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Characteristics of Antioxidant Status and Factors Responsible for Its Formation in Urban and Rural Schoolchildren

Nina Pavlovna Setko[1], Sergey Ivanovich Krasikov[2], Ekaterina Vladimirovna Bulycheva[1, *]

[1]Department of Hygiene and Epidemiology, Orenburg State Medical University, Orenburg, Russia
[2]Department of Biochemistry, Orenburg State Medical University, Orenburg, Russia

Abstract

Modern children aged from 12 to 17 years often have various health problems [1]. One of the main factors leading to aggravation is nutrition [2]. Primarily, nutrition can influence the parameters of antioxidant status of the child organism [3]. The aim of the study was to investigate the antioxidant status of urban and rural schoolchildren, and their actual nutrition. Antioxidant status was analyzed studying the intensity of free radical oxidation and the power of antioxidant systems using the chemiluminescence method; the content of vitamins A, E in schoolchildren biological media, using the fluorometry method, the content of vitamin C, using the visual titration method. Actual nutrition was evaluated by means of daily nutrition reproduction, using the specially developed questionnaire (Martinchik A.N. et al., 1996) and determining biological value of a diet with the help of food composition table. The received data testifies to the tendency of antioxidant status shift to the oxidative stress and the inefficiency of antioxidant nutritional support because of vitamins A, E, ascorbic acid, copper, chromium, ferrum deficiency. That is why it is necessary to correct redox equilibrium parameters developing methodological and organizational approaches to the optimization of urban and rural schoolchildren nutritional status.

Keywords

Antioxidant Status, Actual Nutrition Diet, Oxidative Stress

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1. Introduction

The change of homeostasis and, especially, antioxidant status parameters of learners can indicate the development of stress [3, 4, 5, 6, 7], according to the data of Setko N.P. and Setko A.G. et. al. (2008-2015). According to the works of Hans Selye, in case of stress the systems of neurohumoral regulation are activated under the influence of "first mediator" [8]. Nowadays, free radicals and products of lipid peroxidation are considered to serve as "first mediators" [9]. Consequently, the change of redox balance activates the complex of protective adaptive responses and can have a negative impact on the functional and morphological characteristics of organs and tissues, leading to oxidative stress [10]. Deficiency of vitamins A, E, C due to their biochemical antioxidant properties, can enhance oxidative stress manifestations [11].

2. Research Significance

The investigation includes the comparative study of urban and rural learners antioxidant status and actual nutrition. It is the first large scale study that allowed to identify risk factors for oxidative stress in urban and rural schoolchildren, living in different territories of the Orenburg region.

* Corresponding author
E-mail address: orgma-innova@mail.ru (E. V. Bulycheva)

3. Materials and Methods

The investigation included the study of antioxidant status of urban (n=250) and rural (n=200) schoolchildren. Each group was divided into two age subgroups – schoolchildren aged from 12 to 14 years (n=150 among urban and n=100 among rural schoolchildren) and learners aged from 15 to 17 years (n=100 among urban and n=100 among rural schoolchildren). The study was conducted in accordance with the ethic standards, covered by the World Medical Association's Declaration of Helsinki (Seoul, 2008), in particular, informative consents of the parents of the schoolchildren were received. The present study was also approved by the local ethic committee of the SBEI of HPE OrSMU of the Ministry of Health of Russia.

3.1. Antioxidant Status Evaluation

Antioxidant status was evaluated in accordance with methods of Farkhutdinov R.R. (2002) studying the power of antioxidant systems with the help of chemiluminescence method. This method is based on recording of ultraweak chemiluminescence of free radicals in biological media in terms of lightsum, intensity of fast burst, maximum luminosity, slope, with the help of photomultiplier. In order to investigate chemiluminescence of blood serum, the blood without ethylenediaminetetraacetic acid and heparine was selected. The intensity of lipid peroxidation processes was evaluated in terms of spontaneous and iron-induced chemiluminescence of whole serum and lipoprotein fractions, and high–density lipoprotein capacity to stop free radical oxidation in the model system of phospholipids. The supply of learner`s organism with water-soluble vitamins, important indirect factors influencing the oxidation-reduction reactions in a human organism, in urine (riboflavin, pyridoxine), and fat-soluble vitamins in blood serum (retinol, tocopherol) was studied with the help of fluorometry method and biofluid analyzer FLUORAT 02-ABLF (Lumex, Russia). The quantitative content of ascorbic acid in morning urine was identified by the visual titration method using the oxidation-reduction reaction with Tillman`s reagent (2,6-dichloroindophenol sodium derivative). Total protein level was identified with the help of the method, based on biuret test; albumen level, with the help of colorimetric method with bromocresol green (BCG) in acidic media. Total cholesterol level (TC) and high-density lipoprotein cholesterol (HDL cholesterol) level were identified using direct enzymatic colorimetric method with cholesterol esterase and peroxidase. Triglyceride level (TGs) was identified with the help of enzymatic colorimetric method with glycerophosphoric oxidase; low-density lipoprotein cholesterol (LDL cholesterol), using Friedewald formula (1972).

3.2. Actual Nutrition Evaluation

Actual nutrition was evaluated by means of daily nutrition reproduction, using the specially developed questionnaire (Martinchik A.N. et al., 1996), determining biological value of a diet with the help of food composition tables by Skurykhina I.M. and Tuteljan V.A and correlation of the data of each age group with “The norms of physiological needs for power and feedstuff in different population groups of the Russian federation” (MR 2.3.1.2432-08).

4. Results and Discussion

4.1. Power of Antioxidant Systems

It was stated that urban schoolchildren compared to rural schoolchildren aged from 12 to 14 years and from 15 to 17 years have higher content of free radical oxidation products, which is confirmed by exceeded level of the intensity of fast burst in 4,3 and 5,9 times (Table 1). Probably, it is based on the fact that the urban schoolchildren have the rate of ROS production 4,4-5,7 times higher than the rural schoolchildren, it is confirmed by the maximum luminosity data (2,42±0,52 relative units in the urban schoolchildren and 0,55±0,09 relative units in the rural schoolchildren aged from 12 to 14 years, p≤0,05; 3,11±0,53 relative units in the urban schoolchildren and 0,40±0,02 relative units in the rural schoolchildren aged from 15 to 17 years, p≤0,05). The increased level of ROS in the urban schoolchildren activates signaling pathways, causing the activation of corresponding genes transcription and enforcement of antioxidant defense. It is confirmed by the fact that lightsum, reflecting the power of antioxidant systems of the organism, was 2,2 times higher in the urban schoolchildren aged from 12 to 14 years and 3,3 times higher in the urban schoolchildren aged from 15 to 17 years. Besides, the rate of free radical oxidation was 3,8-7,6 times higher in the urban schoolchildren, which is shown by the slope parameter (1,14±0,22 relative units in the urban schoolchildren and 0,30±0,07 relative units in the rural schoolchildren aged from 12 to 14 years, p≤0,05; 1,51±0,25 relative units in the urban schoolchildren and 0,20±0,03 relative units in the rural schoolchildren aged from 15 to 17 years, p≤0,05).

Table 1. Antioxidant status parameters of urban and rural schoolchildren.

Parameters	Age group			
	From 12 to 14 years		From 15 to 17 years	
	Urban schoolchildren	Rural schoolchildren	Urban schoolchildren	Rural schoolchildren
Lightsum	4,36 ± 0,60	1,95 ± 0,19*	6,35 ± 0,78	1,51 ± 0,19*
Burst	2,82 ± 0,67	0,65 ± 0,1*	3,83 ± 0,84	0,44 ± 0,04*
Maximum luminosity	2,42 ± 0,52	0,55 ± 0,09*	3,11 ± 0,53	0,40 ± 0,02*
Slope	1,14 ± 0,22	0,30 ± 0,07*	1,51 ± 0,25	0,20 ± 0,03*

*p≤0,05 while comparing the data of urban and rural schoolchildren inside each age group

4.2. Content of Fat- and Water-Soluble Vitamins

All in all, while evaluating the condition of antioxidant defense we need to take into account that it is characterized by the low level of lipid antioxidant factor – content of vitamins A, E in blood serum, which protect fatty acids from peroxidation in plasma and membrane structures (especially tocopherol) [12]. The urban schoolchildren experience fat-soluble vitamins deficiency in a greater degree than the rural schoolchildren. The content of retinol in blood serum of the urban schoolchildren aged from 12 to 14 years was 26,7% lower than the physiological norm, aged from 15 to 17 years – 20,0% lower than the physiological norm; it is 1,3 times lower than in the rural schoolchildren (Table 2). The content of tocopherol in blood serum of the urban learners aged from 12 to 14 years was 6,98±0,25 mcg/hour that is 12,8% lower than the physiological norm, aged from 15 to 17 years - 7,22±0,17 mcg/hour and 9,8% lower than the physiological norm. As for the rural learners, the content of tocopherol 7,46±0,09 mcg/hour in 12-14 years age group and 7,22±0,08 mcg/hour in 15-17 years age group, that is respectively 6,8% and 9,8% lower than the physiological norm.

Table 2. Content of vitamins A, E, C in urban and rural schoolchildren.

Age group, years		Vitamins		
		A	E	C
		Physiological norm		
		0,3-0,7 mcg/ml	8-12 mcg/ml	0,7-1,0 mg/hour
12-14	urban	0,22±0,01	6,98±0,16	0,724±0,01
	rural	0,28±0,01*	7,46±0,09*	0,596±0,02*
15-17	urban	0,24±0,01	7,22±0,17	0,713±0,01
	rural	0,27±0,01*	7,22±0,08	0,615±0,01*

*p≤0,05 while comparing the data of urban and rural schoolchildren inside each age group

The received data about the content of fat-soluble vitamins in the blood of the urban and rural learners show the unstable balance of antioxidant defense, forming oxidative stress, which can lead to nucleic acids, proteins and lipids damage. A positive predisposing factor of oxidation- reduction balance formation in the urban schoolchildren is considered to be a level of ascorbic acid (0,724±0,01mg/hour in the learners, aged from 12 to 14 years and 0,713±0,01mg/hour in the learners, aged from 15 to 17 years, physiological norm of this age group is 0,700-1,000mg/hour). This acid is a hydrophilic nonenzymatic antioxidant, which has a strongly pronounced restoring capacity and is oxidized to dehydrogenated form due to 2 electrons and 2 protons recoil (Table 2). At the same time, the level of ascorbic acid in rural schoolchildren appeared to be lower than the physiological norm minimum limit. In learners aged from 12 to 14 years it was 0,596±0,02 mg/hour, that is 14,8% lower than the physiological norm, and in learners aged from 15 to 17 years - 0,615±0,01mg/hour and 12,1% correspondingly. The higher content of vitamin C in urban schoolchildren compared to rural ones can also be the cause of higher antioxidant defense power of learners, living in urban areas. Moreover, physiological level of ascorbic acid in urban learners provides ROS direct reduction as well as recovery of tocopherol oxidized forms caused by neutralization of membrane lipids free radicals. Under that logic, decreased content of vitamin C on the back of tocopherol deficiency in the rural children can contribute to the developing oxidative stress in the organism.

4.3. Factors Forming Antioxidant Defense System

Antioxidant defense system of the organism is one of the main constituent parts of its adaptive function and a multicomponent cluster of different antiradical mechanisms [13]. Evidently, many biochemical processes, aimed at organism adaptation to exogenous factors need energy stored in ATP. These biochemical processes may be synthesis of complex chemical compounds from simpler ones (anabolism reaction), muscle activity (mechanical work), transmembrane potential production, active transport across biological membranes. It is known that riboflavin is necessary for full tissue respiration, during which the main energy resource of ATP cell is synthesized. Riboflavin is found in prosthetic groups of flavin mononucleotide coenzymes and flavin adenine dinucleotide (FAD), also oxidase and reductase; performs redox reactions during cell oxidation. Taking into account that B vitamins can influence antioxidant status processes, it was stated that in the urban and rural schoolchildren of any age riboflavin content was 8,9%-11,9% lower than physiological norm. But in the rural children aged from 15 to 17 years renal excretion of this vitamin was 14,2±0,24mcg/hour, i.e. lower limit of normal (Table 3).

Table 3. Content of B vitamins in urban and rural schoolchildren.

Age groups, years		Vitamin		
		B1	B2	B6
		Physiological norm		
		15-35 mcg/hour	14-30 mcg/hour	40-60 mcg/hour
12-14	urban	20,42±0,49	12,34±0,37	41,11±0,80
	rural	12,58±0,25*	13,68±0,32*	37,92±0,57*
15-17	urban	21,3±0,39	12,76±0,41	40,33±0,64
	rural	13,19±0,2*	14,2±0,24*	37,4±0,37*

*p≤0,05 while comparing the data of urban and rural schoolchildren inside each age group

Considering the fact that antioxidant defense of organism includes SOD, catalase, peroxidase and other enzymes, it becomes clear that amino acid exchange disorder or amin acid deficiency can affect synthesis of these enzymes. Stated that schoolchildren had sufficient level of protein (it was 75,6±2,09 g/l - 77,2±1,9 g/l in the urban children and 75,1±4,44 g/l - 76,6±4,05 g/l in the rural children). Higher level of albumin was found in 45%-51,8% of the urban learners and 4-14,7% of the rural ones, considering that average member of protein in the urban learners was 9,6-32,5% higher than in the rural ones. Albumin deficiency was found only in 16% of the rural schoolchildren, aged from 12 to 14 years. Nevertheless, studied learners had the risk of amino acid metabolism disorders, presented by aneurine and pyridoxine deficiency, which lead to enzyme synthesis disorder, taking part in antioxidant defense. Stated that only the rural schoolchildren had aneurine deficiency. In the children of 12-14 years it was 16, 1% lower than the physiological norm (12,58±0,25mcg/hour), in the children of 15-17 years – 12,1% lower (13,19±0,20mcg/hour) (Table 3). Pyridoxine deficiency in the rural learners aged from 12 to 14 years was 94,8% of the physiological norm, in the learners aged from 15 to 17 years – 93,5%. The tendency to decrease of aneurine level was identified in the organism of the rural schoolchildren compared to the urban learners of any age. Aneurine content in the urban schoolchildren of 12-14 years was 20,42±0,49mcg/hour and 12,58±0,25mcg/hour in the rural ones (p≤0,05); in the urban learners of 15-17 years - 21,3±0,39mcg/hour and in the rural ones - 13,19±0,2mcg/hour (p≤0,05). As for pyridoxine content in the organism of urban and rural schoolchildren, the same pattern occurred. The level of riboflavin content, on the contrary, showed its growth in the rural learners compared to the urban ones (12,34±0,37 mcg/hour in the urban children of 12-14 years and 12,76±0,41mcg/hour in the rural ones, p≤0,05; 13,68±0,32mcg/hour in the urban children of 15-17 years and 14,2±0,24mcg/hour in the rural ones, p≤0,05).

It is stated that oxidative stress plays a great role in transformation of circulating monocytes into macrophages, which migrate into subendothelium, causing chronic inflammatory or immune processes in vessel wall [14]. Reactive oxygen species, including those created because of mitochondrial respiratory chain disorder, play a critical part in endothelial injuries [15]. Besides, reactive oxygen species interact with low density lipoproteins, which oxidized forms increase expression of such chemoattractive agents like MCP-1, colony-stimulating factors like MCSF (monocyte, macrophage-colony stimulating factor), and cell adhesion molecules like VCAM-1 and ICAM-1 in endothelial cells. Macrophages bind and internalize oxidized forms of low density lipoproteins, that leads to their transformation into foam cells [16, 17]. It becomes apparent that higher level of low density lipoproteins on the back of oxidative stress can cause endothelial dysfunction development, which is the key factor of the pathogenic mechanism of atherosclerosis. It is important to say that from 78,3% to 93,1% of urban schoolchildren and from 44% to 55,9% of rural ones have higher level of low density lipoproteins; from 51,7% to 69,6% of urban and from 91,2% to 92% of rural learners have increased level of total cholesterol. Besides, the additional factor of atherogenecity in the urban schoolchildren was the fact that 91,3%-93,1% of them had increased level of triacygyceride, but this index was 14,8% and 17,1% lower in the rural learners aged from 15 to 17 years and from 12 to 14 years respectively. At the same time, decreased level of high density lipoproteins was stated in 45% of urban learners and 42-47% of rural learners. The increased level of this index was indicated in the urban learners and it was 22-49% higher than in the rural ones.

4.4. Actual Nutrition of Schoolchildren

The problem of stabilization of antioxidant status can be solved in different ways, as both radical formation and antiradical defense processes take part in its formation. Use of antioxidants allows to decrease the level of radical formation, but it does not influence the superoxide-neutralizing activity as a multicomponent functional system [13]. At the same time, antioxidant-enriched rational nutrition is one of the most effective ways of antiradical activity rise [18,19]. Besides, the decreased bioavailability of synthetic vitamins and mutual potentiating effect of natural antioxidants complex show the need of nutrient defense against oxidative stress [20,21,22]. The analysis of daily diet of schoolchildren showed that the rural children had more deficient diet (especially in A and E vitamins) than the urban ones (Table 4). Vitamin A deficiency was 83,3% from the physiological norm in the urban learners and 66,7% in the rural learners of 12-14 years; in the urban and rural learners of 15-17 years it was 90% and 17% respectively. Vitamin E deficiency was 59,2% in the urban schoolchildren and 71,7% in the rural ones aged from 12 to 14 years; in the urban and rural schoolchildren aged from 15 to 17 years it was 66% and 70,7% respectively. The content of ascorbic acid in daily diet of either urban or rural schoolchildren was within the limits of physiological norm.

The most adequate way of antioxidant balance correction is to achieve the microelement composition balance, connected with free radical oxidation with the help of antioxidant nutritional support [13]. The studies by T.F.Slater (1988), F.W.Sunderman (1986), J.A.Revazova et al. (2000) indicated the role of some microelements, showing prooxidant and antioxidant properties, in lipid peroxidation reaction. For example, cobalt and chromium ions induce lipid peroxidation process in Fenton and Haber-Weiss reactions [26]; zinc, being a cofactor in the process of lipid peroxides affected plasma membranes stabilization, has antioxidant effect and prevent prooxidant microelements from absorption [27].

Table 4. Content of vitamins and micronutrients in the daily diet of schoolchildren.

Name of micronutrient	Age groups					
	12-14 years			15-17 years		
	urban	rural	physiological norm[1]	urban	rural	physiological norm[1]
Vitamin, mcg						
Vitamin A,	100±2,0	200±4,0*	600	220,0±5,0	170,0±3,0*	1000
Vitamin B1	2,7±0,3	1,4±0,1*	1,3	0,92±0,2	0,81±0,1	1,3-1,5
Vitamin B2	2,1±0,1	1,1±0,1*	1,5	0,44±0,08	0,65±0,09*	1,5-1,8
Vitamin C	59,1±13,8	63,1±12,3*	60-70	99,4±24,8	89,6±21,0	70-90
Vitamin B6	1,2±0,1	0,9±0,1*	1,6-1,7	0,87±0,14	0,99±0,15	1,6-2
Vitamin E	4,9±0,7	3,4±0,6*	12,0	5,1±2,3	4,4±1,1	15,0
Macro- and micronutrient						
Calcium, mg	613,3±87,0	577,0±83,9	1200	314,3±45,6	273,2±43,4	1200
Magnesium, mg	347,0±44,8	250,1±21,8*	300	171,1±19,8	166,8±20,6	400
Phosphorus, mg	1178,4±213,9	1152,5±112	1200	766,7±77,9	673,03±85	1200
Potassium, mg	1499,8±175,5	1343,0±164	1500	1505,8±233,4	1482,9±237	2500
Sodium, mg	544,6±47,3	441,5±56,1*	1100	401,5±55,3	399,2±49,2	1300
Chloride, mg	625,8±75,2	603,9±72,2	1900	617,3±88,1	594,5±79,5	2300
Ferrum, mg	19,3±3,5	20,4±3,5	15,00	14,6±3,3	13,7±2,1	18,0
Zinc, mg	7,18±0,6	6,31±0,9	12,00	5,8±0,9	4,76±0,8	12,0
Iodine, mg	0,44±0,19	0,23±0,13	0,130	0,13±0,07	0,15±0,09	0,15
Copper, mg	0,6±0,02	0,4±0,01*	0,80	0,3±0,02	0,2±0,03*	1,00
Selenium, mg	0,23±0,05	0,12±0,04*	0,04	0,45±0,06	0,34±0,02*	0,05
Chromium, mg	12,4±5,4	9,3±2,7	25,0	21,0±3,8	17,8±3,5	35,0
Fluorine, mg	2,6±0,5	1,6±0,2*	4,00	2,2±0,3	1,5±0,2*	4,00

*p≤0,05 while comparing the data of urban and rural schoolchildren inside each age group

[1]physiological norm of vitamin, macro- and microelement intake of a learner

Multiple correlation analysis, made by Rakitinskiy V.N., Judina T.V. (2005) showed the common patterns of interaction between micronutrient content and free radical oxidation parameters, which allowed to indicate the presence of antioxidant properties of ferrum, zinc and cobalt, and prooxidant properties of chromium, copper and nickel. Nevertheless, in the daily diet of urban and rural learners the deficiency of zinc and chromium intake was stated. Zinc deficiency in the urban and rural children was 68% and 60,7% respectively; chromium deficiency-87,3% and 74%. Besides, their function can be twofold depending on their concentration. Copper, as an inducer of caeruloplasmin protecting cells from lipid peroxides, can serve as an antioxidant and, at the same time, like nickel and chromium, it can induce lipid peroxidation, i.e. copper has dose-dependent effect [28]. The same can be said about ferrum ions [29]. The analysis of daily diet of schoolchildren showed that ferrum intake was 69,2% in the urban schoolchildren and 58,3% in the rural ones; daily copper intake was 71,4% and 42,9% which testifies to the risk of these microelements deficiency. Other very important macro- and microelements, which provide human homeostasis and maintain oxidation-reduction balance, are calcium, phosphorus, sodium, chloride and magnesium. In daily diet of rural schoolchildren calcium deficiency was higher than in the urban ones (33,8% and 41,8% from the physiological norm respectively). Deficiency of phosphorus, sodium and chloride was also higher in the rural learners. Deviations from the physiological norm of phosphorus intake was 79,9% in the urban schoolchildren and 61,5% in the rural ones, sodium intake-74,5% and 61,4%, chloride intake-68,5% and 61,6% respectively. The level of magnesium intake was 16,7% low in the urban learners of 12-14 years, in urban and rural learners of 15-17 years it was 57,2% and 53,8% low respectively.

5. Conclusion

It was stated that urban schoolchildren compared to rural ones aged from 12 to 14 years and from 15 to 17 years have higher content of free radical oxidation products, which is confirmed by exceeded level of the intensity of fast burst in 4,3 and 5,9 times, and the rate of ROS production 4,4-5,7 times higher that is confirmed by the maximum luminosity data. The low level of lipid antioxidant factor – content of vitamins A, E in blood serum was also stated.

A positive predisposing factor of oxidation- reduction balance formation in the urban schoolchildren is considered to be a level of ascorbic acid (0,724±0,01mg/hour in the learners, aged from 12 to 14 years and 0,713±0,01mg/hour in the learners, aged from 15 to 17 years, physiological norm of this age group is 0,700-1,000mg/hour). The level of ascorbic acid in rural schoolchildren appeared to be lower than the physiological norm minimum limit. In learners aged from 12 to 14 years it was 0,596±0,02 mg/hour, that is 14,8% lower than the physiological norm, and in learners aged from 15 to 17 years - 0,615±0,01mg/hour and 12,1% correspondingly.

In the urban and rural schoolchildren of any age riboflavin content was 8,9%-11,9% lower than physiological norm, but in the rural children aged from 15 to 17 years renal excretion of this vitamin was 14,2±0,24mcg/hour. Schoolchildren had sufficient level of protein (it was 75,6±2,09 g/l - 77,2±1,9 g/l in the urban children and 75,1±4,44 g/l - 76,6±4,05 g/l in the rural children). Albumin deficiency was found only in 16% of the rural schoolchildren, aged from 12 to 14 years. Only the rural schoolchildren had aneurine deficiency, in the children of 12-14 years it was 16, 1% lower than the physiological norm (12,58±0,25mcg/hour), in the children of 15-17 years – 12,1% lower (13,19±0,20mcg/hour). Pyridoxine deficiency in the rural learners aged from 12 to 14 years was 94,8% of the physiological norm, in the learners aged from 15 to 17 years – 93,5%. From 78,3% to 93,1% of urban schoolchildren and from 44% to 55,9% of rural ones have higher level of low density lipoproteins; from 51,7% to 69,6% of urban and from 91,2% to 92% of rural learners have increased level of total cholesterol.

Besides, the additional factor of atherogenecity in the urban schoolchildren was the fact that 91,3%-93,1% of them had increased level of triacyglyceride, but this index was 14,8% and 17,1% lower in the rural learners aged from 15 to 17 years and from 12 to 14 years respectively. Vitamin A deficiency was 83,3% from the physiological norm in the urban learners and 66,7% in the rural learners of 12-14 years; in the urban and rural learners of 15-17 years it was 90% and 17% respectively. Vitamin E deficiency was 59,2% in the urban schoolchildren and 71,7% in the rural ones aged from 12 to 14 years; in the urban and rural schoolchildren aged from 15 to 17 years it was 66% and 70,7% respectively. The content of ascorbic acid in daily diet of either urban or rural schoolchildren was within the limits of physiological norm. In the daily diet of urban and rural learners, the deficiency of zinc and chromium intake was stated. Zinc deficiency in the urban and rural children was 68% and 60,7% respectively; chromium deficiency-87,3% and 74%. Calcium deficiency in the rural children was higher than in the urban ones (33,8% and 41,8% from the physiological norm respectively).

To sum up, considering the received data about the antioxidant status and its forming factors, it is necessary to correct redox equilibrium parameters developing methodological and organizational approaches to the optimization of the urban and rural schoolchildren nutritional status.

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