ASSESSMENT AND PREVENTION OF PERSONAL RISK FACTORS IN CHILDREN DWELLING IN INDUSTRIALLY POLLUTED AREAS OF NIZHNI TAGIL

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In contrast to adults, children are more sensitive to effects of environmental factors even at the level of maximum permissible concentrations due to specific features of their growth and development.

Numerous studies have shown that health of children living in areas with high levels of environmental pollution is worse than in children not constantly exposed to effects of components of industrial and motor transport emissions.

A long-term and continuous contamination of environment in Nizhni Tagil worsens indices of children’s health. As a result, we observe the tendency to the increase in the incidence rates of diseases of the nervous system (+25.9 %), chronic otitis (+154.5 %), bronchial asthma (+6.2 %), circulatory diseases (+25.8 %), diseases of the genitourinary system (+3.7 %), atopic dermatitis (+7.3 %) as compared to the long-term average level. In 2008 the rate of acute disease incidence among organized children was 1.6 % higher than that in 2007 (in kindergartens and schools – 0.2 % and 1.2 % higher, respectively). In the structure of the acute incidence respiratory diseases ranked first (67.54-78.4 %) on account of acute respiratory viral infections. The rate of chronic diseases was also higher than the long-term average rate: of the genitourinary system – 4.0 % higher in schools, of the nervous system – 3.0 % higher in kindergartens and 13.6 % higher in schools, of skin and subcutaneous system – 8.6 % higher in kindergartens.

Based on the results of the sanitary and hygienic monitoring, the town of Nizhni Tagil is an area of the Sverdlovsk Region characterized by a high level of environmental pollution where a complex chemical load contributes the most in forming the health status. The children are exposed to a complex of contaminants from ambient air, soil, drinking water and foodstuffs. Adverse factors include the contamination of all environmental media with toxic metals (chromium, manganese, vanadium, lead, cadmium, copper, etc.) and organic compounds.

The assessment of personal exposures made in Nizhni Tagil in 2006 helped establish the true toxic load, routes and pathways of exposure to such toxicants as nitrogen dioxide, benzene, xylene, toluene, ethyl benzene, trichloroethylene, tetrachloroethylene, and formaldehyde using passive samplers and the dust load using active ambient air and indoor air sampling (in kindergartens and at home). We also established concentrations of chemicals in dust samples collected in residences and kindergartens, drinking water, vegetables and fruit grown in private gardens and in soil from these gardens. We found high concentrations of formaldehyde exceeding the maximum permissible level in indoor air. The average concentration was 1.3 times higher than the maximum permissible concentration (0.01 mg/m³) and the maximum detected value was 2.1 times higher. It should be noted that concentrations of formaldehyde in indoor air in households were 5 times higher than those in kindergartens and 18 times higher than that in ambient air, whereas the highest values were 7.7 and 2.3 times higher, respectively. All concentrations of volatile organic compounds (VOC) found during personal sampling and also in ambient air, indoor air in kindergartens and homes did not exceed corresponding maximum permissible concentrations and concentrations found in indoor air were comparable to those found in ambient air. Concentrations of particulate matter and also of lead, copper, chromium,
cadmium, nickel, zinc, arsenic, aluminum, manganese and vanadium in ambient air and in indoor air of kindergartens did not exceed their maximum permissible concentrations.

The assessment of inhalation exposure of children to nitrogen dioxide, formaldehyde, and VOCs with account for the results of the time study showed that indoor air pollution contributed the most to the total exposure, the second and the third places being occupied by indoor air in kindergartens and ambient air, respectively. The inhalation exposures of children to suspended particles showed that the total dust load was equally conditioned by concentrations of pollutants in indoor air (in kindergartens) and ambient air.

Using questionnaires we collected information about the frequency of occurrence of the main risk factors of toxic load among the selected children. Results of assessing children’s nutrition and distribution of some foodstuffs by places of their purchasing showed that meat, milk, cottage cheese, eggs, fish and apples were purchased by the respondents in wholesale and retail stores; at the same time they consumed potatoes, carrots, beet, cabbage, tomatoes and cucumbers grown in their private gardens. In vegetables grown in private gardens of Nizhni Tagil we found no excess of maximum permissible concentrations of all chemicals tested. Yet, in soil samples from the same gardens concentrations of zinc were 1.13 times higher than the permissible value. In some soil samples zinc concentrations were 2.4, manganese – 1.1 and copper – 1.4 times higher than the permissible level. Additional toxic load on children is conditioned by high concentrations of aluminum, manganese, lead, nickel, chromium, arsenic, and vanadium in home dust. Besides, in 50% of home dust samples we found allergic pyroglyphidae ticks.

Based on study results we developed recommendations for administrations of kindergartens on reduction of the established high toxic load and hygienic recommendations for parents including regular ventilation and daily wet cleaning at home, spending more time out of town, stopping smoking in the presence of children and using a gas stove for heating, organizing exhaust ventilation from the gas stove, avoiding the use of synthetic materials at home, additional purification and disinfection/decontamination of indoor air.

In modern conditions radical technological and technical measures that exclude adverse effects of many industrial enterprises and transport on the environment require significant implementation periods and large expenditures. Besides, after the implementation of such measures it will take decades to reduce persistent pollution of soil, water and biota to the levels posing no danger to human health. In this connection rehabilitation actions are of primary importance for reduction of health risks. Health improvement (rehabilitation) is an integral part of the Concept for preserving the population of the Sverdlovsk Region until 2015 in the town of Nizhni Tagil.

Since 2005 a complex action plan on improving health of people residing in contaminated areas of the Sverdlovsk Region until 2015 has been implemented for the first time in the Sverdlovsk Region and Russia. In Nizhni Tagil a complex of measures on hygienic diagnostics, biomonitoring, biological prevention and treatment of children with environment-related diseases has been introduced since 2003.

Based on the results of environmental monitoring and hygienic diagnostics we have developed a set of measures for prevention of environment-related diseases among the population living in the most polluted areas of the town. Priority measures shall be aimed at reducing the chemical load, reducing and preventing the risk of environmental diseases, developing recommendations for optimization of the diet, forming the motivation for preserving and improving health among the population, promoting healthy lifestyle, informing the public about risk factors.

Implementation of a scientifically grounded complex of measures in Nizhni Tagil in the past 6 years has proved effective. Concentrations of toxic metals in biological media have decreased and public health indices have improved.

The annual prevented health damage is over 32.2 million rubles.
A high efficiency of medical and preventive actions for reduction of risk of environmental diseases has been achieved thanks to their targeting (the actions have been implemented for the population truly in need of such help and every person in need has access to specialized assistance) and early hygienic diagnostics.