MICROELEMENT COMPOSITION OF THE TEENAGERS' BLOOD IN AN INDUSTRIAL CITY

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The present study is aimed at the analysis of the human organism of the humans living in the industrial city for a long time. Microelements are an integral part of many proteins. These microelements take part in important biochemical processes especially in performing the basic functions in the free-radical oxidation, oxidation-reduction reactions and tissue respiration. The imbalance of the chemical elements in the human body leads to the development of pathology processes and, at the same time, the absence of clinical manifestations of the disease in children organism does not preclude their metabolic and functional disorders. The investigation included 110 teenagers living in the industrial area. The blood of the sampled teenagers was examined by using the atomic absorption spectrometer MGA-915 with electro thermal atomization. We have observed that the carriage of toxic elements such as mercury and cadmium was significantly at higher levels in the teenagers living in industrial areas. The deficiency of vital element (selenium) was also observed. This deficiency is considered to be most dangerous for growing up organism because the functional system of the body is laid down in the teenage. In the future, this carrier can negatively affect fertility, metabolic processes and the formation of the immunity. These results show necessity for a comprehensive biomedical, clinical and functional investigation of the exposed population.

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Introduction

Negative influence of anthropogenic factors on human health is most visible in the industrial centers. There is need for continuous monitoring of soil due to the fact that it is the ultimate receiver of the majority of man-made chemicals found in the biosphere (Barashkov & Zaitseva, 2004). The imbalance of the chemical elements in the human body leads to the development of pathology process. At the same time, the absence of clinical manifestations of the disease in children organism does not preclude their metabolic and functional disorders. Microelements are an integral part of many proteins and take part in important biochemical processes, in particular, performing basic functions in the free-radical oxidation, oxidation-reduction reactions, and respiration in tissue (Skalny, 2004).

The most important is that the organism undergoes significant changes associated with puberty period in the teenagers. During this period, there occurs the morphological differentiation of tissues, organs and their system in the body during puberty. It is recognized that the growing organism is under the constant influence of anthropogenic factors. It is insensitive to these effects (Boyev & Utenin, 2001; Budarina & Kudaeva, 2010).

The purpose of our study was to analyze the microelement composition of the blood in healthy teenagers during puberty period from an industrial city.

Methods

We selected 110 teenagers in two groups aged 14-16 living in the industrial city. The teenagers were surveyed with the written parental permission (map informed consent to participate in medical-biological monitoring). The controlled groups of 110 teenagers living in ecologically safe region were selected. The teenagers attending educational institutions and complying with the sanitary-hygienic requirements were selected for the survey. The groups of qualitatively similar teenagers were formed. All the teenagers, at the time of investigation, were healthy. None of these teenagers had acute respiratory infection or chronic diseases. Blood samples were taken as per the WHO standards to study the microelement composition. Blood investigation was conducted on the atomic absorption spectrometer MGA-915 with electro thermal atomization. The advantage of this method is that the substance is in an enclosed space.

Microelement composition of blood

The essential elements such as copper, zinc, selenium, toxic-cadmium, lead and mercury were selected for the analysis of the microelement compositions of the blood. Zinc was found in significant amount in sperms. Zinc is essential for the proper completion of all stages of crushing the fertilized egg cell until it is locked into the uterine cavity. Whereas, selenium has antioxidant properties and it prevents the formation of the cancer cells.

Lead, cadmium, and mercury are dangerous for humans due to their high toxicity and widespread use in the industry. Cadmium is a toxic microelement. As one of the main pollutants of the environment, it has a marked effect on the exchange of a number of minerals, especially zinc, copper, iron and selenium. Mercury is one of thiol poisons that blocks sulfhydrate groups of protein compounds and is violating the protein metabolism and the enzymatic activity of the body. It is known that the deficiency of essential and excess of the toxic elements cause metabolic and functional disorders of organism in teenagers. Blood sampling

Blood was carried out from the cubital vein in vacutainer with sodium citrate as recommended by the WHO. Volume of sampled blood was at least 1 ml. Blood samples were stored in the refrigerator up to the usual 3-5 days at a temperature of 00 to 40°C.

Atomic absorption methods

Blood examination was carried out on atomic absorption spectrometer IHA - 915 with electro thermal atomization. The advantage of this method is that the substance is in an enclosed space, and in contrast to devices with flame atomization, it is not carried away by the gas flow. The intensity of the spectral line of the element is in some way related to its concentration in the sample, which allows obtaining reliable calibration characteristics that are directly proportional in the range of five - six orders of magnitude. The guaranteed value of the detection limit, achieved on spectrometers of this class, is a fraction of mg / l. Analytical signals were processed using the software of the spectrometer used calibration curves calculated by the least squares method with a background correction, if necessary - compensation for the mutual influence of the measured elements. Determination of the result in the

display corresponds to the arithmetic mean of several parallel measurements of the analyzed elements. Analysis of measurements is in accordance with approved procedures (Namazbaeva, Mukasheva & Pudov, 2007).

Statistical analysis

The methodological basis of this study was the statistical methods and evaluation criteria. To identify significant differences, and the prevalence in the groups, we used the value of the relative risk (OR) and the chi-square index ($\chi 2$). Statistically significant differences between groups were calculated using the Mann-Whitney nonparametric method for two independent groups. The results were processed using the software package STATISTICA 5.5 (Rebrov, 2006).

Results

The change in the status of element can define a group of metabolic disorders in certain nosological forms. Informativeness proved multielement analysis in solving problems associated with an increased frequency of cancer, cardiovascular, neuro-psychiatric and metabolic diseases in certain biogeochemical regions and for different professional, social and age groups, including children (Aghajanian & Skalny, 2001). Comparative analysis of the microelement composition of blood in teenagers showed that the content of toxic elements such as mercury and cadmium were significantly higher. Simultaneously, there was a reduced content of a vital element (selenium)in blood of teenagers of the industrial region (Table 1).The concentration of microelements in the blood was measured in micrograms per dl (100 ml) of whole blood.

Table 1: Microelements of the blood of teenagers' from in an industrial city

Element	Control group, mkg/dl (n=110)	confidence interval	industrial city, mkg/dl (n=110)	confidence interval
Mercury	0.32±0.06	0.2-0.43	1.77±0.19*	1.38-2.17
Lead	3.28±0.15	2.98-3.58	4.0±0.2	3.61-4.40
Cadmium	0.2±0.19	0.15-0.26	0.63±0.06*	0.52-0.74
Copper	79.8±0.75	78.2-81.3	85.5±1.1	83.30-87.70
Zinc	115.1±0.8	113.5-116.7	116.5±2.6	111.40-121.60
Selenium	138.2±23.2	90.5-185.9	54.8±2.5*	49.80-59.80

Note: * - significant difference at $p < 0.01$

Source: Authors

The relative risk of rise of the mercury and cadmium concentration, and reduction the content of selenium in the blood of teenagers from the industrial region is higher than in blood of the teenagers from eco-friendly region. The significance of the results confirms the value of the quantity $\chi 2 = 4.23$ for mercury, $\chi 2 = 8.97$ for cadmium, $\chi 2 = 16.63$ for selenium (Table 2).

Table 2: The relative risk of a breach of mercury, cadmium, and selenium concentration in the blood of teenagers from industrial city - ecologically clean region

Index	lower limit of the confidence interval	upper limit of the confidence interval	relative risk	χ^2	etiologic fraction
Mercury	1.0	18.19	6.48	4.23	84.58
Cadmium	1.7	11.93	2.61	8.97	61.72
Selenium	3.11	114.4	13.78	16.63	92.7

Source: Authors

Discussion

The results of microelement composition of the blood of teenagers from industrial city indicates the low content of essential element - selenium, which provokes the accumulation of toxic metals such as mercury and cadmium (Skalny & Rudakov, 2004).

In the teenagers' organism, the carriage of toxic elements was observed. It is the most dangerous for growing up organism because, in this period, the functional system of the body is laid. In the future, this carrier can negatively affect fertility, metabolic processes, and the formation of the immunity. These results show necessity for a comprehensive biomedical, clinical and functional investigation of the exposed population.

References

Avtsyn, A.P., Lark, A., Risch, M. & Strochkova, L.S. (1991). Mikroehlementozy cheloveka [*Microelements of person*]. Moscow, Russia: Science.

Aghajanian, N. A. & Skalny, A.V. (2001). Khimicheskie ehlementy v srede obitanija i ehkologicheskij portret chelovaka [*Chemicals in the environment and the environmental portrait of the man*]. Moscow, Russia: KMK.

Barashkov G. & Zaitseva, L. (2004). Mikroehlementy v teorii i praktike mediciny [Trace elements in the theory and practice of medicine].*Vrach* [*Physician*], 10, 45-48.

Boyev, V. M., Utenin, V.V. & Bistrih, V. V. (2001). Disbalans mikroehlementov kak factor ehkologicheski obuslovlennykh zabolevanij [Imbalance of trace elements as a factor of environment-related diseases].*Gigiena i sanitarija* [*Hygiene and sanitation*], 5, 68.

Budarina, L. A. & Kudaeva, I.V. (2010). Obmen kholesterina u detej i podrostkov promyshlennykh gorodov vostochnoj Sibiri [Cholesterol metabolism in children and adolescents in industrial cities of eastern Siberia].*Gigiena i sanitarija* [*Hygiene and sanitation*], 6, 20-23.

World Bank. (2008). *Public policy and the challenge of chronic noncommunicable diseases*. Washington, D.C.: The World Bank. Retrieved April 8, 2013, from http://siteresources.worldbank.org/INTPH/Resources/PublicPolicyandNCDsWorldBank2007FullReport.pdf

Namazbaeva, Z. I., Mukasheva, M. A. & Pudov, A. M. (2007). Opredelenie soderzhanija tjazhelykh metallov v obektakh okruzhajushhejj sredy i biomaterialov na atomno-absorbcionnom spektrometre MGA-915 [*Determination of heavy metals in the environment and biological materials with atomic absorption spectrometry MGA-915*]. Astana: Kazakhstan.

GOST 51309-99. (2007). Opredelenie soderzhanija ehlementov metodami atomnojj-spektroskopii s ispolzovaniem atomno-absorbcionnogo spektrometra MGA-915 PU 18-2007[*Determination of elements by atomic spectroscopy "using atomic absorption spectrometer MGA-915 PU 18-2007*]. St. Petersburg, Russia: IPK Izdatelstvo standartov. Retrieved April 8, 2013, from http://www.gosthelp.ru/gost/gost3161.html

Rebrov, O. (2006). Statisticheskijj analiz medicinskikh dannykh [*Statistical analysis of medical data*]. (IV. ed.). Moscow, Russia: Media Industry.

Skalny, A.V. (2004). Khimicheskie ehlementy v fiziologii i ehkologii cheloveka [*Chemical elements in the physiology and ecology*]. Moscow, Russia: Onyx. PMid:15549862

Skalny, A.V. & Rudakov, I. A. (2004). Bioehlementy v medicine [*Bioelements in medicine*]. Moscow, Russia: Onyx. PMid:15549862

WHO. (2007). *Practical guide for a venipuncture for laboratory analysis*, WHO guidelines for blood collection: Innovative practices in phlebotomy. WHO, Switzerland: WHO.

GOST. (2006). GOST 8.207-76 Gosudarstvennaya sistema obespecheniya yedinstva izmereniy. Pryamyye izmereniya s mnogokratnymi nablyudeniyami. Metody analiza nablyudeniy. Osnovnyye polozheniya. [*GOST 8.207-76 State system for ensuring the uniformity of measurements. Direct measurement with multiple observations. Methods for the analysis of observations. The main provisions*]. Moscow, Russia: Izdavatelstvo standartov. Retrieved April 8, 2013, from http://www.gosthelp.ru/gost/gost4226.html