

Конкурсна робота під шифром «Здоров'я дітей»

**Psychophysiological status of preschool
children under the influence of technogenic
origin lead**

List

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Introduction

Creating conditions for the high quality of life of a modern person is today's primacy of every civilized society for the purpose of protection, preservation and strengthening of health. In turn, a sufficient level of population health is considered, by the human community, according to the decision of the General Assembly of the United Nations (UIV YA 34/58, 1979), to be the only measure of expediency and effectiveness of all areas of human activity without any exception. From these positions, the provision of every citizen of Ukraine with full physical, psychological and social well-being, and for the child - creating the conditions for harmonious growth and development, is the most important task of the state level.

It is proved that human health is determined by the variability of the factors of the habitat. WHO experts [13] believe that 23% of all diseases and 25% of all cancer cases are caused by environmental factors. 40% of these cases are children under 5 years old, the total number of which is 10% of the world's population. Over 5 million children are dying from the effects of an unfavourable environment all around the world every year [15, 19]. In real conditions, the establishment of the contribution of a factor into the development of the disease is a very difficult task due to the complex mechanism of interaction.

In this regard, the problem of environmental factors adversely affecting the health of the population is becoming increasingly relevant and is actively developed by leading specialists of our state and other countries of the world [15, 20]. Ukraine is on the 108th place among the countries of the world and the post-Soviet space by the size of the index of ecological security and occupies the first place in terms of the largest contribution to the total atmospheric pollution [2].

Today in Ukraine has a complicated, unfavourable, and in some regions - even an acute ecological situation. The analysis of scientific publications of the recent years concerning the massive atmospheric pollution proves it. Residents of industrially - developed areas which include the most powerful industrial Dnipro region, are living in adverse conditions, to hygienic research of which a number of fundamental studies of many scientists are devoted [5, 8, 9].

The threatening ecological and hygienic situation leads to a broad discussion of the impact of environmental pollution on the health of the population. The assessment of the significance of environmental pollution by the degree of biological effect on the organism and the level of health of the population is more objective than comparing the concentrations of individual pollutants with hygienic norms, since health indicators take into account the integrated impact of all, including unidentified, pollutants and their complex and combined effects on the human body [5].

An analysis of modern scientific literature shows that the most dangerous form of human anthropogenic pollution is an aerogenic, which acquires a special status when affecting the health of the children's contingent of the population as a traditional risk group. The matter is not only in a double-adverse combination but the most dangerous type of inflow of pollutants by aerogenic means in a highly sensitive body of a child. It is the above-mentioned circumstances that explain the great amount of scientific researches and the increased attention of scientists to the problem of the health of the children's population, especially on the emanating territories, since there have been clear tendencies in increasing the incidence and severity of childhood morbidity in recent decades [1, 7, 10].

Extremely dangerous xenobiotics include such a global pollutant as lead that affects the various structures of the central nervous system, leads to intellectual disruption, memory loss, decrease of language skills and concentration of attention, etc. [21, 22]. With prolonged action of lead on the children's organisms at low concentrations nonspecific reactions may first appear predominantly on the nervous and endocrine systems and only 10-20% of children with a syndrome of general x-rays sensation could be showing specific signs of toxicity some time later. The results of in-depth epidemiological studies performed in many countries of the world confirm the severe danger of lead pollution for the environment and for health, and especially for the mental development of kids [14, 25].

Children of the early age are most susceptible to toxic action of lead, with which many authors associate the delay of neuropsychiatric development, the reduction of the possibility to learn, violation of movements', memory's, hearing coordination etc.

[17].Researches of leading scientists have established the existence of a direct connection between the accumulation of plum lead bum in the child's body and a decrease in one's IQ [9], a diminished attention, disorders of speech functions and impairment of the ability to perceive the school program and adapt to school conditions. There is a significant decrease in the indicators of psychophysiological tests that characterize the emotional sphere, the ability to orient, some motor functions of children within an increase of lead m level in blood.

Goal

Taking into account that, firstly, the preschool age is a special age period of intense mental and physical development, and secondly, a number of social, environmental and hygienic factors, including lead, which can cause mental disorders of children [4, 6, 7, 23], the purpose of this work was to assess the degree of complex exposure of lead on children of industrial and control areas by the integral indicator - total daily income (TDI), to estimate the connection and the nature of the impact of environment being under pollution of lead on mental health.

Methods and techniques of research

To conduct the research a powerful industrial district of Ukraine - city of Dnipro has been selected, which is characterized by the fact that the residential area is located practically on the territory of the sanitary protection zone of different industrial enterprises. The probable influence of lead on psychophysiological indicators of preschool children was estimated in accordance with the requirements of the conceptual method of epidemiological research.

The generalization of previous studies of the Department of General Hygiene of the State institution "Dnipropetrovsk Medical Academy of the Ministry of Health of Ukraine" regarding the concentration of lead in the environment allowed to calculate

the TDI and the contribution of various ways of this element to the body of an average child in the conditions of industrial and control areas of observation. The calculation was made on the absolute daily value (mg / day) for a child of 5-6 years old. The data was compared with the permissible daily intake set for xenobiotics in accordance with the requirements of the Joint FAO/WHO Expert Committee on Food Additives, as well as the scientific literature on this issue [12,13].

Total daily income was calculated according to the general formula:

$$TDI = ADI + WDI + FDI,$$

where: TDI - total daily income of substance from air, water, food products per day (mg / day);

ADI - aerogenic daily intake, mg;

WDI - water daily intake, mg;

FDI - food daily intake, mg.

For the hygienic research of the influence of lead on the psychophysiological state of preschool children, the selection of children was carried out in accordance with the requirements of analytical epidemiology on the principle of homogeneity, namely: single district and duration of residence (not less than 3-6 years); the only children's preschool institution; age of 5-6 years; absence of professional harm and bad habits from parents; average material income in the family; the absence of chronic diseases (1-2 groups of health). Along with this, written consent was received from parents for the examination of children, which corresponds to the existing ethical and legal provisions of such studies in children.

The study group included 57 children aged 5-6 years, residents of the industrial region. Another investigated control group included 20 children, living in an environmentally clean area and attending the local kindergarten. To determine the psychological development of preschool children, a standard set of psychodiagnostic techniques was used.

Psychophysiological testing was carried out in the morning and afternoon individually in specially designated premises. The features of thinking (Raven's test, combinatorics, comparisons in form), attention (proof-reading, "confused lines"),

peculiarities of memory ("Verbal memory"), level of general awareness ("Conversation"), level of workability, level of endurance (teing-test), level of development of language of children were tested. It is known that psychologists distinguish many components: readiness for school; physical development; the formation of motivation for learning; readiness to adopt a new "social position"; the development of the intellectual and volitional spheres [21, 22]. In our testing, we used tests to evaluate the two last components, namely, the level of development of intellectual abilities (attention, thinking, auditory and visual memory), and the arbitrary regulation of activity (the ability to conquer the actions of the task), as well as the force and endurance of the nervous system.

The results are processed by traditional methods of variation statistics using Excel licensing programs.

Research results

When conducting hygienic monitoring of lead, it has been established that in the atmospheric air of urban observation areas this xenobiotic is determined in concentrations which in the vast majority do not exceed the corresponding normative values. At the same time, the content of lead in the air of the industrialized area compared with the control indicates a statistically significant excess of both maximum and average values ($p < 0.001$).

Lead's admission to the body with air, water, food form the total daily dose. Therefore, the problem of its definition, in conjunction with the influence on the health of the child, is relevant in modern hygiene [17, 18].

Calculation analysis of lead's TDI into the body of children of preschool age indicates that in the industrial area for children has 0.09 mg with a maximum value of 0.150 mg. The proportion of income is different. The contribution of the food way to the TDI is greater and makes up 98.8% and 93.8%, with drinking water lead is virtually non-existent. The amount of lead entering with the air in the TDI is only 0.002 mg per day (0.025%).

Consequently, such a toxic and dangerous xenobiotic, as lead, is constantly determined in life-saving objects of the environment, which creates conditions for its complex influence on the child's organism.

The results of TDI of lead in the body of children in the control area indicates 0.042 mg / day and on average does not exceed permissible, however, with the maximum value - higher by 1.12 times. The dominant way of receiving this xenobiotic is also food, as its specific weight is 50.2% of the TDI. With drinking water 48.8% of lead comes in, with air of only 1.02%.

Thus, the study of the total supply of lead in the body of children with air, water, food products showed that, despite the permissible average values of TDI of metals, in the industrial region the complex input of the priority pollutant of the environment - lead - is increased, compared with the control. The dominant route of this xenobiotic is food.

Intellectual development is one of the most important indicators of the health of pre-school children. At this age, there are significant changes in the nature and content of the child's activities, in the development of individual cognitive processes. Sensory development of a child during this period is determined by the ability to recognise a form and adequately pick up the figures. During the examination of children in the industrial region, it was found that 45% of these children had a weak type of nervous system, with 39.2% of them have a low level of learning (the speed of mental operations). This suggests that every second child with a prolonged and intense psycho-emotional load tends to get tired (45%). Only 36.7% of children in the industrial region have well-developed abilities to compare and analyze objects in form, size and colour. Survey data from the control district of children indicates that 89% of them have a moderate and severe type of nervous system. These data is evidence that children are able-bodied, enduring, stress-resistant, well tolerate intensive and long psychoemotional stresses, can study for a long time and work without rest for rest. The same amount of children (89%) has a sufficient level of perception of subjects; 84.3% easily distinguish geometric shapes; 73.5% of the surveyed have a sufficient concentration of attention.

During this age period of life kid's memory has some specific features. Thus, involuntary memorization and reproduction is in a significant advantage, also figurative and verbal-logical memory is developing. The analysis of the data shows that only 31.4% of children in the industrial region and 73.6% of the control children had well-developed visual memory. At the same time, the auditory memory, which is more closely connected with studying in group lessons, is highly developed in 45.1% of children - inhabitants of contaminated territories and preschoolers of an unpolluted area have not enough development - each second examined child (53%) showed a weak the level of development of auditory memory.

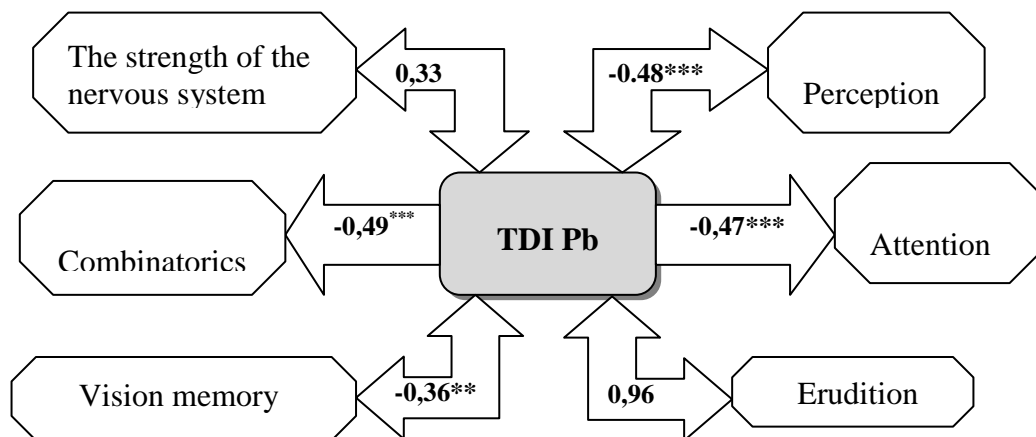
The leading role in the development of cognitive activity is perception. In this period, children improve the imagination of the relationship between objects, actively form spatial imagination, the perception becomes consistent with practical actions. It was established that 32.7% of preschool children of a conditionally pure area managed to success the perception test, while contaminated did 29.5% .

A characteristic feature of this age period is attention. Increased stability of attention increases its volume. Stability of attention is characterized by the interval of time during which the child can engage in predetermined activity. Thus, this indicator was determined at a low level in 48% of children in the control area. Each second child (55%) of the industrial area has a low concentration of attention. This shows the complexity of perceiving monotonous information and the weakness of volitional efforts while keeping one's focus. In addition, 39.2% of children have a low level of prompt processing of new information, indicating a lack of development of memory, thinking and attention.

But 94% of the children of the industrial area's inhabitants have a high and average level of general experience, which, in combination with good indicators of the development of auditory memory, speaks of well-placed educational work with children in preparation for schooling. Despite the fact that about 70% of children in the control area have a very developed thinking and a good level of learning, more than half of the examined children (68%) showed a low level of general erudition.

Only 30.5% of the surveyed children meet the necessary requirements for this indicator.

Mathematical and statistical processing of the data allowed to establish the existence of some statistically significant correlation relationships (Figure). So, inversely proportional is the quantitative relationship between mean strength between the lead TDI and combinatorics ($r = -0.49$; $p < 0.001$), visual memory ($r = -0.36$; $p < 0.01$), perception ($r = -0.48$; $p < 0.001$) and attention ($r = -0.47$; $p < 0.001$).



*** $p < 0,001$, ** $p < 0,01$.

Figure. Dependence of indicators of individual psychophysiological tests from TDI lead from environmental objects

Thus, based on the obtained data using the correlation analysis, it has been proved that the accumulation of lead in the child's body is due to its external influx and affects the functional state of the central nervous system, which is manifested in their mental working capacity and ability to study. These data coincide with the findings of other WHO scientists and experts on reducing the mental development of children under the influence of lead, even at low concentrations [11, 16, 21, 22].

Psychophysiological research showed that 34-45% of children in industrial areas has been identified with a weak type of nervous system, low level of training, violation of the logical sequence of tasks, poorly developed visual memory. Only 36.7% of children in industrially polluted areas were characterized by well-developed

abilities to compare and analyze objects in form, size and colour. 89% of children in the control area have an average and strong type of nervous system, 70% have developed thinking, level of learning and visual memory, 89% of them noted with good level of perception of subjects, sufficient concentration of attention.

Thus, children of preschool age of the industrial region have a reliable ($p < 0,001$) reduction of almost all psychophysiological indicators in comparison with the residents of the control. The psychophysiological study conducted by us has revealed some changes in the functional state of the central nervous system of preschoolers in industrial districts and is a testimony to neurodynamic violations and violations of higher forms of regulation and cortical functions.

Consequently, the increased income of lead into the body of preschoolers living in an industrial city compared to the control group is accompanied by a significantly higher frequency of psychophysiological disorders. Together with other data it confirms the conclusion about the negative influence of lead on the health of children in conditions of technologically contaminated territories.

Summing up the results of the studies, it should be emphasized that, despite the relatively low external concentrations of lead in the environment, it enters the children's body living in the industrial district of the city and causes certain changes, including the central nervous system. This fact is another evidence of the global spread of lead in life-supporting environments and underscores the potential danger even of its small concentrations in the environment for the child's body.

Conclusions

1. Lead was determined in concentrations at maximum and average values in the atmospheric air of the industrial area significantly, exceeding the corresponding concentrations of the control area.
2. In the conditions of the industrial region, the integrated receipt of the priority pollutant of the environment - lead - according to the calculations of its TDI -

increased compared with the control. The dominant route of this xenobiotic is food -50,2%.

3. Significant deterioration of all psycho-physiological indices of the central nervous system of children living in the industrial region was established, which was registered in 70-89% of children in the industrial region, compared with 34-45% of the children of the control area, which to a certain extent was caused by the negative influence of the increased lead content in the air.
4. Mathematical calculation of the data allowed to establish the existence of some statistically significant correlation links. So, inversely proportional is the quantitative relationship between the lead TDI and combinatorics ($r = -0.49$; $p < 0.001$), vision memory ($r = -0.36$; $p < 0.01$), perception ($r = -0.48$; $p < 0.001$) and attention ($r = -0.47$; $p < 0.001$).
5. The results of the conducted research allowed to scientifically substantiate the need for further research on the development and implementation of effective preventive measures for the negative influence of lead on children of industrial contaminated territories in order to increase the adaptive-compensatory reserves of the organism, accelerate the rehabilitation and health promotion of the children's population.

References

1. Бабушкина Н.П., Черепанова М.В. Влияние экологических факторов на развитие детского организма. – Владивосток: ВГЭУ, 2004. – 184 с.
2. Белицкая Э.Н. Особенности загрязнения атмосферного воздуха промышленного региона // Врачебное дело. – 1996. – № 5-6. – С. 73-76.
3. 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. Марзєєва АМН України. – К., 2003. – 35 с.

4. Бердник О.В., Серых Л.В., Антамонов М.Ю. Показатели популяционного и индивидуального риска при оценке влияния факторов окружающей среды на здоровье детского населения // Гигиена и санитария. – 2001. – №5. – С.94-96.
5. Білецька Е.М., Риженко С.А., Головкова Т.А. Досвід еколого-гігієнічної оцінки вмісту важких металів в об'єктах довкілля у взаємозв'язку з техногенним забрудненням промислового міста // Гігієна населених місць. – 2003. – Вип. 42. – С. 373-376.
6. Быков А.А., Ревич Б.А. Оценка риска загрязнения окружающей среды свинцом для здоровья детей России // Медицина труда и промышленная экология. – 2001. – №5. – С. 6-10.
7. Влияние загрязнения окружающей среды свинцом на состояние здоровья детей / Б.Бурмаа, В.Б.Дорогова, Ш. Энцэцэг и др. // Гигиена и санитария. 2002. - № 3. - С. 21 -23.
8. Гігієнічні пріоритети оцінки техногенної контамінації довкілля як ризик-фактора для здоров'я людини / Е.М.Білецька, Н.М. Онул, Т.А. Головкова та ін.// Гігієнічна наука та практика: сучасні реалії: Матеріали XV з'їзду гігієністів України. - 2012. - С.446-448.
9. Главацкая В.И. Комплексная гигиеническая оценка региональных особенностей загрязнения объектов окружающей среды свинцом и его влияния на показатели здоровья детей: Автореф. дис. ... к. мед. н.: 14.02.01. – Донецк, 2006. – 20 с.
- 10.Кіцула Л.М. Свинець і здоров'я дітей //Гігієна населених місць. - 2001. - Вип.38.-С.372-375.
- 11.Кундиев Ю.И., Трахтенберг И.М. Химическая опасность в Украине и меры по её предупреждению // Журн. АМН України. – 2004. – т.10, №2. – С. 259-267.
- Н. Н. Молодкина и соавт. // Мед. труда и пром. экология. - 2001. - № 5. - С.29-34.

12. Оценка некоторых пищевых добавок и компонентов. Сорок первый доклад Объединённого комитета экспертов ФАО/ВОЗ по пищевым добавкам. – ВОЗ. – Женева. – 1994. – С. 50-55.
13. Оценка рисков для организма человека, создаваемых химическими веществами: обоснование ориентировочных величин для установления предельно допустимых уровней экспозиции по показателям влияния на состояние здоровья // Гигиенические критерии состояния окружающей среды. – Женева: ВОЗ, – 1995.– 35 с.
14. Панов В.И., Сараева Н.М., Суханов А.А. Влияние экологически неблагоприятной среды на интеллектуальное развитие детей. — М.: URSS, 2007. — 224 с.
15. Ревич Б.А. Загрязнение окружающей среды и здоровье населения. Введение в экологическую эпидемиологию: Учебное пособие. – М.: МНЭПУ, 2001. – 264 с.
16. Розанов В.А. Нейротоксичность свинца в детском возрасте: эпидемиологические, клинические и нейрхимические аспекты // Укр. мед. часопис. – 2000. – Т.IX/X, №5. – С. 9-17.
17. Свинец и его действие на организм (обзор литературы) / А.И. Корбакова, Н.С. Сорокина, Н.Н. Молодкина и др. // Медицина труда и промышленная экология. – 2001. – №5. – С. 29-34.
18. Свинець в умовах промислових міст: зовнішня експозиція / І.М. Трахтенберг, Е.М. Білецька, В.Ф. Демченко та ін. // Довкілля та здоров'я. – 2002. – №3. – С. 10-12.
19. Тимченко О.І., Сердюк А.М., Турос О. І. Гігієна довкілля: політика, практика, перспективи. – К.: Преса України. – 2000. – 126 с.
20. Тяжелые металлы внешней среды и их влияние на репродуктивную функцию женщин / А.М.Сердюк, Э.Н.Белицкая, Н.М.Паранько, Г.Г.Шматков - Д: АРТ-ПРЕСС,2004. – 148 с.
21. Antonova O.V., Zemlyakova T.D., Glavatskaya V.I. Donozological parameters of child health as markers of technogenic lead intake // Матеріали наук.-

- практич. конф. з міжнар. участю «Бабенківські читання» присвячена пам'яті акад. Г.О.Бабенка. - Івано-Франківськ, 2017. - С.15.
- 22.Beletskaya E.M., Antonova O.V., Zemlyakova T.D. Special aspects of psychophysiological status of preschool children under the influence of lead of technogenic origin// Збірник наукових праць співробітників НМАПО імені П.Л.Шупіка. - 2017. - Вип.27. - С.384-390.
- 23.Glavatskaya,V.I., Antonova O.V., Zemlyakova T.D. The long-term effect of lead on the health of preschool children of the industrial city Web of Scholar Multidisciplinary Scientific Journal. - N1(19), Vol.2, January 2018. - P.10-13.