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ROLE OF ELEMENTAL IMBALANCE IN SEPARATE PATHOLOGIES DEVELOPMENT IN CHILDREN OF THE VILYUYSKY REGION

ABSTRACT

It was investigated Vilyui child population of the region and the city of Yakutsk in the age from 6 to 10 years to study the characteristics of the element status of children Vilyui region and its influence on the prevalence of dental caries. The study found that children living in these regions, there are many violations of the content of chemical elements, which gives grounds to assume an important role of diselementosis in the pathogenesis of dental caries.

Keywords: micro- and macro elemental imbalance, dental caries, environment, Republic of Sakha (Yakutia).

A complex medical-biological monitoring examinations of the environment and health state of the population of the villages and cities located along the Vilyuy River have been acted under the urging of the public and scientific institutions of the republic since the end of the 80s of the XX century in the Vilyuysky region of Yakutia. The work was carried out by the staff of institute of applied ecology of the North and medical institute of the North-eastern federal university. Long-term researches have confirmed negative influence of the happening processes on medical-demographic indicators of population's health of the Vilyuysky region (Mirny, Suntar, Nyurba, Verkhnevilyuysk, Vilyuysk uluses). High incidence of diseases of digestive, cardiovascular, musculoskeletal systems, cases frequency of malignant tumors and congenital development anomalies, pathology of pregnancy and childbirth have confirmed the accumulation of subtoxic and toxic doses of industrial poisons, chemical pollutants on the human health. Nowadays the ecological situation in connection with the falling of parts of the carrier rocket "Sous-2.1a" started from the East spaceport has joined negative factors of anthropogenous influence, including excess heavy metals and deficiency of the vital chemical elements. These facts influenced on the modern scientific researches in the diamond-mining province. They study deep mechanisms developing in organism under the influence of separate or a complex of ecological factors. So, there are many data that the macro and microelement structure of food and drinking water exerts impact on prevalence and the course of various somatic pathologies, including caries of teeth and its complications [2,3,7].

Micro-elements often are the component of proteids and obligatory component of apatite crystals of teeth tissue. In the first case, they are the active centers of enzymes of protein synthesis and exchange processes in tissues. In the second case, being built in a crystal lattice of apatite, they change physical-chemical state and change its solubility. Minerals can act on processes of mineralization and demineralization in norma and pathology.

Recently the attention is paid not only to minerals, but also their balance in an organism and ranging of risk factors of pathology developing among the population. M. V. Veldanova has found the influence of macro – microelements imbalance on the development and course of endemic goiter [9]. Mn and Cd, deficiency of P, K, Se and Zn efficiency of corrective influence of iodine on the disease decreases and microelement analysis of hair as an effective method of identification of goitrogen complex is recommended. Similar results received by A.N. Karchevsky revealed imbalance in association chain of "iodine: manganese: cobalt: zinc, chrome: lead", characteristic of the children living in the industrial city [10]. The author draws a conclusion about microelements imbalance as a cause of iodine deficiency disorders against iodine insufficiency.

The expressed anticariogenic activity was proved only of minimum minerals. Despite numerous researches on microelement studying of teeth, the exact answer about a role of many elements wasn't present still. It is impossible to make a conclusion about the role of these minerals in enamel structure formation on the basis of increased level of nickel, arsenic, silicon and zinc content in temporary teeth among children of Yakutia. Therefore, in the Republic of

Sakha (Yakutia) the leading role in caries developing belongs to fluorine deficiency in water, soil, microelements deficiency of food and also photoperiodism in the North [8].

Thus, the role of physiological and biochemical reactions of organism in response to action of ecotoxicants remains topical issue.

The **purpose** of our work - studying of features of the elemental status among children of the Vilyuysky region and its influence on prevalence of dental pathology - teeth caries.

MATERIALS AND METHODS

The research abstract of the children's population of Nyurbinsky and Verkhnevilyuysk uluses of the Vilyuysky region and Yakutsk aged from 6 till 10 years old was presented in the article. The first group (main) included 50 children of the Yakut nationality living in the diamond-mining Vilyuysky region of Republic of Sakha (Yakutia) from the moment of their birth (Nyurbinsky and Verkhnevilyuysky uluses). The second group included 50 children of the Yakut nationality who are natives and constantly living in Yakutsk. The work was carried out with application of noninvasive methods of researches.

The cohort examination was conducted with the ethical standards of Helsinki declaration and European community Directives (8/609 EU) (2000), received informed consent of lawful representatives of children to participation in research.

24 chemical elements in hair of children has been investigated by system of the multielement analysis with AES-ICP and MS-ICP methods. Definition of elemental structure of bio-substrates (Al, As, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Na, Ni, P, Pb, Se, Si, Sn, Ti, V, Zn, mkg/g) was carried out by methods of atomic emission spectroscopy and mass spectrometry with плазмой inductive coupled argon plasma (AES-ICP, MS-ICP) by the technique approved by Ministry of Health of the Russian Federation (S. I. Ivanov and others 2003; L.G. Podunova and others, 2003) in experimental laboratory of ANO "Center of biotic medicine", Moscow (accreditation certificate of ГСЭН.RU.ЦОА.311, registration number in the State register of Russia RU.0001.513118 of May 29, 2003).

Case rate of 2113 children of country and urban population aged from 6 till 10 years old since 2000 to 2013, analyses of primary medical documentation (ф025/у), materials of medical examinations of children by pediatricians has been studied. The analysis of diseases of children has been carried out according to the International classification of diseases X revision. Prevalence, intensity of teeth caries and hygienic status were estimated by Fedorova-Volodkina's index.

Statistical processing of research results was carried out with the program "Microsoft Excel XP", "Statistica 6.0." and included descriptive statistics, assessment of reliability of distinctions by Student's coefficient and correlation analysis with assessment of coefficients reliability of correlation.

RESULTS

The comparative analysis of the average values of concentration of micro-macroelements in hair of the children who are constantly living on the territory of the Vilyuysky region of the Republic of Sakha (Yakutia) with the group of comparison (Yakutsk), has shown existence of statistically reliable difference by many chemical elements (tab. 1).

Table 1

Average values of micro-macroelements content in children's hair in the Republic of Sakha (Yakutia) living in Vilyuysky region and Yakutsk, mkg/kg

Element	Vilyuysky region, Republic of Sakha (Yakutia)		Yakutsk
	Nyurbinsky region	Verkhnevilyuysky region	
1	2	3	4
Al	**18,87±2,7**	12,28±1,18 *	11,37±0,79
As	0,05±0,004	0,05±0,002	0,04±0,002
Be	0,01±0,001	0,01±0,001	0,01±0,001
Ca	**381±34**	**350±26**	676±48
Cd	0,12±0,02	0,06±0,01	0,08±0,02
Co	0,03±0,004	0,02±0,003	0,02±0,001
Cr	**0,43±0,07**	0,68±0,03 *	0,65±0,04
Cu	**10,08±0,16**	**9,77±0,23**	13,52±0,98
Fe	**30,06±1,21**	34,46±2,24	37,08±2,16
Hg	**0,24±0,04**	**0,37±0,05**	0,16±0,01
K	**341±47**	429±98	586±81
Li	**0,03±0,003**	0,02±0,002	0,04±0,002
Mg	68,6±10	79,7±14	74,1±5,9
Mn	**3,51±0,5**	**2,54±0,43**	1,03±0,1
Na	518±81	637±220	664±89
Ni	**0,33±0,06**	**0,42±0,08**	0,74±0,12
P	131±3	135±3	137±3
Pb	**6,12±0,75**	**3,79±0,57**	2,1±0,35
Se	**0,14±0,01**	**0,12±0,01**	0,22±0,01
Si	22,89±1,69	23,68±1,45	23,93±1,57
Sn	0,16±0,02	**0,08±0,01**	0,2±0,03
Ti	**0,55±0,04**	**1,14±0,06 ***	0,92±0,06
V	0,06±0,01	0,07±0,01	0,07±0,01
Zn	**108,78±5,8**	**153,67±8,21 ***	177,84±7,29

Note: bold print - reliable difference in comparison with Yakutsk ($p<0,05$); *-reliable difference between two regions ($p<0,05$)

It should be noted that children of the Nyurbinsky region have Pb and Mn concentration in hair was maximum among all examined children.

Children of the Verkhnevilyuysky region unlike children of Yakutsk were characterized authentically ($p<0,05$) by lowered concentration in hair of Ca (350±26 and 676±48 mkg/g), Cu (9,77±0,23 and 13,52±0,98 mkg/g), Li (0,02±0,002 and 0,04±0,002 mkg/g), Ni (0,42±0,08 and 0,74±0,12 mkg/g), Se (0,12±0,01 and 0,22±0,01 mkg/g), Sn (0,08±0,04 and 0,2±0,03 mkg/g), Zn (153,67±8.21 and 177,84±7,29 mkg/g). At the same time, higher concentration in hair of Hg (0,37±0,05 and 0,16±0,01 mkg/g), Mn (2,54±0,43 and 1,03±0,1 mkg/g), Pb (3,79±0,57 2,1±0,35 mkg/g), Ti (1,14±0,06 and 0,92±0,06 mkg/g) was in children of the Verkhnevilyuysky region than in children from Yakutsk.

The analysis of the obtained data showed reliable increase of aluminum, mercury, lead –chemical elements possessing toxic action in hair of children of the Vilyuysky region.

More expressed extent of changes of separate elements concentration in children's hair of the Nyurbinsky region attracts attention when comparing element structure of hair of the children living in the Nyurbinsky ulus with data of the children living in the Verkhnevilyuysky ulus. So, Al, Cr, Ti, Zn in hair of children of the examined uluses authentically differ among themselves.

Thus, children living in the Vilyuysky region of the Republic of Sakha (Yakutia) substantially are affected by toxic elements influence, such as aluminum, lead, mercury. Concentration of lead - one of the most widespread elements of pollutants - exceeds the recommended level of normal physiological contents, equals 5 mkg/g in hair of children of the Nyurbinsky ulus [5,6].

The comparative assessment of elemental profile of children of the Vilyuysky region and Yakutsk was presented in table 2.

Table 2

The excess and insufficient content of elements in children of Vilyuysky region of Republic of Sakha (Yakutia) and Yakutsk

Residence	Elemental profile	
	Excess amount	Deficiency
Vilyuysky region	Cr, Mn, Fe, Na, Mg, K, Pb	Se, Co, Cu, Zn, P, Ca, Mg, Cr
Yakutsk	Cr, Mn, Fe, Na, Mg, K, Zn, Ca	Se, Co, Zn, P

Note: elements which frequency of deviations in contents exceeds 30% were included (20% for toxic elements).

The submitted data, in the surveyed region and in Yakutsk have noted hyperelementosis in 6 elements – Cr, Mn, Fe, Na, Mg, K. At the same time, the increased content of lead was found in hair of children of the Vilyuysky region and in Yakutsk – zinc and calcium. The special attention was given to the high content of lead which was observed among 46% of children of the Nyurbinsky region and among 24% of children of the Verkhnevilyuysky region. The lowered concentration of 4 elements – Se, by Co, Zn, P was observed in children of the Vilyuysky region and children of Yakutsk. Besides, hyperelementosis of Ca, Mg and Cr was observed in children of Nyurbinsky and Verkhnevilyuysky uluses and not found in children of Yakutsk.

On the basis of the analysis of frequencies of chemical elements deviation in hair of children of the Vilyuysky region it was possible to make a conclusion about high frequency of disorders of considerable chemical elements concentration. On average, 70% to 80% of children had disorders by 6 – 8 elements. Thus, it is possible to speak about presence of characteristic element profile among children of the Vilyuysky region in comparison with children of Yakutsk.

The analysis of the examined children aged from 6 till 10 years old in Nyurbinsky and Verkhnevilyuysky regions has shown that the most widespread were diseases of gastrointestinal tract (1302,4 ‰) which prevalence was nearly 8 times higher, than in Yakutsk. 77,0% of teeth caries was in the examined region; pathology of gall bladder and bile ducts – 31,7%; gastroduodenal pathology has been found in 13,8% of children. Our results were coordinated with I.D. Ushnitsky research data, examining dental health of children of 7 - 12 years old of the Vilyuysky region. He has revealed nearly 100% prevalence of caries which pathogenesis was low enamel acid resistance and weak mineralizing saliva potential because of low concentration in calcium and inorganic phosphorus [8]. Scientific works have many data that macro-microelement structure of food and drinking water exerts impact on prevalence and course of teeth caries that allows to consider this disease as ecological pathology [8,2,3,7].

So, caries intensity is influenced by concentration of calcium and magnesium in water which defines its rigidity. It is considered that the water is softer; the caries affection of solid tissues of tooth is higher and vice versa. The increase of its mineralization degree was revealed while studying the mechanism of isoionic exchange in hydroxyapatite crystals in surface short-term treatment of enamel solution containing magnesium ions, which was expressed by increase of resistance to action of demineralizing factors and reduction of speed of enamel dissolution on phosphorus and selective emission of magnesium ions in solution promoting preservation of homeostasis in enamel. Besides, magnesium is necessary for activation of alkaline phosphatase. Besides, influence of deficiency of fluorine, copper, zinc, cobalt in water on the microhardness dentine decrease has been proved. More active course of caries was noted in environment zinc deficiency by G.D.Ovrutskim [10]. Cobalt and manganese exert impact on development of bones by alkaline phosphatase activation. Strontium and barium inhibit alkaline phosphatase, causing processes of mineralization. At the same time, strontium and barium can force out calcium from bone tissue, changing its quality to the worst aspect.

Our research has revealed that children living in Verkhnevilyuysky and Nyurbinsky regions with caries have disorders of many chemical elements concentration, including excess of iron (54,3%), lack of cobalt (97,1%), selenium (85,7%), zinc (80%), copper (60%), and imbalance of manganese (74,3%), calcium (54,3%), sodium (54,3%), chrome (51,4%). Higher prevalence of teeth caries in the Vilyuysky region, in comparison with Yakutsk gives the grounds to assume an important role of diselementosis in pathogenesis of this disease among examined children.

CONCLUSION

Thus, the revealed micro-macroelements imbalance among examined children living in the Vilyuysky region of the Republic of Sakha (Yakutia) is an indicator factor in the development of pathological processes including oral cavity and assumes the preclinical preventive events directed to imbalance overcoming.

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