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## BIOMONITORING OF LEAD IN CHILDREN ORGANISM AS MARKER OF ITS TECHNOGENIC INTAKE

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A study of lead in children industrial areas of Dnepropetrovsk. It is determined a significant internal contamination of lead, which averages range from 15.6 mkg/dl to 45.9 mkg/dl in the blood and from 0.16 mkg /ml to 0.32 mkg /ml in the urine of examined children. The results indicate the need for comprehensive hygiene research in this direction and is the scientific basis for the need to conduct biomonitoring of lead in child population of industrialized areas, including Dnipropetrovsk region.

**Key words:** *lead, microelements, biosubstrates, influence on children's health.*

### Introduction

Due to the intensive development of industry, transport, use of agricultural chemicals the increasing technogenic burden of the environment with heavy metals (HM) leads to their higher concentrations in the environment - in the air, water, soil, food and, in turn, to accumulation of HM in the human body, which creates a real threat to public health. Of the range of HM lead (Pb) is the most toxic one [2]. Technogenic pollution with lead increases the possibility of human being exposed to not only biological but also toxic concentrations of it from soil, air, plants and animals. Age characteristics of the child population allow to emphasize critical periods of development of a child when the influence of environmental factors is especially dangerous. This effect of lead to a restructuring of the child's body metabolism that further may lead to the formation of different pathological states [5].

In estimating the impact of lead on the human health there are widely used methods of biomonitoring, which allow to compare its content in human biological substrates with appropriate acceptable levels. As far as the key point of migration of HM, including lead, in the objects of environment is human organism, biomonitoring has a value.

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The blood is the most carefully studied from all the biosubstrates, that allows to describe the internal metal contamination of organism in the most precise way, as it is the best indicator of recent exposure of the organism to xenobiotics [1, 9]. The level of lead in the blood is the main indicator of its impact on children's health [5, 8]. In Ukraine such studies have an isolated character, there is no national research program of this important figure, as it is in the number of other countries. A number of domestic and foreign authors point out the dependence of lead and other biological substrates concentration in the body (urine) from the level of it in the environment [8].

### Research methods

We conducted the survey of children aged 3-5 living in two polluted industrial areas of city Dnepropetrovsk and the control area where is no industrial zone. We defined levels of lead, copper and zinc in biological substrates' indicators - blood and urine by atomic absorption spectrophotometry on AAS-1N.

### Results of investigation

Data analysis of monitoring of lead in blood of the surveyed three observation-

al groups of children (Figure 1) shows that concentrations ranged from 0.9 mg/dl to 56 mg/dl, which coincides with the data [3] for children living in other industrial cities.

For the surveyed from the first industrial area the average concentration of lead is  $15,60 \pm 3,64$  mkg/dl, for the second one -  $45,87 \pm 0,83$  mkg/dl, which exceeds the literature data for the technogenic regions [1], as well as WHO standards, which is 10 mg/dl for children [2]. The lead content in the blood of children in industrial areas is 9,5-28 times statistically significantly higher ( $p < 0,001$ ) than the control one. This figure varies significantly in the first and second observational regions ( $p < 0,001$ ), which is possible due to different sources and character of contamination. As for the essential trace metals-microelements, the average concentration of them in the blood of investigated children of industrial areas are: for copper -  $60,0 \pm 13,4$  mkg/dl and  $53,70 \pm 3,16$  mkg/dl, zinc -  $108,20 \pm 14,26$  mkg/dl and  $38,98 \pm 9,92$  mkg/dl, respectively. These values correspond to the normal physiological data for the first area, but for the second are much lower than the permissible level: for copper 6.3 mkg/dl lower and zinc and is 1.8 times lower of normal limits.

The average copper content in the blood of children of the control area corresponds its physiological content -  $78,20 \pm 9,05$  mkg/dl. The number of such an essential trace element as zinc, is at the lower limit of normal -  $69,260 \pm 2,401$  mkg/dl, which can contribute to the state zinc-insufficiency. We established the statistically significant difference ( $p < 0,001$ ) between the content of zinc in the blood of the first and second industrial areas, and between industrial areas and the control one ( $p < 0,01$ ), ( $p < 0,001$ ), respectively.

From the standpoint of toxicokinetical patterns the biomonitoring of abiotical metals in various biological

substrates have a different informatively in reference to the duration of flow of these substances into the body. So if blood flow is an indicator of recent flow, the urine - of old one. This situation is caused mainly by renal excretion of HM from the body, for instance 75% lead is derived this way [1].

The average lead content in the urine of the surveyed children of the first and second industrial areas is  $0,280 \pm 0,047$  mkg/ml and  $0,320 \pm 0,036$  mkg/ml, respectively. On comparing with normal values [6], these values are higher in 11,2-12,8 times for lead and can be regarded as metal-carrying or initial stages of lead intoxication (fig.2).

The concentration of lead in the urine of children of control area is  $0,160 \pm 0,025$  mkg/ml, that exceeds normal values, but is significantly lower ( $p < 0,001$ ) at 0,12-0,16 mkg/ml than for children of industrial areas. As for the essential trace elements - copper and zinc, their average concentrations in the urine of children of different areas are in range from 0,030 ±

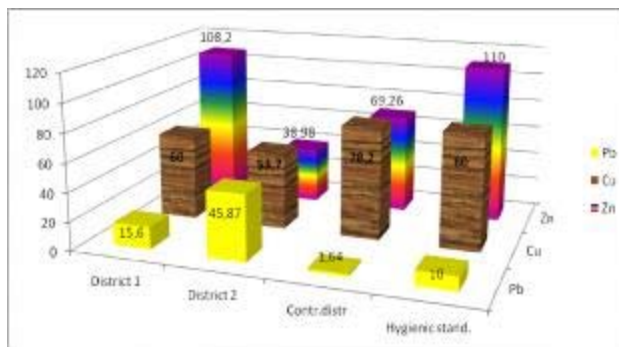


Fig. 1. Concentrations of heavy metals in the blood of children of control and industrial areas (mkg/dl)

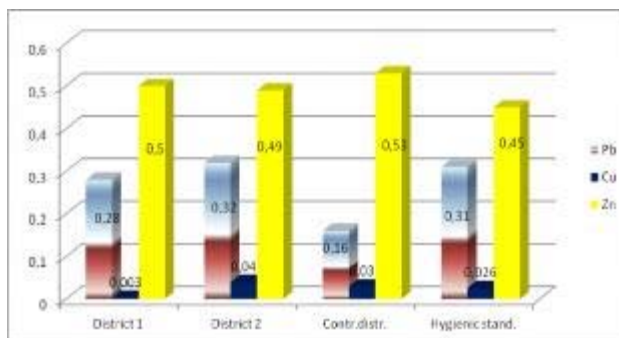


Fig. 2. Concentrations of heavy metals in the urine of children of control and industrial areas (mkg/ml)

0,003 mkg/ml to  $0,06 \pm 0,01$  mkg/ml for copper and  $0,540 \pm 0,041$  mkg/ml to  $1,120 \pm 0,163$  mkg/ml for zinc, which exceeds the limits of physiological fluctuations. These results can be interpreted as attributes of infringement of trace element metabolism in the body of preschool children. The concentration of copper and zinc in urine of the examined groups was not statistically different ( $p > 0,05$ ) and for children of industrial and control areas is almost the same on average value -  $0,030 \pm 0,003$  and  $0,040 \pm 0,006$  mkg/ml for copper and  $0,500 \pm 0,035$ - $0,530 \pm 0,745$  mkg/ml for zinc.

#### Conclusion and recommendations for future research in this area

Thus, biomonitoring studies indicate a significant internal contamination of children with lead, which averages range from 15.6 mkg/dl to 45.9 mkg/dl in the blood and from 0.16 mkg /ml to 0.32 mkg /ml in the urine of examined children. The lead content in biological substrates of children of industrial areas is statistically significantly higher than in control area's children, which proves its technogenic origin.

Comparative analysis on the data of our monitoring confirmed the assumption that there is more significant technogenic boarding of child organism in the conditions of industrial city. In the analysis of the obtained results there was indicated elevated level of lead concentration in biological substrates of surveyed children of industrial areas above standard values and values obtained in the control area. These data confirm the regularity of lead intake from various environmental objects that form using different ways its complex impact on the child's organism.

The results indicate the need for comprehensive hygiene research in this direction and is the scientific basis for the need to conduct biomonitoring of HM in child population of industrialized areas, including Dnipropetrovsk region.

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### Резюме

#### БИОМОНИТОРИНГ ВМІСТУ СВИНЦЮ В ОРГАНІЗМІ ДІТЕЙ ЯК МАРКЕР ЙОГО ТЕХНОГЕННОГО НАДХОДЖЕННЯ

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Проведено дослідження вмісту свинцю в організмі дітей промислових районів м.Дніпропетровська. Визначили значне внутрішнє забруднення свинцем, середні величини якого коливаються від 15,6 мкг / дл до 45,9 мкг/дл у крові та від 0,16 мкг/мл до 0,32 мкг/мл у

сечі обстежених дітей. Отримані результати свідчать про необхідність продовження комплексних гігієнічних досліджень у цьому напрямку и є науковим підґрунтям необхідності ведення біомоніторингу свинцю у дитячого населення промислово розвинутих територій, в тому числі Дніпропетровського регіону.

**Ключові слова:** свинець, мікроелементи, біосубстраті, вплив на здоров'я дітей.

### Резюме

#### БИОМОНИТОРИНГ СОДЕРЖАНИЯ СВИНЦА В ОРГАНИЗМЕ ДЕТЕЙ КАК МАРКЕР ЕГО ТЕХНОГЕННОГО ПОСТУПЛЕНИЯ

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Проведено исследование содержания свинца в организме детей промышленных районов Днепропетровска. Определили значительное внутреннее загрязнение свинцом, средние величины которого колеблются от 15,6 мкг/дл до 45,9 мкг/дл в крови и от 0,16 мкг/мл до 0,32 мкг/мл в моче обследованных детей. Полученные результаты свидетельствуют о необходимости продолжения комплексных гигиенических исследований в этом направлении и являются научным основанием необходимости ведения биомониторингу свинца в детского населения промышленно развитых территорий, в том числе Днепропетровского региона.

**Ключевые слова:** свинец, микроэлементы, биосубстрате, влияние на здоровье детей.

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