

ECOLOGY

Lipid Peroxidation and Antioxidant System in Children Living in the Northern Transbaikal Region

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Exposure to extreme environmental factors of the North creates prerequisites for hyper-activation of free-radical oxidation reactions which may limit the adaptive potential of cells and organism.

Key Words: *children; North; lipid peroxidation; antioxidant activity*

Predominant utilization of lipids for the maintenance of energy balance occurs in the body under conditions of the Extreme North. Lipogenesis activation indicates essential functional reserve of endogenic metabolism [7].

We compared lipid peroxidation (LPO) and antioxidant activity of the blood in indigenous population of Northern Transbaikal region and newcomers.

MATERIALS AND METHODS

Sixty healthy children aged 7-11 years living in the North were examined (20 Evenks, 10 indigenous Russians, and 20 Russian newcomers). Control group consisted of 43 age-matching healthy children living in Chita.

LPO products were measured by extraction spectrophotometry in the heptane and isopropanol phases [3]. Total lipids, phospholipids, and total proteins were measured by conventional methods using commercial kits.

Plasma LPO level was expressed per mg lipids. The level of products reacting with 2-thiobarbituric acid (TBA) was determined [1]. The concentrations

of heptane- and isopropanol-extracted LPO products were expressed in oxidative index units calculated in the relevant phases of lipid extract as the ratio of light absorbancies E_{232}/E_{220} for diene conjugates (DC) and as E_{278}/E_{220} for ketodienes and conjugated trienes. The concentrations of Schiff's bases [5] and erythrocyte peroxide resistance [4] were determined. The antioxidant activity was estimated from plasma or erythrocyte ability to suppress biogenic lipid peroxidation *in vitro* [2,6]. The results were analyzed by the variational statistics methods. The differences were evaluated using Student's test.

RESULTS

Plasma level of total lipids was significantly increased in all children living in the Transbaikal region. This increase was not due to the phospholipid fractions which was significantly decreased (Table 1).

Testing the heptane phase of lipid extract for the initial products of free-radical lipid oxidation was low-informative: the DC concentration did not change significantly in all the groups, and their relative content (E_{232}/E_{220}) was low only in Russian newcomers.

Shifts in the isopropanol phase were as follows: the level of DC was increased significantly in newcomers in comparison with the residents of Chita

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TABLE 1. LPO and Antioxidant System Values in Children of the Transbaikal Region ($M \pm m$)

Parameters	Control (n=43)	Children of Extreme North		
		Evenks (n=20)	indigenous Russians (n=20)	newcomers Russian (n=20)
Total lipids, g/liter	6.51±0.11	8.05±0.15*	7.55±0.14*	7.97±0.16*
Total phospholipids, mmol/liter	2.45±0.15	1.46±0.33*	2.83±0.34*	2.17±0.34*
LPO products				
Heptane phase:				
DC, Δ_{233} /mg lipids	0.23±0.01	0.32±0.07	0.21±0.03	0.27±0.02
$E_{232/220}$	0.80±0.02	0.91±0.14	0.85±0.03	0.68±0.03*
Isopropanol phase:				
DC, Δ_{233} /mg lipids	0.69±0.03	0.75±0.06	0.70±0.04	0.83±0.05*
$E_{232/220}$	0.48±0.02	0.53±0.01*	0.55±0.01*	0.52±0.01
ketodienes and conjugated trienes, Δ_{278} /mg lipids	0.31±0.01	0.29±0.03	0.33±0.03	0.40±0.04**
$E_{278/220}$	0.19±0.01	0.19±0.01	0.26±0.02**	0.23±0.04
TBA-active products				
serum, mmol/mg lipids	0.73±0.04	0.67±0.08	0.64±0.06	0.91±0.06**
erythrocyte, mmol/g proteins	13.46±1.36	13.13±1.4	12.45±1.62	17.21±1.27**
Schiff's bases in erythrocytes, U fluorescence/mg lipids	1.36±0.09	1.09±0.1*	1.42±0.1*	1.54±0.18*
Erythrocyte peroxide resistance, % hemolysis	5.38±0.12	5.10±0.26	4.52±0.38	7.19±0.53**
Antioxidant activity				
Superoxide dismutase, U act./mg erythrocytic protein	0.13±0.02	0.10±0.01	0.12±0.02	0.07±0.01*
Erythrocyte catalase, nmol/sec×mg erythrocytic protein	11.31±1.1	10.76±1.0	9.16±0.97	14.11±1.3*
Plasma catalase, nmol/sec×mg protein	5.25±0.50	7.48±0.80*	2.8±0.40**	9.45±1.59*

Note. *Significant differences in comparison with the control, *in comparison with Evenks, **with indigenous Russians.

and indigenous children. The relative index ($E_{232/220}$) of newcomers did not differ from that in other children, while in the indigenous population this parameter was significantly higher than in children from Chita. The maximum concentration of ketodienes and conjugated trienes was typical of the newcomers, and the $E_{278-220}$ was different only in indigenous Russians in comparison with the Chita children.

A significant increase in the levels of TBA-reactive products in the plasma and erythrocytes was observed in the newcomers. The concentration of Schiff's base, an indicator of the function of biological membranes and activities of membrane-bound enzymes and transport proteins was significantly lower in the Evenks. This may be due to genetically determined features in the structure and metabolism of cell membranes in the Evenk children.

The activities of enzymes that metabolize oxygen radicals in erythrocytes were virtually the same

in the controls, Evenks, and indigenous Russian children.

In the Russian newcomers, the shifts manifested themselves in decreased superoxide dismutase content and increased catalase activities. The erythrocyte resistance to peroxide hemolysis was decreased in the newcomers: the percentage of lysed erythrocytes was significantly higher than in all other examines, including the controls.

Changes in the rate of hydrogen peroxide decontamination in the plasma were different. In indigenous Russians catalase activity decreased almost by half ($p < 0.001$) in comparison with the control, while in the Evenks it was higher ($p < 0.05$) than in the children from Chita. The maximum catalase activity was recorded in the newcomers, which may be a compensatory adaptive reaction and a result of dysadaptation disorders that lead to destruction of the membrane structures and release of this antioxidant factor into the extracellular space, where it exerts its protective effect.

Chronic exposure to the extreme environmental factors of the North creates prerequisites for hyperactivation of free-radical oxidation which may act, at certain stages, as factors limiting the adaptive potential of cells and host. In healthy children living in Northern regions for a long time the studied antioxidant parameters remain normal, the increased content of LPO products. This fact indicates exhaustion of the antioxidant resources of the organism, because normally the LPO:radical inhibitors ratio is maintained at a constant level. The adaptation response requires "compensation", i.e., restructuring of biochemical processes, primarily of free-radical oxidation of lipids which, due to their universal nonspecific nature, serve as an indicator of the stability of permanent transformations in the organism, affecting its compensatory adaptive po-

tential and determining a probable development of pathological processes.

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