Of Materials Science And Engineering. 2024. Volume 9. Issue 4. P. 323–336. DOI: 10.36868/ejmse.2024.09.04.323

DOI https://doi.org/10.36059/978-966-397-522-1-80

DIETARY FIBER IN THE IMPROVEMENT OF CELLULAR IMMUNITY INDICATORS IN UKRAINIAN CHILDREN WITN ELEVATED BLC

Hnida N. I.
Lecturer at the Department of Histology, Cytology, Embryology and Pathological Morphology with the Course of Forensic Medicine
Odesa National Medical University
Odesa, Ukraine

Hnidoi I. M.
Candidate of Medical Sciences,
Associate Professor at the Internal Diseases Department
International Humanitarian University
Odesa, Ukraine

The immune system is continually exposed to various environmental pathogens and xenobiotics, including heavy metals such as lead, and appears to be one of the most vulnerable targets [1]. The effects of lead poisoning are most critical for children because their bodies are growing and developing [2–5]. The problem is exacerbated by the fact that in low- and middle-income countries, to which Ukraine belongs, there are no such state programs for the primary and secondary prevention of lead lesions that operate in developed countries [6]. In Ukraine, all these negative factors are joined by such as active hostilities in a large part of the territories for three years. Therefore, the problem of assessing the accumulation of lead in the organism of Ukrainian children and the development of methods for the prevention and treatment of chronic lead lesions of their immune system is urgent.

The **purpose** of this investigation was to evaluate the effectiveness of dietary fiber (DF) in reducing blood lead concentrations (BLC) and improvement of cellular immunity indicators in Ukrainian children.

Methods. 80 children of a random sample aged from 4 to 15 years were examined. Determination of lead was carried out in heparinized venous blood by

the method of atomic absorption spectrometry with electrothermal atomization. Indicators of the cellular link of immunity were determined in capillary blood.

To establish the dependence of the studied parameters on the BLC, as well as considering the recommendations of the WHO on the feasibility of clinical intervention [7], children were divided into 2 groups: 1) a group with a lead content of up to 4.9 μg/dL, n = 62; 2) a group with a lead level in the range of 5.0-9.9 μg/dL, n = 18. Evaluation of calculations χ^2 showed that by age, by the presence of certain diseases, the groups were homogeneous. The control in assessing the ecopathogenic effects of lead was the first group of children. In assessing the efficacy of the intervention, indicators at the beginning and end of observation were compared.

The **results** of the study are presented in table 1.

Table 1

Indicators of the cellular link of immunity in children of different groups, M±m

Indicators	At the beginning of the observation		At the end of the observation	
	BLC ≤ 4.9 μg/dL	BLC 5.0–9.9 μg/dL	BLC ≤ 4.9 μg/dL	BLC 5.0–9.9 μg/dL
Lead, μg/dL	3.21±0.23	8.61±0.22*	3.14±0.21	5.16±0.27**
T-lymphocytes ($CD3^+$), %	55.39±0.78	51.94±1.42*	54.68±1.07	53.67±0.89
T-lymphocytes active ($CD3^+$+HLA-DR^-), %	41.98±0.85	38.44±2.03	39.68±1.22	38.61±1.03
T-helpers ($CD4^+$), %	40.35±0.83	37.33±1.43	40.53±0.95	39.22±1.10
T-suppressors ($CD8^+$), %	15.05±0.56	13.89±0.82	14.11±0,56	14.44±1.34
T-helpers/T-suppressors index	2.98±0.15	3.00±0.38	3.19±0.17	3.33±0.45
B-lymphocytes ($CD19^+$), %	13.34±0.46	12.17±0.56	13.86±0.49	12.33±0.45
NK sells ($CD16^+$), %	31.13±1.02	35.78±0.56*	31.47±1.03	33.89±1.00
Phagocytic neutrophil activity, %	59.92±1.09	64.61±3.83	58.31±1.68	59.78±1.20
Phagocytic neutrophil index, %	2.50±0.05	2.26±0.12*	2.49±0.05	2.37±0.10
Eosinophils, %	1.65±0.24	2.83±0.54*	1,77±0,23	1,17±0,28**

Note. * – The difference is reliable ($p < 0.05$) with the indicator of the first group, ** – the difference is reliable ($p < 0.05$) between the indicators at the beginning and at the end of the observation in each group.

Analysis of BLC in children showed that about a quarter of them have a concentration above 5 μg/dL at the start of observation. These were children of the second group. They also had the verified decreasing of relative number of T-lymphocytes, as compared with this index in the group of children with lead level up to 4,9 μg/dl. The relative content of active T-lymphocytes and T-helpers tended to decrease compared with controls. This is consistent with modern research [1, 4, 5] and it can result in disturbance of the adaptive immune response process.

With it the relative number of NK-cells and eosinophils was increased reliably in these children. It was shown also the verified decreasing of neutrophile phagocytosis index ($p<0,05$) in the same children. This is consistent with data from other researchers [4], and it may be associated with the course of diseases on the background of elevated lead levels in children, and in the future can lead to an inadequate immune response and the development of immune-mediated diseases, or to depletion of the reserves of the immune system and the development of chronic pathology.

Therefore, it is important to apply medical intervention to prevent this.

When choosing a medical intervention, we relied on the recommendations of the WHO [7]. We informed the parents of the children that "in all cases of lead exposure, action should be taken to identify the source of lead and stop ongoing exposure, as this will, in itself, reduce the blood lead concentration and improve clinical features of toxicity" [7].

According to the algorithm from the WHO, nutritional interventions are recommended in children with a BLC $\geq$ 5 μg/dL but $<$ 40 μg/dL [7]. In our study, these are the concentrations of the second group of children. As a nutritional supplement for these children, dietary fiber from cereals of 10 g per day was used for 30 days, as an addition to main dishes and salads during lunch.

As a result, BLC in children of the second group significantly decreased (see Table 1). This confirms the data about the sorption properties of DF [8–11].

At first glance, it seems that dietary fiber did not affect those immunogram parameters that required correction in children with elevated BLCs. After all, a comparison of the indicators before and after the intervention of children in the second group did not reveal significant differences. At the same time, we see that the differences with the indicators of the first group, which were before the intervention, have also disappeared. That is, T-lymphocytes, NK sells, Phagocytic neutrophil index no longer differ from control in children of the second group after the intervention. So, dietary fiber still contributed to the improvement of these indicators in children in whom BLC was elevated. In addition, a decrease in the relative number of eosinophilic leukocytes in children of the second group after the intervention reached a degree

of reliability. Our results are consistent with the literature on the positive effect of dietary fiber on the immune status [9, 12–15].

Conclusions. Dietary fiber contributes to the removal of lead from the body and helps to improve the immune status in children with elevated levels of lead in the blood. This allows us to recommend this dietary supplement for the improvement of children undergoing environmental lead pressure.

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