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Research Article

**NONCARCINOGENIC RISKS AND CONTEMPORARY  
TECHNOGENESIS****Anastasia A. Kamaletdinova<sup>1\*</sup>, Irina D. Sitdikova<sup>1</sup>, Leila Au. Akhtyamova<sup>2</sup>, Alexey V. Shulaev<sup>2</sup>, Veniamin A. Berezin<sup>2</sup>, Yuri D. Udalov<sup>3</sup>**<sup>1</sup> Kazan Federal University, Kremlyovskaya St, 18, Kazan, Tatarstan, Russia, 420008<sup>2</sup> Kazan State Medical University, Ulitsa Butlerova, 49, Kazan, Tatarstan, Russia, 420012<sup>3</sup> Federal Medical Biological Agency, Moscow, Russia**Abstract:**

The paper presents the results of a sociological study of the specific influence of adverse effects of man-caused environmental pollution on human health. The study involved residents of the territory, located 2 km from a large chemical enterprise. This company is engaged in the production of polymers and copolymers of ethylene. The study involved an adult working population. The results of an assessment of the non-carcinogenic risk of different levels of air and water pollution for the health of the population living in the study area are presented. In particular, an assessment of the non-carcinogenic risk of chronic inhalation exposure, as well as the oral intake of various pollutants into the human body was conducted.

Values of risk factors of non-carcinogenic risks from exposure to pollutants from water through dermal contact and oral intake are presented. The data obtained do not exceed the maximum risk levels for the development of chronic pathological effects [1].

The results of calculations of hazard indices indicating the likelihood of developing chronic effects from the cardiovascular system, the blood system, the immune system, respiratory organs, and the central nervous system are presented.

The values of hazard indices for combined effects of compounds on organs or systems (the reproductive system, the processes of the development of the organism, the central nervous system, the liver, the kidneys, the eyes, the hormonal system) do not exceed the permissible levels [2].

The definition of the risk assessment was based on the guidelines for assessing the health risks of the population exposed to the environmental chemical pollution.

**Keywords:** Non-carcinogenic risk, sociological research, technogenic pollution, petrochemical enterprise, risk assessment, technogenesis.

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## INTRODUCTION:

A sociological survey of the population on the topic "Identification of the specific effects of air and water of different levels of pollution on the health of the population" was carried out in a territory located 2 km from a large chemical industrial enterprise. The main types of products of this enterprise are ethylene, high and low pressure polyethylene, ethylene oxide, phenol-acetone and polyethylene pipes. The study area also houses engineering facilities. This paper studies the effects of air and water of different levels of pollution on the adult working population of a given geographical area.

The study area set up in 1994 includes residential microdistricts, and borders large residential areas.

The climate of the study area is temperate continental. Snow cover is moderate; fogs can be in autumn and spring, only 16 days a year. The average annual wind speed is 3.7 m/s, and the air humidity is 75%. A stable positive temperature, on average, is set in early April, and a stable temperature below zero is at the end of October. During the year, the average number of days with precipitation is about 197.

The sphere of the consumer market and services is diverse, includes shopping malls, shops, catering chains, pharmacies and consumer services points.

The objective of this study was to identify the characteristics of the impact on residents of the study area of man-made pollution of the environment.

Risk assessment is a multi-step process aimed at identifying or predicting the likelihood of an adverse impact of harmful substances on a person. It takes into account a variety of information about the level of this pollution, the toxic properties of the substance, its migrations and transformations in the environment, and the effect on humans [3].

Polluting factors of the environment can have a harmful effect on human health. Harmful substances can cause functional, pathological changes in the human body. The peculiarity of harmful influence depends on the substance itself, its concentration, toxicity, duration of exposure, ability to accumulate in tissues and organs [4].

The application of the selected risk assessment methodology is advisable in highly industrialized zones, therefore it was chosen as the study area.

## METHODS:

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 survey covered the following topics: the places of staying

outside the home over the last year on weekdays and on weekends, the causes of residents' anxiety when consuming tap water, the consumption of various types of water for drinking and with food, the presence of odors of different stability produced by operating enterprises at various times of the day inside and outside the house, the nature and sources of unpleasant odors in the air.

To assess the risk of adverse effects of man-caused pollution of the environment on human health, the methodology described in the manual for assessing the health risks of the population when exposed to environmental pollutants was applied. This manual was approved by the Chief State Sanitary Doctor of the Russian Federation P 2.1.10.1920-04 on March 5, 2004. The methodology allows expressing the sanitary and ecological ill-being that develops on the territory by comparing the observed or calculated levels of its technogenic pollution with the permissible ones, as well as the expected adverse response from the health of the population [5].

The methodology of the "risk assessment" is carried out in 4 stages: identification of the harmful factor, evaluation of exposure, evaluation of the exposure-response relationship, and risk characteristics.

The identification of the risk for carcinogens occurs according to three descriptors used to describe the substance as a carcinogen: a known or probable carcinogen; cannot be defined as a carcinogen; and probably not a carcinogen.

Calculating the total dose of a substance that pollutes different components of the environment and with different exposure routes is a reasonable approach to risk assessment. In the transition from concentrations of toxicant in air and water to doses, the "standard parameters" of pulmonary ventilation and water consumption for the adult population were used. As an average estimate of the volume of pulmonary ventilation per day, 20 m<sup>3</sup> is recommended; drinking water consumption is 1.9 l. [6].

The hazard ratio (HR) characterizes the risk to public health. HR is obtained through the ratio of the estimated human exposure (dose or concentration) to the reference dose or concentration of the pollutant. The hazard index (HI) is calculated as the sum of the hazard ratios of the individual components of the mixture of exposure substances [7].

## RESULTS:

We obtained the following results: more than 40% of residents constantly stay in the area of residence and

do go beyond the city. On weekdays and weekends, the main place of stay in the area of residence is the house.

In each house there is a tap water in the study area. The taste (52%) and the smell (50%) of tap water are greatest concern about the quality of water to the residents of the study area. For drinking and cooking they prefer extra treated tap water (49% of the total consumption of drinking water).

It has been noted with statistical reliability that residents often notice an expressed smell from the adjacent operating enterprises in the evening relative to morning and night ( $p < 0.05$ ,  $p < 0.001$  - respectively). The structure of the smell distribution is as follows: in the morning (20%), in the evening (25%), at night (17%). More often, respondents complain about the smell of gas ( $p < 0.001$ ), chemicals and household chemical waste ( $p < 0.001$ ), phenol ( $p < 0.001$ ), burning odor ( $p < 0.001$ ). The structure of the nature of the smell has the form: gas (31.5%), chemicals and chemical household waste (14.5%), phenol (8%), garbage (6%).

According to the majority of respondents, the main source of unpleasant odors is a chemical industry enterprise (73% of respondents).

At the stage of "hazard identification", 40 priority chemicals affecting the health of the population were identified in the emissions of this petrochemical enterprise. An assessment of the non-carcinogenic risk of chronic inhalation exposure was performed based on the results of the ranking of the identified chemicals. The results showed that the maximum value of the hazard ratio is indicated by ethylene  $HR = 1.33$ . Acceptable hazard level  $HR = 1.0$ . Values of hazard ratios for other substances do not exceed the allowable value.

Calculations of hazard indices (HI) taking into account all enterprises indicate the probability of developing chronic cardiovascular effects (HI up to 1.65), the circulation system (HI up to 1.59), the immune system (HI up to 1.56) for account of ethylene (contribution - 80.54-85.28%). In addition, there is a possibility of the development of chronic effects on the part of the respiratory organs (HI up to 0.99) and the central nervous system (HI up to 0.9) due to a mixture of saturated hydrocarbons C1-C5 in pentane (contribution - 51.93-56.58 %), the permissible level is  $HI = 1.0$ . Along with this, the calculation of hazard indices (HI) indicates the permissible probability of development of chronic effects on the part of the reproductive system (HI up

to 0.26), body development processes (HI up to 0.21), liver (HI up to 0.144), kidneys (HI up to 0.12), eyes (HI up to 0.08), the hormonal system (HI up to 0.00018). The contribution of the chemical enterprise to the formation of total hazard indices is 92.33-96.67%. The probability of the development of chronic effects on the part of the respiratory organs and the central nervous system at the expense of this enterprise only is permissible, that is, the hazard index does not exceed 1.0 [8].

Values of non-carcinogenic risks from harmful substances entering the water through the skin are much lower than the permissible levels - 1.0, including: from exposure to chloroform ( $HR = 4.99 \cdot 10^{-3}$ ), ammonia ( $HR = 1.32 \cdot 10^{-4}$ ), aluminum ( $HR = 6.82 \cdot 10^{-5}$ ).

Thus, the likelihood of chronic non-carcinogenic effects from the central nervous system, gastrointestinal tract, blood, kidney, liver, hormones, bone system, teeth, biochemical changes in the body of the studied territory does not exceed the maximum permissible levels.

Values of non-carcinogenic risks with oral intake of chloroform ( $HR = 0.135$ ), ammonia ( $HQ = 0.018$ ), fluorides ( $HQ = 0.3$ ) with drinking water are significantly below 1.0. Thus, the likelihood of chronic pathological effects of consumed water on the part of the bone system, teeth, circulation system, kidneys, mucous membranes, central nervous system, hormonal system, liver, biochemical changes in the body, nervous system, development processes, reproductive, immune systems, and GIT does not exceed the maximum permissible levels of risk [9].

## DISCUSSION:

The respondents were surveyed in the residential areas of the study area, located in close proximity to a large industrial enterprise. This enterprise produces more than 1 million tons of chemical products and is the largest in Russia for the production of low and high pressure polyethylene, polyethylene gas pipes, phenol, acetone, cooling liquids, chemical reagents for oil extraction and natural gas drying. It is the main pollutant of air, soil and water in the territory under consideration. The study found out that within a year more than 40% of the inhabitants do not go beyond the investigated territory. The houses of all residents of the given territory are equipped with a water pipe, and gas stoves, and a number of apartments, in addition to the gas stove use a gas water heater.

Analysis of the results of the study showed that more

than 50% of respondents are concerned about the quality of water consumed, in particular its taste and smell.

All respondents note the occurrence of a noticeable unpleasant odor more often in the mornings, evenings and at night. The most strong are smell of gas, chemicals, phenol, and burning odor.

Analysis of the results obtained during the risk assessment indicates a high probability of developing chronic effects on the part of the cardiovascular system, circulatory system, immune system, central nervous system and respiratory organs. These non-carcinogenic risks are caused by the effect of ethylene and a mixture of saturated hydrocarbons C1-C5, entering the human body from atmospheric air. Risk assessment has revealed a low probability of developing chronic non-carcinogenic abnormalities caused by pollutants entering the human body with water [10].

#### SUMMARY:

- 1) 52% and 50% of the surveyed residents are most concerned about taste and smell of the consumed water, respectively.
- 2) 31.5% of the surveyed residents of the study area worry about gas odor, 14.5% - chemicals and household waste, 8% - phenol, and 6% - burning odor.
- 3) The characteristics of the risk posed by non-carcinogenic substances in the air indicates that the effect of ethylene causes a high probability of developing chronic cardiovascular effects (HI up to 0.94), circulatory system (HI up to 0.87), immune system (HI up to 0.84).
- 4) There is a possibility of the development of chronic effects on the part of the respiratory organs and the central nervous system (HI up to 0.99 and HI up to 0.9, respectively) due to a mixture of saturated hydrocarbons C1-C5 in pentane.
- 5) The values of non-carcinogenic risks of pollutants contained in drinking water when entering the skin are much lower than permissible levels, which indicates a low probability of chronic non-carcinogenic effects on the part of the central nervous system, GIT, blood, kidney, liver, hormones, bone system, teeth, and biochemical changes in the organism of the population of the studied territory.
- 6) Values of non-carcinogenic risks with oral intake of pollutants contained in drinking water are significantly below the permissible level. Thus, the likelihood of chronic pathological effects of consumed water on the part of the bone system, teeth, circulation system, kidneys, mucous membranes, central nervous system, hormonal system, liver,

biochemical changes in the body, nervous system, development processes, reproductive, immune systems, and GIT does not exceed the maximum permissible levels of risk.

#### CONCLUSIONS:

The paper is devoted to the study of the impact of technogenic pollution of the environment on the health of the population living 2 km from a large petrochemical enterprise. The study of this issue allowed us to conclude about harmful effect of the polluting substances emitted by this enterprise on human systems, including: cardiovascular, circulatory, immune, central nervous system, etc.

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