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FEATURES OF THE MICROELEMENTAL STATUS OF THE CHILDREN'S POPULATION OF THE INDUSTRIAL REGION

Abstract. *The problem of environmental distortion is relevant for industrialized areas due to the significant deterioration of almost all population health indicators, especially in children. Among the significant variety of environmental factors affecting the human body, chemical factor has leading positions, in the spectrum of which heavy metals (HM) take a special place and, above all, such a global and potentially dangerous toxicant, as lead.*

The purpose of the study was to determine the content of lead, as abiotic, and copper and zinc, as biotic metals in the blood of children living in the industrially tense areas.

Mathematical treatment included the calculation of primary statistical values and the establishment of relationships among the variables.

Despite the low levels of external exposure to lead, biomonitoring studies indicate a significant internal contamination of children bodies. The average values of lead content in the blood vary from 15.6 µg / dL to 45.9 µg / dL, which are significantly higher than the existing standards and are detected in 50-100 % of examined children. The content of lead in the blood of children of industrial regions is statistically significantly higher than that of the control region children, which proves its technogenic origin.

Keywords. *Environment, lead health, of children.*

Introduction. In the context of disruption of the environment, anthropogenic pressure impact on the population health, including children health, has become a problem of extraordinary significance today. This is especially true for such industrially developed territories as a city of Dnipro. According to WHO data, one of the globally spread hazardous substances is lead. Along with it, this metal is considered to be one of the most toxic elements to the growing body of the child due to its ability to accumulate in the body, causing polytropic action. Lead is one of the priority pollutants for Dnipropetrovsk region resulting from the prevalence of metallurgical, metalworking industries and massive motor vehicles pollution [1-3]. At the same time, adequate intake of essential microelements is particularly important in childhood due to the intense growth and development. Copper and zinc play a significant role in the growth, hematopoiesis, and immune response of the developing body of the child. In addition, these elements have inherent properties of biological antagonism in the presence of lead.

Microelements of the human body play an important role in its functioning. Excess or lack of individual chemical elements or their compounds often leads to the emergence of pathological conditions. HM, as environmental pollutants, play a special role in microelement imbalance. One of the most informative methods for determining HM in the body, especially in conditions of low (at the level or below MPC) concentrations in environmental objects, is biomonitoring. Biomonitoring observations of any heavy metal content in human biomaterials make it possible to determine the degree of man-made load on the body in general. According to many authors [4,5], one of the human biological substances that most adequately reflects the pattern of HM accumulation is whole blood.

Present studies were conducted among the organized children contingent of two industrial and one control areas. Biomonitoring of lead, copper and zinc content in the blood was conducted.

Research results. The analysis of biomonitoring data showed that lead concentrations in the blood of the children of three observation groups ranged from 0.9 µg / dL to 56 µg / dL, which coincides with data [5] in children living in other industrial cities. For surveyed children of the first industrial area, the average lead value was 15.60 ± 3.64 µg / dL, in the second area value was 45.87

± 0.83 μg / dL, which exceeds both literature data about technogenic regions [6] and the WHO standard, which is 10 μg / dL for children. Individual variations in lead content ranged from 3.3 to 46.0 μg / dL in the first region and from 47.0 to 56.0 μg / dL in the second region.

In the blood of children in the control area lead was determined at an average concentration that corresponds to the limit of permissible variations and background values in children of unpolluted territories, and did not exceed the standard in almost all 100% of the surveyed. The content of lead in the blood of children in industrial areas is 9.5-28 times statistically significantly higher (p <0.001) than that of the control group. This indicator is significantly different between the first and second observation areas (p <0,001), which is possibly due to different sources and the nature of contamination. As for essential metals-microelements, the average concentrations in the blood of the children we examined in the first and the second industrial regions were 60.0 ± 13.4 μg / dL and 53.70 ± 3.16 μg / dL for copper, 108.20 ± 14, 26 μg / dL and 38.98 ± 9.92 μg / dL for zinc, respectively. These values correspond to normal physiological content for the data of the first area, but in the second area values are much lower than the allowable level - copper is 6.3 μg / dL lower, and zinc is 1.8 times lower than the standard limit. The average content of copper in the blood of children in the control area is at the level of a physiological norm - 78.20 ± 9.05 μg / dL. The amount of such essential micronutrient as zinc is at the lower limit of the norm – 69.260 ± 2.401 μg / dL, and in 6.67% of children it is significantly lower, which may contribute to the development of a zinc deficiency state. We determined a statistically significant difference (p <0.001) between zinc content in the blood of the first and second industrial areas, as well as between industrial and control areas (p <0.01), (p <0.001), respectively.

In metabolic processes and metabolism in general, not only the individual microelements are important, but also balance among them. Taking it into account, we performed an analysis of the Cu:Zn ratio in the blood of the examined children. It was determined that these ratios between copper and zinc in children of industrial regions, were 1:1.8; 1:0.73, in control region - 1:1.13. Comparing the results with the data of other authors and calculated physiological ratios (1:7) [7], we noted a significant violation of them in children of industrial regions, which confirms the presence of a critical imbalance of microelements in the body of the examined preschool children, and responsible for the risk of ecologically dependent diseases.

The mathematical treatment was used to analyze the relationships among metal concentrations in the blood of examined children. The reverse relationship between the content of lead and zinc in the blood (r = -0.30; p <0.05) was determined, confirming the known fact of the natural antagonism between these heavy metals in the human body.

Thus, the mathematical processing of data proved the existence of quantitative relationships between external concentrations of lead and its content in the blood of the children.

Conclusion. The results of the conducted biomonitoring and their analysis indicate a significant amount of lead in the blood of children of industrial regions compared with the existing standards and data of the surveyed preschoolers of the control area. This, together with the fact of increased integrated intake of this toxicant, allows suggesting a negative influence of small lead concentrations on the environmental objects on the child's body.

After evaluation of the biomonitoring results, a conclusion can be made: despite relatively low external concentrations of HM in environmental objects, such abiotic metal as lead is detected in elevated concentrations in children of industrial districts of the city. This can be explained by the constant and prolonged intake of lead into the body of preschoolers with air, water, and food; the impact of this HM begins with the fetal development period [8-10].

References

1. Belitska E.M.,Onul N.M.,Antonova O.V. Contamination of industrial city atmospheric air as an actual and hygienic problem.- Nauka i studia.-2014.-№8(118).-P.35-42
2. Білецька Е.М., Антонова О.В., Землякова Т.Д., Чорна Н.О. Антропогенне забруднення атмосферного повітря як фактор ризику для здоров'я населення промислового міста Актуальные проблемы транспортной медицины.-2015.- №2(40).-С.38-40

3. Головкова Т.А., Антонова О.В. Досвід еколого-гігієнічного моніторингу довкілля Актуальные проблемы транспортной медицины.-2015.- №4, т.2(42-2).- С.38-41.(ISSN 1818-9385). БД:РИНЦ,Index Copernicus
4. Ларионов Т.К. Биосубстраты человека в эколого-аналитическом мониторинге тяжелых металлов // Мед.труда и пром.экология. – 2000. – №4. – С. 30-33.
5. Кіцула Л.М. Свинець і здоров’я дітей // Гігієна населених місць. – 2001. – Вип. 38. – С. 372-375.
6. Дисбаланс микроэлементов в организме детей с экологозависимой патологией / В.В. Утенина, Е.В. Плигина, В.В. Утенин и др. // Гигиена и санитария. – 2002. – №5. – С. 57-59.
7. Боев В.М. Среда обитания и экологически обусловленный дисбаланс микроэлементов у населения урбанизированных и сельских территорий // Гигиена и санитария. – 2002. – №5. – С. 3-8.
8. Тяжелые металлы внешней среды и их влияние на репродуктивную функцию женщин. Реальная суммарная нагрузка организма человека тяжелыми металлами в условиях промышленного региона / А.М. Сердюк, Э.Н. Белицкая, Н.М. Паранько, Г.Г. Шматков // Д.: АРТ-ПРЕСС, 2004. – 148 с.
9. Тимченко О.І., Сердюк А.М., Турос О. І. Гігієна довкілля: політика, практика, перспективи. – К.: Преса України. – 2000. – 126 с.
10. Бердник О.В. Основні закономірності формування здоров’я дитячого населення, що проживає в регіонах з різною екологічною ситуацією: Автореф. дис. ... д-ра мед. наук: 14.02.01 / Інститут гігієни та мед. екології ім. О.М. Марзеєва АМН України. – К., 2003. – 35 с.