PREVENTIVE MEDICINE: THE CURRENT STATE AND PROSPECTS

DOI https://doi.org/10.30525/978-9934-26-226-5-69

HYPERHOMOCYSTEINEMIA IN UKRAINIAN CHILDREN LIVING NEAR THE CHERNOBYL EXCLUSION ZONE

ГІПЕРГОМОЦИСТЕЇНЕМІЯ У ДІТЕЙ УКРАЇНИ, ЯКІ ПРОЖИВАЮТЬ ПОБЛИЗУ ЧОРНОБИЛЬСЬКОЇ ЗОНИ ВІДЧУЖЕННЯ

Bandazhevsky Yu. I.
Doctor of Medical Sciences, Professor,
Head of the Board of PI
Coordination and Analytical Centre
«Ecology and Health»
Ivankiv, Kyiv region, Ukraine

Бандажевський Ю. І.
доктор медичних наук, професор,
Голова правління
Координаційний аналітичний центр
«Екологія і здоров'я»
смт Іванків, Київська область,
Україна

Dubova N. F.
Candidate of Medical Sciences,
Associate Professor,
Associate Professor at the Public
Health Department
Shupyk National Healthcare University
of Ukraine
Kyiv, Ukraine

Дубова Н. Ф.
кандидат медичних наук, доцент,
доцент кафедри
громадського здоров'я
Національний університет охорони
здоров'я України імені П. Л. Шупика
м. Київ, Україна

Research conducted in Ukraine in the period 2015–2022, within the framework of the European Commission project "Health and Ecological Programs around the Chernobyl Exclusion Zone: Development, training and coordination of health-related projects", with the financial support of the Rhone-Alpes Regional Council and the public organization "Children of Chernobyl" (France). Revealed high levels of the sulfur-containing amino acid homocysteine (H_{cy}) in the blood of children aged 12-17 from the Ivankovsky and Polesye districts of the Kyiv region, bordering the Chernobyl Exclusion Zone (ChEZ).

It was established that an increase in the level of H_{cy} in the blood of these children and an increase in the number of cases of hyperhomocysteinemia (H_{cy} > 10 μmol/l) occurred after forest fires in the ChEZ in 2015 and 2020.

In 2015, the proportion of cases of hyperhomocysteinemia in the group of children before the forest fire in the ChEZ was 48.8%, after – 75.3% [1]. After a forest fire in the ChEZ in 2020, the proportion of cases of hyperhomocysteinemia in January 2022 in a group of children from the Ivankovsky district was 65.4% [2].

Soils and forest trees in the ChEZ contain a huge amount of long-lived radioactive elements (^{137}Cs, ^{90}Sr, ^{241}Am), which spread, as part of air currents, at considerable distances from the fire epicenter. In this regard, the ChEZ is a source of radiation hazard for the population living in the nearest settlements [3].

The results of a long-term study allow us to conclude that the effect of incorporated radionuclides and their decay products suppresses the cellular energy of the child's body, and therefore, the functioning of the most important metabolic cycles, including those involving methionine, vitamins B_9 and B_{12}.

The consequence of this is an increase in the content of H_{cy} in the blood, which occurs, regardless of the state of the genetic system of the folate cycle, with a clear functional deficiency of vitamins B_9 and B_{12} [1].

With elevated, above physiological limits, concentrations of H_{cy} in the blood of children, there is an increase in the production of thyroid-stimulating hormone by the adenohypophysis, which is the basis for the occurrence of pathological processes in the thyroid gland [4].

In the examined group of children, in 35.5% of cases, violations of the production of thyroid hormones were detected, in 5.6% of cases – structural changes in the thyroid gland [5].

On the territory of the Kyiv region, including the Ivankovsky district, in the post-Chernobyl period, a high proportion of cases of thyroid cancer was determined [6].

In the course of the studies, it was revealed that the increased formation of H_{cy} significantly changes the calcium metabolism in the child's body. At the same time, a direct relationship arises between H_{cy} and calcium, and the bonds between calcium and parathyroid hormone, calcium and phosphorus disappear [7; 8].

Thus, the body loses control over the processes of calcium-phosphorus metabolism, which leads to violations of osteogenesis and structural and functional changes in vital organs.

It should be noted that most of the examined children had cardiac disorders [1].

Inverse correlations between H_{cy} and vitamins B_9 and B_{12} indicate the existence of a deficiency of these vitamins in the body of children from areas affected by the accident at the Chernobyl nuclear power plant [1].

Thus, the residence of children near the ChEZ, under conditions of constant radiation exposure, causes an increase in the content of H_{cy} in the body, which contributes to the occurrence of serious diseases with a fatal outcome or disability. There is a known relationship of hyperhomocysteinemia in adults with diseases of the cardiovascular and nervous systems, impaired pregnancy and congenital malformations, and oncological diseases [9; 10; 11].

In this regard, the situation is of particular concern after February 24, 2022 in the ChEZ, when, as a result of its occupation by Russian troops and hostilities there, the level of environmental pollution with radioactive elements increased sharply. According to the Screencshot data of the Ecocenter – State Specialized Enterprise, the level of gamma background on February 24, 2022 at some points in the ChEZ reached 65,500 nSv/h. According to the norms of radiation safety of Ukraine (NRBU-97), the value of the radiation background level is considered acceptable – 300 nSv/h.

Given the ease of spread of radiation agents and combustion products of trees outside the ChEZ with air currents, children and adults living in the settlements of Ivankovsky and Polesye districts are at risk.

In this regard, it can be reasonably argued that it is necessary to take anti-radiation protection measures, up to the evacuation of children to radiation-clean areas inside and outside the Ukrainian territories. Metabolism correction involves the use of methylated forms of vitamins B_9 and B_{12}.

References:

1. Bandazhevsky Yu. I., Dubovaya N. F. Chernobyl catastrophe childrens health. 35 years of world tragedy. Ivankov : PI Coordination and Analytical Center «Ecology and health». Kyiv : «Alyant» LLC, 2022. 158 p.

2. Bandazhevskyi Yu. I., Dubova N. F. Genetic control of homocysteine metabolism in children living nearthe Chernobyl exclusion zone. *Environment&Health.* 2022. № 2 (103). P. 10–15. DOI: https://doi.org/10.32402/dovkil2022.02.010.

3. Bandazhevsky Yu. I., Dubovaya N. F. Forest fires in the Chernobyl exclusion zone and children's health. Ivankov : PI Coordination and Analytical Center «Ecology and health». Kyiv : «Aliant» LLC. 2021. 44 p.

4. Bandazheuski Yu., Dubovaya N. Association between folate metabolism and hypothalamic-pituitary-thyroid axis in children, who live in the regions affected by the Chernobyl nuclear power plant accident. *Pediatrics. Eastern Europe.* 2019. Vol. 7. № 2. P. 252–261.

5. Bandazhevsky Yu. I. Improvement of quality of life in the population of Ivankov and Polesie districts by preventing conditions associated with the impact of environmental factors. *Scientific and practical collection «Chernobyl: ecology and health»*. Ivankov: PI Coordination and Analytical Center «Ecology and health». Dnipro: Serednyak T.K., 2017. № 6. P. 12– 5.

6. Tronko M., Bogdanova T., Saenko V. et al. Thyroid cancer in Ukraine after Chernobyl. Dosimetry, epidemiology, pathology, molecular biology. Nagasaki : Nagasaki Association for Hibakushas ´Medical Care (NASHIM), 2014. 175 p.

7. Bandazhevskyi Yu. I., Dubovaya N. F. The state of folate metabolism and calcium metabolism in children living in districts affected by the Chernobyl nuclear power plant accident. *Collected of scientific works of staff members of NMAPE named after P.L.Shupik*. Kyiv. 2019. Vol. 33. P. 85–96.

8. Bandazheuski Yu. I., Dubovaya N. F. The metabolic relationship of calcium and phosphorus to the state of genom of folate metabolism in children living in the areas suffered from the Chornobyl nuclear power plant accident. *Environment&health*. 2019. № 4. P. 51–56.

9. Keshteli A., Baracos V., Madsen K. Hyperhomocysteinemia as a potential contributor of colorectal cancer development in inflammatory bowel diseases : A review. *World J Gastroenterol.* 2015 ; 21 (4) : 1081–1090. doi: 10.3748/wjg.v21.i4.1081.

10. Moretti R., Giuffré M., Caruso P. et al. Homocysteine in Neurology: A Possible Contributing Factor to Small Vessel Disease. *Int J Mol Sci.* 2021 ; 22 (4) : 2051. DOI: https://doi.org/10.3390/ijms22042051.

11. Ganguly P. and Alam S. Role of homocysteine in the development of C ardiovascular disease. *Nutr J*. 2015 Jan 10 ; 14 (6) : 2–10. doi: 10.1186/1475-2891-14-6.