ANNOTATION

dissertation for the degree of Doctor of Philosophy (PhD)
on speciality 6D060700 – Biology

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Influence assessment level of the anthropogenic environment pollution in Karaganda region on the health of children based on non-invasive screening methods

The relevance of the topic. Children, being in the functional instability of the regulatory systems of the body, are most sensitive to changes in environmental conditions; therefore, the health of the child population can serve as a reliable indicator of environmental distress. The development of the industry of Karaganda region has led to the emergence of artificial biogeochemical regions, concentrated in large industrial cities, wherein the environment there is an increased level of such chemical elements as lead, cadmium, manganese, etc. A certain concentration of elements in environmental objects can affect the elemental composition of biological materials (hair, urine, nails, blood, etc.) causing a deterioration in the health of children. One of the effective ways to maintain their health is early diagnosis of borderline states, which can ensure the timeliness of preventive measures, and here, first of all, it is necessary to accurately quantify the elements in human biosubstrates.

Assessment of the content of chemical elements in the human body makes it possible to fairly accurately judge the efficiency of its morphological systems and the risk of developing certain pathological conditions, which makes it possible to use such an assessment as a means of pre-nosological diagnostics of the population living in the industrial regions of Kazakhstan. A large number of works are devoted to the study of the relationship between the content of metals in the hair of the population and the degree of pollution of the environment. It has been established that the environment and the population of industrial cities in Kazakhstan are experiencing anthropogenic pressures associated with various industries. The risk of developing certain pathological conditions in the population of Kazakhstan is widely studied by domestic researchers at the level of epidemiology and occupational risk. However, insufficient attention is paid in our country to the study of the microelement status of the population living under conditions of technogenic load. Some scientific publications assess some chemical elements as a negative factor characterizing the quality of the environment.

Analysis of literary sources showed that the industrial cities of Karaganda region were included in the top ten cities of Kazakhstan with "increased" and "high" levels of air pollution. Moreover, each individual, from the industrial cities of Karaganda region, has its environmental characteristics of environmental pollution, features of the impact on the health of the living population and forms the so-called level of environmental problems in the region.

In scientific publications of Russian scientists: A.V. Skalny, et al. (2000; 2002); Notova S.V. et al. (2006): Lugovaya E.A. et al. (2007; 2017); Eremeishvili A.V. et al. (2012); Kazakh researchers: F.E. Ospanova (2007, 2013); G.A. Batyrova, (2019); American researchers; Bridges, R.K. Zalups (2005), it was concluded that it is necessary to take into account the regional characteristics of the microelement status of the organism, including that of children.

A promising direction is the study of the elemental "portrait" of the population of certain biogeochemical regions for the scientific development of normative indicators. Particular attention is paid to non-invasive methods, where the object of research to identify the state of metabolism of trace elements in the body can be hair. However, in Kazakhstan there is a limited database of the diagnostic significance of the content of trace elements in biomaterial, there are no regional standards for the content of trace elements in human biomaterial, in particular in children, which requires additional research in this direction.

Besides, there is a limited number of works on assessing the effect of the imbalance of trace elements on the course and prognosis of respiratory diseases. Therefore, the study of the dynamics of diseases of the upper respiratory tract of the child population, associated with the peculiarities of the content of chemical elements in the environment of industrial cities of Karaganda region, is an urgent issue, which makes it possible to take into account the peculiarities of the premorbid state of children living in unfavourable environmental conditions.

Thus, despite the variety of work performed, the problem of imbalance of chemical elements in the body and health problems in children is far from being resolved and needs to be continued research, primarily taking into account the regional aspect. This fact served as the purpose of the dissertation research.

The purpose of the dissertation: to study the effect of the level of anthropogenic pollution of the environment of Karaganda region on the child population with the identification of risk groups, based on non-invasive screening methods.

Objects of research: air, soil, children of the cities of Karaganda region at the age of 6-8 years, outbred laboratory white rats.

The scientific novelty of the research.

For the first time, a violation of the barrier properties of epithelial cells and a decrease in the number of normal cells of the mucous membrane of the nasal cavity and buccal epithelium of the cheeks were revealed in children 6-8 years old, which is evidence of early manifestations of metabolic changes in the body.

The toxic effect of soil dust in the cities of Karaganda region was established, and an imbalance was revealed in the level of lipid peroxidation and antioxidant defence reactions, the generation of nitric oxide metabolites, the accumulation of destructive changes in the base cells of bronchoalveolar fluid and lungs of rats, indicating the organ-specific effect of the studied elements.

For the first time, the accumulation of chemical elements in the hair of children 6-8 years old living in Karaganda region was revealed, and a denotative scale for the content of conditionally toxic and essential chemical elements was developed.

For the first time, a link has been established between increased levels of lead, reduced levels of zinc, copper and chromium in hair, and an increase in the incidence of upper respiratory tract infections in children.

The negative impact of soil dust from industrial cities of Karaganda region on the state of the respiratory system and the general physiological status of a person is confirmed by the results of a model experiment conducted on laboratory animals.

The structure and scope of the thesis. The dissertation contains 145 pages of typewritten text, consists of definitions, symbols and abbreviations, an introduction, a literature review, the main part (materials and research methods, chapters of own research), conclusions, 54 tables, 16 figures and a bibliography including 276 sources.

Main results

- high levels of anthropogenic pollution of the environment of the cities of Karaganda region and the peculiarities of the quantitative chemical composition of atmospheric and soil dust lead to a high risk of health problems for children.

- the accumulation of toxic heavy metals in the components of the environment (air and soil) of the cities of Karaganda region and the biomaterial (hair) of children has been determined.

- it was shown that changes in the immunoreactivity of the nasal mucosa in the cells of the nasal epithelium and buccal epithelium of the cheeks, manifested in a decrease in the number of normal cells, an increase in the number of cells with vacuolar dystrophy, karyorrhexis, phagocytosed apoptosis bodies, obese, binucleated, anucleated microflora cells, epithelium indicates a decrease in the barrier and protective properties of the mucous membrane of the upper respiratory tract.

- the interrelation of the content of metals in the environmental components of the cities of Karaganda region and biological media of children has been revealed.

- the significance of cytogenetic disorders in children as biomarkers of the endogenous effect was revealed. A toxic effect was established, where the general metabolic syndrome manifested itself as an imbalance of lipid peroxidation and antioxidant protection, the generation of nitric oxide metabolites, the accumulation of destructive barrier changes in basic cells in the lungs, indicating the organ-specificity of dust exposure, and substantiating the possibility of their use as early informative indicators.

- the quantitative values of essential microelements have been determined: Cu, Fe, Zn, Mn, Cr, Co; conditionally essential: Ni, As; toxic: Pb, Cd in children of Karaganda region.

- the ranges of the content of microelements were established using a denotative indicator for the cities of Karaganda region.

- Excessive accumulation of toxic microelements against the background of a deficiency of essential microelements is a distinctive feature of the elemental status of children in Karaganda region.

In the course of a model experiment carried out on laboratory animals, the negative impact of soil dust from industrial cities of Karaganda region on the human body was confirmed.

The theoretical and practical significance of scientific results

The theoretical significance of the work lies in the fact that data were obtained on the violation of the barrier properties of epithelial cells and a decrease in the number of normal cells of the mucous membrane of the nasal cavity and buccal epithelium of the cheeks, indicating early manifestations of metabolic changes in the body of children, and a decrease in the protective properties of the mucous membrane of the upper respiratory tract. Under the influence of environmental factors of industrial cities of Karaganda region in experimental conditions, the toxic effect of dust from industrial cities of Karaganda region on the physiological state and immunological resistance of the respiratory organs of animals was established. The features of the accumulation of metals in the hair of children living in industrial cities have been revealed**.**

Practical relevance: the data obtained allowed us to establish the permissible range of the content of trace elements in the hair of children of Karaganda region, a "Denotative table of the content of trace elements in the hair of children 6-8 years old of Karaganda region" was developed.

Indicators of microelement status make it possible to identify children at risk for the development of diseases of the upper respiratory tract under the influence of salts of heavy metals

The results of the study of the imbalance of micronutrients in children of the region are recommended to be used in the development of measures for the prevention of mixed micronutrient deficiency.

Approbation of work and publication

The main content of the thesis is reflected in 11 printed works, including 1 article in an international edition, cited in the Scopus database; 4 articles in journals recommended by the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 1 article in the journal cited in the RSCI database; 2 articles in materials of international conferences, 1 article in materials of republican conferences of the Republic of Kazakhstan and 2 methodological recommendations.