical facility.

A large-scale questionnaire was used - interviewing among residents living near the large chemical industrial enterprise. The questionnaires contained 3 blocks [3,4]. The first block - issues of a socio-hygienic nature, the second block - questions of the medical and biological profile, the third block - the assessment of factors of industrial ecology.

The carcinogenic and non-carcinogenic risks of damage to the health of the population living within a 3 km radius from the industrial facility (petrochemical enterprise) were calculated [5,6,7].

The hazard index was calculated. Risk assessments were made according to the approved risk management guidelines (2008). The calculated risk levels allow us to determine the priority level of the choice of preventive measures and influence the mechanism of management decisions and control over the situation in the given territory [8,9].

The calculated hazard indices help identify the priority pollutants and target organ systems when exposed to a specific adverse set of industrial ecology [10].

**RESULTS:**

The studies have shown that 17% of respondents, children of preschool and school age, as well as part of the adult population of the study area spend most of their time in the residential district on weekdays, the rest of the residents – in neighboring areas.

On weekends, the residents change their place of stay. According to the results of the survey, the population prefers going to large shopping malls and entertainment centers. The dynamics of migration significantly increases, the most popular places of stay, according to respondents, are adjacent areas.

More than 40% of the residents never leave their

area. Only 12.9% of the population go abroad for 20-30 days a year on vacation.

Among all age groups, a common feature is the choice of the main place of stay in the area of residence on weekends and weekdays - their house. The age group from 16 to 50 years is somewhat different, since there is a noticeable tendency to increase the time spent outside and in public transport due to the educational and working process of this part of the population.

The overwhelming majority of respondents prefer buses, private cars and taxis on weekdays and weekends, and only less than 1% choose trolley, tram and metro.

It is important to say that women of all age groups occupy a leading place, relative to men, in wasting time on washing and taking a shower both during the hot and cold seasons. If we talk about the difference between age groups, neglecting the gender identity of the respondents, then children under 2 and of 6-10 years old, as well as youth under 20 years spend most time in contact with water.

Consumption of water by the adult population (19-60 years) is 3 liters per day, and in the cold season, water consumption is reduced to 2 liters.

Water consumption by children does not depend on the season, but on their age.

Residents of the study area are concerned about water quality, especially its taste (56%) and smell (52%). 58% of the population in this region use tap water after additional treatment. Untreated water from the tap is used by only 32.51% of the residents, and 22.11% prefer bottled water.

Longer contact with soil is observed in children under 5 years throughout the year, except in autumn. Children of two years old are most in contact with sand, reaching 55 minutes in summer and 14 minutes in winter. A similar situation is with the earth: 47 minutes in summer and 29 minutes in winter. As for older children aged 6 to 10 years, the difference in the duration of contact in different seasons is not observed.

Respondents note the presence of a noticeable smell most often in the mornings, evenings and at night, most stable in the evening (29.2%). Also, respondents of this village admit that the smell becomes more distinct in the evening (15.4%) and at night (13.8%) ( $p < 0.05$ ,  $p < 0.001$ , respectively).

The opinion of the majority of the surveyed residents of the district turned out to be the same on the main source of smell - the industrial petrochemical plant (83.1%).

According to the survey of the population, a noticeable smell in the air is present in the evening, at night and in the morning, most expressed in the evening (29.2%). The most common smell is gas (25.2%); smells of chemicals and household waste (13.1%) and phenol (13.1%) are also present in the air.

The level of benzene, epoxyetane, chromium VI and divinyl in the atmospheric air in the investigated area causes a total carcinogenic risk in the volume of  $1.34 \cdot 10^{-5}$ . The concentration of ethylene in the air increases the hazard index for the cardiovascular system up to 0.32 and the nervous system up to 0.27. The significance of carcinogenic risk in case of cutaneous water intake, which depends on the presence of a large amount of cadmium in water, reaches  $1.36 \cdot 10^{-8}$ .

#### DISCUSSION:

This research was conducted in a residential area, which is located in close proximity to a large industrial plant, which is one of the main reasons for the deplorable state of the environment in the territory under consideration. In this regard, the study of the order and lifestyle of the local population, including the dynamics and structure of its migration, had a strategically important role in determining the degree of influence of carcinogenic risk factors and predicting possible deterioration in the health of the residents of the area.

Priority pollutants of the area were identified: benzene, chromium VI, divinyl, ethylene, and cadmium oxide.

All substances except for ethylene are carcinogenic, extremely or moderately hazardous substances. Ethylene is contained in atmospheric air and enters the body through the respiratory tract, affecting its mucous membranes. The effect of ethylene leads to a worsening of the cardiovascular system.

As for carcinogenic substances: cadmium enters the body with water, leaches calcium and helps promote the development of diseases of the nervous system; chromium VI penetrates the body through the air, as it damages the mucous membranes of the respiratory tract, can lead to the development of jaundice and peptic ulcer; benzene enters the body through the respiratory tract and may be the primary cause of

disruption of the central and peripheral nervous systems; divinyl enters the body during inhalation, provokes loss of consciousness and respiratory paralysis.

#### SUMMARY:

According to the results of the study, we concluded that the respondents spend most of their time in their actual place of residence and in the nearby areas, which suggests the constant impact of negative environmental factors on the body of local residents. The indicators of population migration are very low, even on weekend, the majority of the surveyed with a view to rest and purchase food and clothing at affordable prices are ready to go to easily accessible large markets.

It becomes obvious that the study of the frequency and duration of contacts with water is of great importance in terms of impact on human health of carcinogens contained in water, the cause of which is a poor ecology. According to the results of this study, we determined that women aged 19 to 20 years spend the most time in contact with water, washing nearly 26 minutes in summer and 14 minutes in winter; a group of men aged 16 to 18 years account spend 13 and 14 minutes, respectively. It should be noted that the children of two years old are also among the respondents whose daily contact with water lasts about 16 minutes. The showering with tap water takes most of the time in children under 10 years, whose contact with water lasts continuously from 35 to 37 minutes in hot and cold weather. Processing of research materials led to the conclusion that approximately 70% of the residents of the district are concerned about the quality of water consumed. It is important to say that the volume of drinking water for an adult on average is 3 liters in summer and 2 liters in winter, while children start to consume more water during their growth, so the demand increases from 0.5 to 1.5 liters per day. The main scaring factor in tap water consumption is its odor (about 56% of respondents) and taste (about 50%). Only 29% of the surveyed drink purchased bottled water at home, and only 42% use tap water filtered with additional equipment, 32.5% of the population uses tap water without any additional treatment.

Children under two and from 6 to 10 years old often have contact with the soil, about 50-55 minutes a day, after which it becomes necessary to use water for washing their hands, which in total increases the exposure time of the polluted environment to the child's organism characterized by low immune defense. The insufficiency of the structure and equipment remains the main water supply problems.

Worsening of the condition of water supply networks, 42% of which need to be re-structured, and their service life exceeding the norm, are the cause of secondary water pollution. Disinfection of water occurs with the help of chlorine - a toxic substance - which is dangerous to the health of the population of a millionaire city.

The greatest pathogenic effect on the organism of the residents of the region causes air, since the place of residence of the population is in close proximity to the industrial enterprise. This is due to the lack of individual means of protection in the population and a set of preventive measures aimed at irradiation of carcinogenic effects. According to a survey of the population, a noticeable smell in the air is present in the evening, at night and in the morning, most strong in the evening (29.2%). The most common smell is gas 25.2%; there are also smells of chemicals and household waste (13.1%) and phenol (13.1%), most often found on the housing site (14.2%). Furthermore, according to residents, there is often a smell of burning and gas, which is more stable. As the main sources of unpleasant smell in the air the respondents indicate the petrochemical enterprise and the solid waste dump.

#### CONCLUSIONS:

Summarizing the obtained materials, we can conclude that we have convincing data on the presence of high risk factors for the development of malignant tumors, which have a permanent negative impact on the inhabitants of the studied area. This study can be used to develop a set of preventive measures against the development of oncology. Such measures should be aimed at renovation of the polluting enterprises, as well as the use of individual protection measures by citizens. Strict monitoring of the level of carcinogens in air, water and soil, the regulation of the use of toxic substances and the stimulation of the construction of environmentally friendly enterprises are priority areas for the activities of the sanitary inspection service. To reduce the incidence of cancer, it is important to participate in the health care system, which should focus on careful monitoring of the health status of the residents of the area due to being at risk.

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