RISK ASSESSMENT PRACTICE

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ASSESSMENT OF HYGIENIC RISK FACTORS OF ONCOLOGIC DISEASES IN THE CONDITIONS OF SMALL INDUSTRIAL TOWNS

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The individual carcinogenic risk from children's oral exposure to heavy metals was found to amount to 2.15E-05 and 9.52E-05 for Alatyr and Shumerlya, respectively.

The children who are exposed to the highest lifetime individual risk are those residing in the town of Shumerlya – 10 new cases of malignant neoplasms for every 100,000 children of the corresponding age. In contrast, in Alatyr, there are only 2 new cases of malignant neoplasms.

We have detected a relationship between environmental components and an increase in the incidence of oncological diseases in the studied areas.

Keywords: *incidence of malignant neoplasms, small towns, individual carcinogenic risk, children.*

Malignant tumors are one of the most important medical and social problems of the modern society.

Beginning with 2000s there are more than 450,000 cases of malignant tumors registered in Russia annually. The annual growth of absolute number of people with the disease is on average 0.2%. Malignant tumors are the second (in order of importance) reason for mortality in Russia and in the world after cardiovascular pathology [3].

It has been proved that malignant tumors have a multiple-factor character conditioned by the combinatory impact of natural, anthropogenic, demographic and social-economic factors [3, 4].

As for the International Agency on Cancer Studies data, the formation of 85% of human tumors might be connected with environmental factors. It is considered that tumors in the majority of cases are an overall result of combinatory influence of small doses of multiple carcinogens [5].

The growth in the number of people taken ill taking into account the specificity of demographic situation in Chuvash Republic indicates the real growth of cancer morbidity as it is observed on the background of population decrease (in 2012 in comparison with 1997 the population decrease comprised (-6.4%), growth of people with the disease was 51.8%).

In the structure of total mortality of the population in Chuvash Republic malignant tumors (MT) are still on the third place after cardiovascular diseases, traumas and poisonings in 2012 (9.0%).

For the analyzed period from 1997 to 2012 the average annual growth of MT morbidity was

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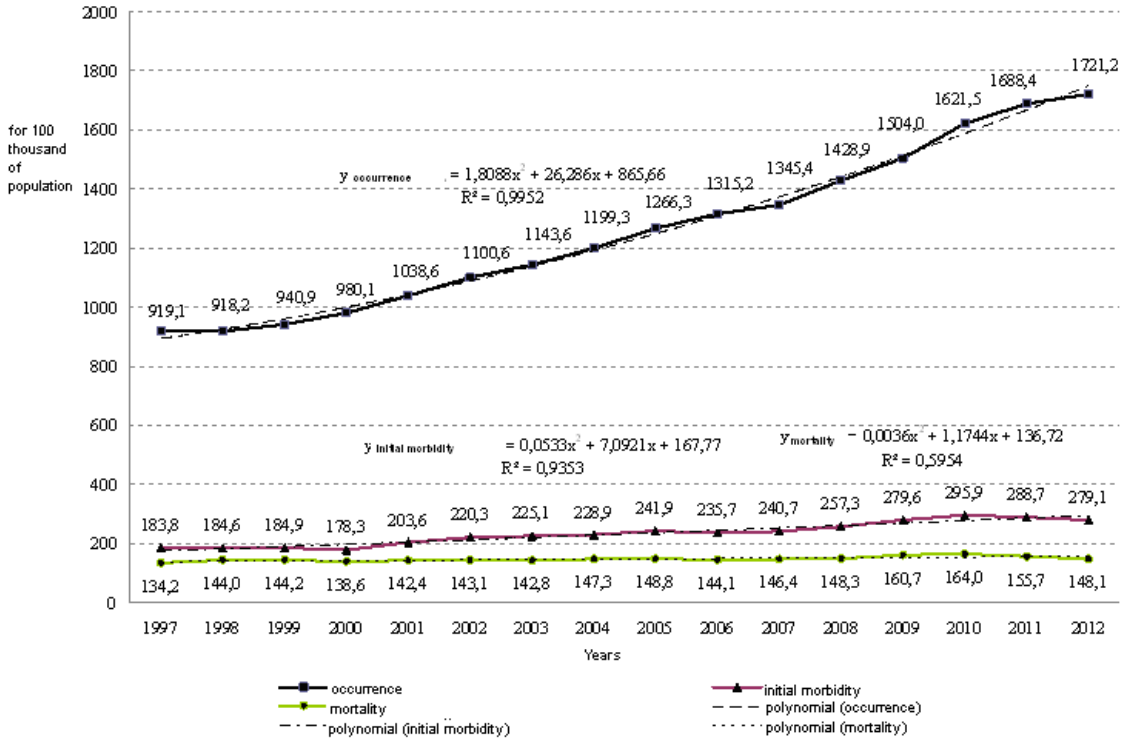
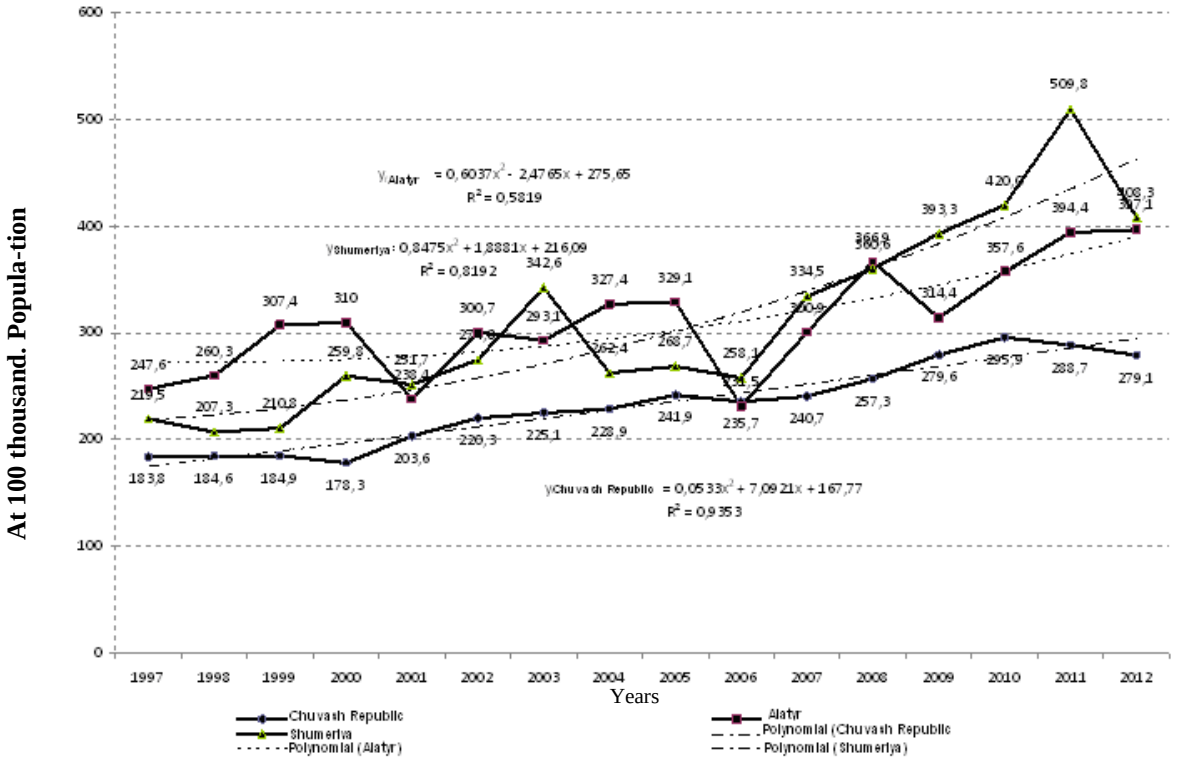
1.7%: in 1997 its indicator equaled to 183.8$^0/_{0000}$, and in 2012 it was 279.1$^0/_{0000}$. Though over the same period the average annual mortality rate growth from MT was 0.42% (with 134.2$^0/_{0000}$ in 1997 up to 148.1$^0/_{0000}$ in 2012) (pic.1).

On the administrative territories of the Republic the morbidity from MT over the period of 2001 to 2012 varies as the lowest indicators of morbidity rate (lower than 249.7$^0/_{0000}$ – long-term average annual in Chuvash Republic) are registered in 11 out of 26 municipal entities of the Republic. The highest rates (more than 249.7$^0/_{0000}$) – are registered in Alatyrskiy, Poretskiy, town of Alatyr, town of Shumerlya. At the same time it's estimated that the MT morbidity rate growth was 1.7% in the town of Alatyr and Poretskiy district, Alatyrskiy district had – 1.5%, the town of Shumerlya – 2.7% annually.



Pic. 1. Dynamics of occurrence, initial morbidity, mortality from MT of the population in Chuvash Republic over the period from 1997 to 2012 (for 100 thousand of population)

Based on the data of MT morbidity of Chuvash Republic population, Alatyr, Shumerlya over the period 1997-2012 and its dynamics there's been worked out a medium-term forecast on MT morbidity up to the year of 2014 (pic. 2). We used a method of extrapolational forecast on several types of differentiable functions (direct, second order polynomial, polynomial function). According to the data obtained, MT morbidity rate of the population of Chuvash Republic, Alatyr, Shumerlya indicates a possible increase of morbidity rate by 2013 up to 303.7±10.1$^0/_{0000}$ (in the interval from 293.70/$_{0000}$ to 313.8$^0/_{0000}$), up to 408.0±35.7$^0/_{0000}$ (in the interval from 372.3$^0/_{0000}$ to 443.7$^0/_{0000}$), up to 493.1±42.0$^0/_{0000}$ (in the interval from 451.2$^0/_{0000}$ to 535.1$^0/_{0000}$) accordingly. A similar situation will be observed in 2014 with the morbidity rate 312.7±9.8$^0/_{0000}$ (in the interval from 302.9$^0/_{0000}$ to 322.5$^0/_{0000}$), up to 426.7±35.4$^0/_{0000}$ (in the interval from 391,3$^0/_{0000}$ to 462,1$^0/_{0000}$), up to 524.7±42.0$^0/_{0000}$ (in the interval from 482.60/$_{0000}$ to 566.7$^0/_{0000}$) accordingly.



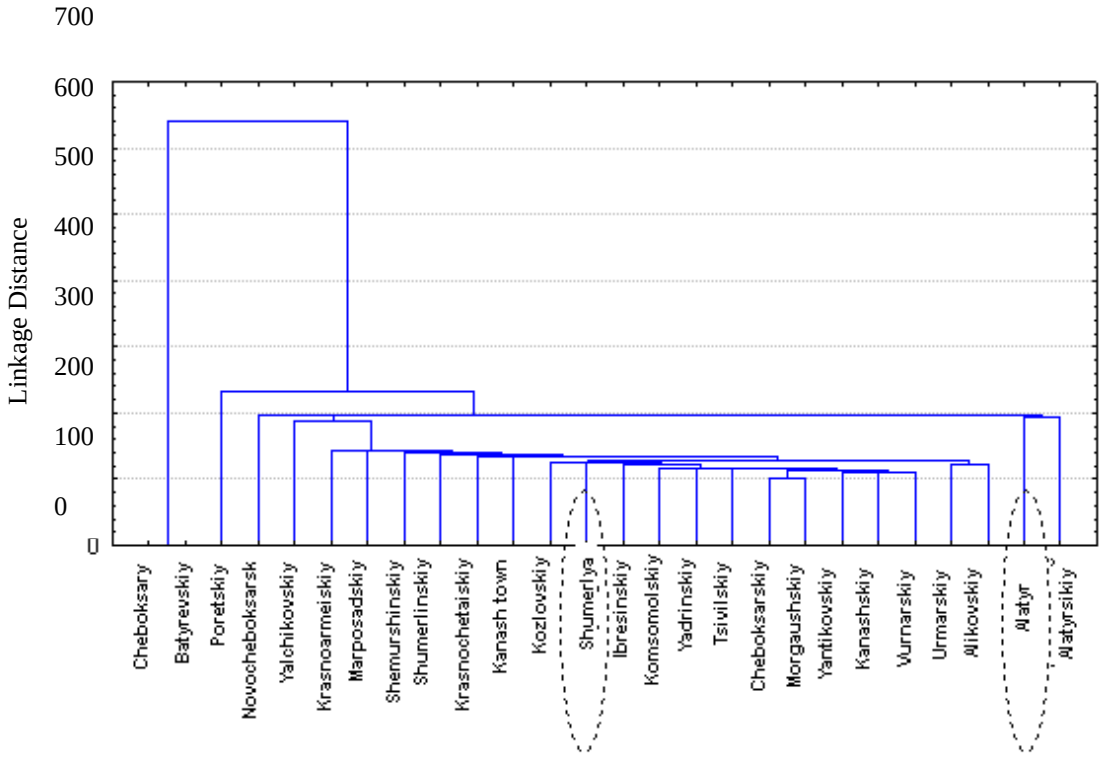
Pic. 2. Dynamics of initial MT morbidity of the Chuvash Republic population, Alatyr, Shumerlya over the period from 1997 to 2012 (for 100 thousand of the relevant population)

Cluster grouping according to the level of initial MT morbidity of the population of 26 administrative entities of Chuvash Republic classified small towns into one cluster but different subclusters which indicates the homogeneity of factors determining the level and dynamics of initial MT morbidity which, to a great extent, is conditioned by ecologic-hygienic situation on the territory (pic. 3).

That is why revealing the priority factors facilitating MT development among the population of small towns in Chuvash Republic is of particular interest in connection with the steadily increased level of oncologic diseases in those towns in comparison with not only average republican morbidity but even with morbidity in other cities characterized by higher life environment pollution including carcinogens.

Towns of Alatyr and Shumerlya are located in one economic-geographic and climatic zone.

According to the criteria of regioning assessment by V. L. Suslikov, those towns are part of Prisurskiy (PS) subregion which is characterized by prevalence of sand-bleached soil with peat-bog land plots. The presence in PS region of open field of silicon considerably affects the cycles of biogenic migration of microelements of specific silicon character. In all the stages of bio-geo-chemical food chain in PS subregion there might be observed extreme excess of silicon, calcium, fluorine and manganese, relatively high amount of zinc, copper and strontium and obvious deficit of iodine and cobalt as well as the highest rates of toxic elements such as lead, cadmium and aluminum, unfavourable ratio of micro-elements to iodine and silicone [2].



Pic. 3. Cluster grouping of the Chuvash Republic territories according to the level of initial MT morbidity over the period from 1999 to 2012.

Right within the city boundary of small towns there are industrial enterprises characterized by the proximity of industrial and residential areas without any required boundaries between the sources of impact and places of full-time residence of people.

The main industrial branches in those towns are machinery manufacturing, food production and wood-pulp and timber industry.

Among the stationary sources over the many years the main contribution has been made by machinery manufacturing and metal-processing industries: from 39% up to 50% and housing maintenance and utility service: from 17.35% up to 23%. Emissions of pollutants from vehicles are more than 50% of the total amount of emissions.

The conducted ranging of air pollutants in small towns showed that 40% of the emitted into air substances (under the classification of IARC (International Agency for Research of Cancer) relate to carcinogenic substances: soot, formaldehyde, chrome VI, lead and its non-organic compounds, cadmium, benzine, nickel soluble salt. Among the singled out carcinogenic substances emitted into the atmosphere of both cities, more than 60% affected mostly respiratory organs, 34% - central nervous system, blood organs, kidneys.

While assessing industrial pollution of the environment, a great attention is given to the condition of deposit media, including soil. Many researches consider soil as an indicator of long-term influence.

According to the benchmark scale of pollution danger on accumulative indicator of pollution, soil in the studied cities relates to the category of soils with permissible level of pollution ($Zc<16$).

When determining the concentration criterion (Cc) of certain metals, as a rule, they base on comparison of absolute indicators of concentration with background indicators. As background indicators we used the lower quartile of the whole town selection. Cadmium

(Cc=3.6) and lead (Cc=2.5) had the greatest prevalence over the background in total element composition. As for mobile forms, the excess over the background was observed with the following metals: nickel (Cc=6.2), copper (Cc=4.1), zinc (Cc=1.8) and chrome (Cc=1.8). Consequently, health risk for the population of Alatyr and Shumerlya from soil pollution by metals is still observed in spite of hygienic standards observation.

According to the results of previously conducted studies on the territory of Chuvash Republic, there's been detected cause-and-effect connection between kidney cancer and bladder cancer and the amount of cadmium, nickel and uranium in the soil [1].

The main source of domestic and drinking water supply of the Alatyr and Shumerlya population is the river Sura. Subsoil water used by the population is located in aquifers of Devonian, Carbonic periods and in deposits of the Kazanian age of Lower Permian aquifer and is characterized by high concentration of ferrum.

The comparative analysis of the long-term annual average concentration of chemical substances in the sources of centralized water supply and in drinking water of the distribution network of those towns showed that their concentrations have been steady and have not exceeded the hygienic norms and regulations (for exception of ferrum concentration and residual chlorine).

Currently the preference is given to complex assessment of chemical substances perceived by the human body with account of all media and routes of entry and exposure. As children (to a greater extent than adults) are susceptible to unfavorable or harmful impacts of the environment, the assessment of peroral entry of carcinogenic substances (lead, cadmium) from various media (soil, water, foodstuff) have been conducted for the children population of the republican small towns.

Individual carcinogenic risk from peroral influence of heavy metals (HM) on the children organism is determined at the level 2.15E-05 (Alatyr), 9.52E-05 (Shumerlya), which corresponds to moderate risk level. The given levels are subject to constant control. In some cases at such levels of risk there might be taken additional measures on their reducing. The greatest contribution to the accumulated lifelong carcinogenic risk in both cities is made through foodstuff, in particular because of cadmium contamination (1.43E-05-1.56E-05).

The analysis of total carcinogenic risks, conditioned by simultaneous entry of carcinogens from various media perorally, showed that the children of Shumerlya are subject to greater lifelong risk with 10 cases of MT per 100,000 children of the relevant age. Alatyr has 2 cases of tumors.

Three carcinogens (Pb, Cd, Ni) have been found in the hair of children from small towns. The analysis of microelement composition of children aged 10-14 living in small towns, showed that in spite of presence of heavy metals in the objects of the environment, over the long-term period their concentration have not exceeded hygienic regulations. Nevertheless, the concentration of nickel (2.0-3.4 μg/g) and lead (2.6-5.1 μg/g) accumulated in children's hair was relatively high as their concentration was higher than physiological boundaries established in other residential locations.

Thus, the obtained data show that there is dependence between the quality of life environment components and growth of oncologic diseases in the studied regions.

However, it is worthwhile noticing that the assessment of carcinogenic risk has been carried out only for peroral entry of heavy metals without assessing household and inhaling carcinogenic exposure.

Steady growth of the number of people with the first diagnosis of MT, considerable difference in the level of morbidity and its growth on the given administrative entities make it necessary to identify the priority factors influencing the development of oncologic diseases.

Referencts

1. Ilivanov Y. D. Peculiarities of oncologic pathology formation in urinary system of the Chuvash Republic population under the influence of several environmen-tal factors: Published summary of a thesis of the candidate of medical science, 14.00.14/ Kazan, 2007;

2. Suslikov L. V., Semenov V. D. Bio-geo-chemical regioning of the territory of Chuvash ASSR. Bio-geo-chemical laboratory of the Institute of geochemistry and analytical chemistry after V. I. Vernadskiy RAS. M.: Nauka. 1981. volume.19.

3. Chissov V. I., Starinskiy V. V. Malignant tumors in Russia in 2010 (morbidity and mortality). — M.: MNIOI/МНИОИ named after P. A. Herzen, 2011;

4. Yudin S. V., Luchkevich V. S., Kiku P. F. Medical and social and ecologic-hygienic risk factors of oncologic diseases. — SPb/СПб., 2002;

5. WHO. Air Quality Guidelines. -Geneva, 1999.