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Jiemuratova G.K.,
Institute of Immunology and Human Genomics,
Academy of Sciences of the Republic of Uzbekistan
Danilova E.A.,
Institute of Nuclear Physics, Academy of Sciences
of the Republic of Uzbekistan
Akhmedjanova Z.I.,
Institute of Immunology and Human Genomics,
Academy of Sciences of the Republic of Uzbekistan

FEATURES OF CHANGES IN SOME MICROELEMENTS IN CHILDREN OF THE ARAL SEA REGION

Abstract

Introduction. Deviations in the intake of macro and microelements by the human body, which adversely influence their ratios affecting their activity in the body, reduce or increase its resistance, and therefore the adaptability. The long-term chemical load has a significant impact on the content of the essential microelements in the body of people living in the Aral Sea region.

The purpose of the study. Determination of the content of macro and microelements in children's' hair living in the Aral Sea region is conducted.

Materials and research methods. To determine the content of macro and microelements, hairs samples of people living in Nukus city were examined. All children were divided into 4 age groups: group I consisted of children from new – born to 4 years of age, group II comprised children from 4 to 8 years old, group III consisted of children from 8 to 15 years old and group IV comprised children from 15 to 19 years old.

Determination of the content of essential microelements (chromium, manganese, iron, cobalt, copper, zinc, selenium, iodine, etc.) in the hair samples was carried out in the laboratory of activation analysis of the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan by instrumental neutron activation analysis (INAA).

The results of the survey. While studying the elemental composition of children's hair from the abovementioned groups I, II, III and VI an imbalance in macro and microelements of varying degrees of severity was revealed. All examined children exhibited a statistically significant decrease in the content of Cu, Co, Zn, I and Cr in groups II, III, and VI. This indicates the increased probability of developing anemia and disorders in the gastrointestinal tract, endocrine and immune systems.

Comparison of the microelement analysis results of the hair samples of children and their parents (Tables 1 and 2 respectively) revealed that parents also exhibited a deficiency of Cu, Co, Cr, I, and Br. At the same time, an increased content of toxic element -uranium was revealed in children and parents, which indicates the occurrence of environmental pollution in the Aral Sea region.

Conclusion. The study confirms the potential promise of screening studies of macro and microelements in biosubstrates in various population groups in order to correct both the elemental status and improve the indicators of population health and quality of life in general.

Testing of various biological environments for the most common chemical environmental pollutants allows us to develop ways of preventing and correcting detected violations.

Keywords: hair, macro and microelements, neutron activation method, ecological factors, the Aral Sea region.

One of the most important and prerequisites for the normal functioning of an organism is the stability of its chemical composition.

Learning the effect of a deficiency or excess of microelements on the adaptation of the human body to environmental conditions and the occurrence of endemia is the subject and tasks of a new branch of science – biogeochemical ecology. Deviations in the intake of macro and microelements into the human body, violation of their ratios affect the activity of the body, reducing or increasing its resistance, and therefore the adaptability [1].

Anthropogenic impacts, including excessive intake of heavy metals, as well as endogenous and exogenous deficiency of vital chemical elements, which is observed in provinces of high environmental and biogeochemical risk, contribute to reduction of health at the individual and population levels, and in some regions, to an increase in depopulation [2; 3]. The main environmental factors affecting the health status of the Aral Sea region's population: desertification of the land, deficiency of pure drinking water, massive salinization of the land, chemical pollution of natural environments (water, air, soil, plants), increased air dryness and extreme temperatures. From this point of view, the systematic monitoring of the composition of the soil, plants, water, air, and other natural objects, raising awareness about the real environmental situation in the region, is relevant and important. A long-term chemical load has a significant effect on the content of essential microelements in the body of the population living in the Aral Sea region, particularly in Karakalpakstan [4; 5]. The most susceptible to diseases associated with the violation of macro and microelement status are children. This is due to their increased demand for essential microelements and their high sensitiveness to the toxic effects of heavy metals. In this regard, the study of macro and micronutrients' content, in children with physiological and pathological conditions and the possible impact of their imbalance on the condition of the child, is noteworthy [6].

Available data show that the content of microelements in the hair shows the microelement status of the organism as a whole and can serve as an integral indicator of the environment's condition [7].

Hair is the most appropriate material for medical and environmental studies. As a biological object of study, hair has an advantage over other biosubstrates. Their collection is simple, painless, so the hair is indispensable when conducting mass researches.

Currently, there are various modern methods for the determination of macro and microelements in human biosubstrates. Most of these methods require a sample decomposition procedure for the quantitative isolation of elements, which is often associated with possible sample contamination and with rather complicated sample preparation [1; 7].

The neutron activation method allows with high sensitivity and performance to determine more than 25 elements in one sample set, wherein sample preparation is quite simple and does not require sample decomposition. The main stages of instrumental neutron activation analysis are the selection of the optimal time regime (irradiation time, "cooling" time, measurement time) and spectrometry of the irradiated sample. The time regime should be selected so as to provide with the most useful signal

and reduce the effect of radiation from interfering radionuclides and, at the same time, provide a sufficiently high analysis performance [1; 4].

The purpose of the survey.

Determination of the content of macro and microelements in children's' hair who are living in the Aral Sea region.

Material and research methods

To determine the content of macro and microelements, hairs of people who are living in the city of Nukus were examined. While working with patients, the ethical principles of the Helsinki Declaration of the World Medical Association (World Medical Association Declarationof Helsinki 1964, 2000) were followed.

Hair was cut from the occipital part of the head directly from the scalp with 3 cm long strands. It is known that hair grows at a speed of 1–1.5 cm per month, therefore, 3 cm long strand reflects the elemental status of the organism over the past 2–2.5 months. Cut hair was thoroughly washed in acetone, dried, weighed and packaged in labeled plastic bags. The prepared samples were subjected to neutron activation analysis.

All children were divided into 4 age groups: group I consisted of children from birth to 4 years, group II children from 4 to 8 years old, group III from 8 to 15 years old and group IV from 15 to 19 years old.

Analysis of the hair samples for the content of essential microelements (chromium, manganese, iron, cobalt, copper, zinc, selenium, iodine, etc.) was carried out in activation analysis laboratory at the Institute of Nuclear Physics, the Academy of Sciences of the Republic of Uzbekistan, by instrumental neutron activation analysis (INAA). The methods of preparing and conducting INAA have been described in detail in previous studies [3; 4]. The obtained data on the content of microelements in the hair of patients were compared with reference indices of practically healthy children aged 1 year to 18 years [10]. Statistical processing of the research results was carried out by the Student's t-criterion method of statistical analysis, using Excel 2010 and STATISTICA 6 software.

Results and discussion

The data on the content of microelements in the hair of children living in the Aral Sea region in accordance with the different age groups are listed in (table 1).

Table 1.– The content of elements in the hair of children living in the Aral Sea region in accordance with the different age groups (mkg/g)

Element	Examined children				Normal range	
	Group I 1–3years n=16	Group II 4–8 years n=14	Group III 9–14years. n=16	Group VI 15–19years. n=6	Minimum	Maximum
Cr	0.41±0.11	0.28±0.026	0.26±0.016	0.27±0.073	0.35	1.0
Mn	1.2±0.34	0.61±0.056	0.53±0.039	0.40±0.074	0.35	1.0
Fe	29±5.6	20±1.9	21±1.5	16±3.5	15	30
Co	0.020±0.0027	0.013±0.0034	0.022±0.0044	0.017±0.0034	0.02	0.11
Cu	6.9±0.97	6.6±0.89	7.5±1.0	7.2±1.0	10	15
Zn	83±14	120±73	120±8.1	170±18	150	250
Se	0.44±0.038	0.41±0.038	0.36±0.036	0.46±0.029	0.35	1.0
Br	4.7±0.96	2.6±0.40	1.3±0.23	1.0±0.16	1.0	3.0
I	0.61±0.30	0.61±0.16	0.17±0.055	0.22±0.12	0.8	1.5

When analysing the elemental composition of the children's hair samples from groups I, II, III, and VI, an imbalance in macro and microelements of varying degrees of severity was revealed, and each individual group possessedits own characteristic distinguishing features in each individual group.

In the first group (from new – borns to 4 years of age), the contents of manganese and bromine were higher than that those reported in the references. The increased contents of Br and Mn in Group I are connected with a high content of these elements in mothers during pregnancy, who had experienced problems of the cardiovascular and nervous systems [9].

According to the content of iron in the hair samples of children from groups I, II, III and VI, there were no significant differences ($p > 0.05$). The average concentration of iron in the hair samples of children from all age groups corresponded to the physiological norm, however, significant differences were observed between groups ($p < 0.05$).

In all examined children there was a statistically significant decrease in the content of Cu, Co, Zn, I, and Cr in groups II, III, and VI. First of all, this indicates the probability of developing anemia and disorders of the gastrointestinal tract, endocrine and immune systems.

Comparison of the microelement analysis results of the hair samples of children and their parents (Table 2) revealed that parents also exhibited a deficiency in Cu, Co, Cr, I, and Br and 35.3% of parents had an increased Mn.

Environmental pollution by toxic elements primarily affects children, since their intensive accumulation occurs even in the placenta of a pregnant woman. This leads to the occurrence of congenital malformations, a delay in mental and physical development, a decrease in immunity and the development of diseases, often with a chronization of the pathological process [10].

Table 2. – The content of macro and microelements in the hair samples of parents living in the Aral Sea region (mkg/g)

Element	Surveyed parents	Normal range (A. V. Skalny. 2004)	
		Minimum	Maximum
Cr	0.34±0.028	0.35	1.0
Mn	1.2±0.32	0.35	1.0
Fe	23±3.7	20	30
Co	0.029±0.0052	0.05	0.15
Cu	6.8 ±0.73	10	15
Zn	170±19	150	250
Se	0.39±0.033	0.35	1.0
Br	0.92±0.15	1.0	3.0
I	0.22±0.095	0.8	1.5

Conclusion

Accumulated data support the prospect of screening studies of macro and microelements in biosubstrates in different population groups with the aim of correcting both elemental status and improving indicators of population health and quality of life in general.

Testing of various biological environments for the most common chemical environmental pollutants allows us to develop ways of preventing and correcting detected violations.

Deviations in the content of chemical elements caused by environmental, occupational, climatic and geographical factors or diseases lead to a wide range of health disorders. In this regard, the identification and assessment of deviations in the exchange of macro and microelements, as well as their correction, are a promising area of modern medicine that allows us to approach the solution of many theoretical and especially practical issues that significantly affect the health indicators of the population of the regions, which differ sharply in terms of economic, social development, climatic and geographical and biogeochemical conditions.

References:

1. Agadjanyan N. A., Suslikov V. L., Ermakova N. V., Kaplanova A. Sh. (2015) Microelement deficiency and children's health problems. Pediatrics,– Vol. 94.– No 6.– 224 p.
2. Ismailova Sh. T., Makhmudova D. I., Salikhova K. Sh. Comparative analysis of the content of toxic metals in hair and other human biosubstrates Microelements in medicine – 10(1–2). 2009.– P. 88–90.
3. Lux A., Martinka M., Vaculik M., White P. J. Root responses to cadmium in the rhizosphere: a review. J. Exp. Bot.– Vol. 62.– No. 1. 2011.– P. 21–37.
4. Jumamuratov A. The neutron-activation method in the study of the geochemical and agrochemical state of irrigated soils of the Aral Sea region and ways to improve it. abstract dissertation Doctor of agricultural sciences / A. Jumamuratov; – Tashkent, 2011.– 42 p.
5. Jumamuratov M. A. Clarks of the concentration of certain chemical elements in the bottom sediments of the Karakalpak region // Universum: Chemistry and Biology: Electron. scientific journal – 3 (57). 2019.
6. Eremeishvili A. V., Firago A. L. = Ecological – biological monitoring of the microelement status, development and health status of children aged 1 to 3 years in an industrial city (on the example of the city of Yaroslavl). Modern High-Tech Technologies Journal.– 7. 2010.– P. 186–190.
7. Chojnacka K., Michalak I., Zielinska A. et al. Interrelationship between elements in human hair: the effect of gender // Ecotoxicol. Environ Saf.– Vol. 73.– No. 8. 2010.– P. 2022–2028.
8. Sloiewski M., Czerny B., Safranow K. et al. Microelements in stones, urine, and hair of stone formers: a new key to the puzzle of lithogenesis? // Biol. Trace Elem. Res.– Vol. 137.– No. 3. 2010.– P. 301–316.
9. Mircoelement of iron in the Aral Sea region and weekly ferro-complementation in the most vulnerable groups of the population: abstract of thesis. Dr. med. Sciences: 14.00.07 / R. A. Shakieva; Kazakh Academy of Nutrition.– A., 2005.– 50 p.– state number Registration OD53.28.01.
10. Namazbaeva Z. I. Sakiev K. Z. Ibraeva L. K. Ibraibekova A. M. Iskendirova A. Zh. The content of microelements in children of the Aral Sea region. Journal of Occupational Hygiene and Medical Ecology.– 3 (48). 2015.– P. 58–62.
11. Namazbaeva Z. I., Sabirov Zh.B., Darkesheva A. M., Berjanova R. S., Pochevalov A. M. Microelement status of the Aral Sea population. Occupational medicine and human ecology,– 3. 2017.– P. 38–42.