

## EVALUATION OF LIPIDS, LIPOPROTEINS AND APOLIPOPROTEINS CONCENTRATIONS IN CORD BLOOD SERUM OF NEWBORNS FROM RURAL AND URBAN ENVIRONMENTS

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**Abstract:** The purpose of the present study was to check the influence of rural and urban environments on some of the parameters of lipids metabolism in the cord blood serum in healthy newborns, as well as the evaluation of the concentration of lipids, lipoproteins and apolipoproteins in the cord blood serum with relation to risk factors of atherosclerosis in the family of the studied newborns. The study included 75 newborns (37 from rural areas and 38 from urban areas). Newborns weight and length were recorded at birth. On the basis of the family history taken from the mothers, the atherosclerosis risk factors were established in the families of the studied newborns. In all of the studied newborns, concentration of triglycerides, total cholesterol and LDL, VLDL and HDL cholesterol as well as of apolipoproteins (apo-AI, apo-B) in the cord blood serum sampled soon after birth were performed. No statistically significant differences between the mean levels of triglycerides, total cholesterol and cholesterol of fractions: LDL, VLDL, HDL and apolipoproteins (apo-AI, apo-B) in the cord blood serum in the newborns from rural and urban areas were found. However, when analysing the concentration of parameters of lipid metabolism in cord blood serum in newborns with regard to gender, higher concentrations of total cholesterol, LDL cholesterol and apo-AI in female newborns from rural areas, and higher HDL cholesterol and apo-AI in female newborns from urban regions were confirmed. When analysing the concentration of lipids and lipoproteins in cord blood serum in newborns from families with risk factors confirmed as compared to the families without that risk, both in the rural and urban regions no significant differences were confirmed. The studies have not proved any significant differences between the levels of lipids, lipoproteins and apolipoproteins in the cord blood serum in newborns from rural and urban areas.

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### INTRODUCTION

The observed changes within the people's lifestyles resulting from the hastened urbanisation and mechanisation of the production within the last decades have an effect on the occurrence of so-called civilisation illnesses. The main factors that influence health are: reduction of the physical activity among people and changes in nourishment. Civilisation illnesses appear due to the difficulties connected

with people's adaptation to the fast changes of the environment [17].

One of the most dangerous illnesses nowadays is atherosclerosis. The diseases which develop on the basis of atherosclerosis: cardiac ischaemia, cardiac infarction and stroke are still a big health problem for people in the present day world.

Atherosclerosis has been developing for many years and although its clinical symptoms are visible in older age, the

onset of atherosclerotic alterations may have their origin in early childhood. The onset and development of atherosclerotic changes depend on the presence of the favouring factors, such as genetic, constitutional and environmental factors [6]. The prognostic factors for cardiac ischaemia development are as follows: disorders of lipid metabolism, hypertension, diabetes, obesity, insufficient physical activity, inadequate diet, gender, tobacco smoking, alcohol abuse and prolonged stress. Family history including cardiac ischaemia is often considered an independent risk factor and the offspring of these families constitute a group especially predisposed for early development of atherosclerotic changes [21]. An early possible detection and limitation of risk factors are the basis for prevention of atherosclerosis and its complications [5, 20].

On the basis of the conducted research, the bigger prevalence of atherosclerosis risk factors and increased morbidity and mortality due to cardiovascular diseases within the urban areas than within rural areas were proved [14, 28].

Disorders of lipid metabolism, and in particular elevated cholesterol concentration, are certainly factors favouring atherosclerotic changes. The disorders of lipids metabolism are the factors which can be detected early enough, i.e. at the birth.

Therefore the aim of the present study was to check the influence of rural and urban environments on some of the parameters of lipids metabolism in the cord blood serum in healthy newborns, as well as the evaluation of the concentration of lipids, lipoproteins and apolipoproteins in the cord blood serum with relation to risk factors of atherosclerosis in the families of the studied newborns.

## MATERIAL AND METHODS

The research was carried out on 75 healthy newborns who were born between 1 May 1999 – 31 August 1999 at Maternity Ward of a Public Hospital in Lubartów, Poland and whose mothers agreed to be examined. Among the newborns of normal pregnancy and naturally born in an overall good condition, and without congenital malformations, there were: 37 (20 male and 17 female) newborns from rural areas and 38 (17 male and 21 female) newborns from urban areas. The evaluation of the health condition of the newborns after birth was evaluated for 8-10 points according with the Apgar scale. Newborns weight and length were recorded at birth. The gestational age of the studied newborns ranged from 36-42 weeks. On the basis of the family history taken from the mothers, the atherosclerosis risk factors were established in the families of the studied newborns: hypercholesterolemia, obesity, hypertension, diabetes, cardiac infarction and stroke. The parents of the studied children are young and do not always show any clinical symptoms of cardiac ischaemia, therefore the family history including this illness was taken into consideration here.

In all of the studied newborns, concentration of triglycerides, total cholesterol, LDL cholesterol, VLDL cholesterol

and HDL cholesterol as well as of apolipoproteins (apo-AI, apo-B) in the cord blood serum sampled soon after birth were performed.

The concentration of triglycerides, total cholesterol and HDL-cholesterol were assayed with the reagents by "Cormay". The concentration of LDL cholesterol and VLDL cholesterol was defined by using the formula given by Friedewald. Apolipoproteins: apo-AI and apo-B were assayed by immunoturbidimetric method with the reagents by "Roche". The assays were performed with a Cobas-Mira S apparatus. The concentration of lipids, lipoproteins and apolipoproteins were characterised by a mean arithmetic (M) and standard deviation (SD). The evaluation of the significance of the differences in the mean values of lipids, lipoproteins and apolipoproteins in cord blood serum of newborns with relation to the rural and urban environments, and with relation to the risk factors of atherosclerosis, were tested with t-Student test for the values characterised by the normal distribution. In case of abnormal distribution of the variables the statistical analysis was performed by Mann-Whitney test. The significance of the differences between the groups was evaluated on the level  $\alpha = 0.05$ , therefore the differences for  $p < 0.05$  were considered statistically significant.

## RESULTS

The mean of birth weight of newborns from the rural areas –  $3,459.46 \text{ g} \pm 396.66 \text{ g}$  and from urban areas was  $3,311.84 \text{ g} \pm 547.82 \text{ g}$ . The mean of body length of newborns from rural areas was  $54.81 \text{ cm} \pm 3.82 \text{ cm}$  and from urban areas –  $55.03 \pm 2.22 \text{ cm}$ . No statistically significant differences between the mean of birth weight and of birth length of newborns from both rural and urban groups were confirmed.

The mean values of the concentration of triglycerides, total cholesterol and cholesterol of fractions LDL, VLDL, HDL and apolipoproteins in the cord blood serum in newborn from rural urban areas is presented in Table 1. No statistically significant differences between the mean levels of lipids, lipoproteins and apolipoproteins in the cord blood serum in the newborns from rural and urban areas were confirmed.

Statistical characteristics of the concentration of triglycerides, total cholesterol and cholesterol of fractions: LDL, VLDL and HDL, as well as of apo-AI and apo-B in the cord blood serum in newborns from rural areas with relation to the gender and the range of mean values are presented in Table 2. The concentration of total cholesterol, LDL cholesterol and apo-AI in the cord blood serum of the female newborns from rural environments was higher in comparison to the levels in male newborns and the differences were statistically significant ( $p < 0.05$ ). The concentration of HDL cholesterol and apo-AI had the highest value in the cord blood serum of the female newborns from urban areas as compared to the level of the male newborns, and the differences were statistically significant ( $p < 0.05$ ).

**Table 1.** Concentration of lipids, lipoproteins and apolipoproteins in cord blood serum of newborns from urban and rural environments.

Parameters (mg/dl)	areas	n	Min	Max	Mean	SD	p
Triglyceride	rural	37	22.0	399.0	56.8	93.8	ns
	urban	38	20.0	245.0	56.2	46.2	
Total cholesterol	rural	37	33.0	136.0	62.0	20.1	ns
	urban	38	36.0	194.0	66.8	27.5	
LDL – cholesterol	rural	37	15.2	63.2	33.5	11.9	ns
	urban	38	16.4	107.6	35.4	17.0	
VLDL – cholesterol	rural	37	4.4	39.8	9.7	6.0	ns
	urban	38	4.0	49.0	11.4	9.2	
HDL – cholesterol	rural	37	9.5	36.7	19.0	6.4	ns
	urban	38	5.0	57.0	20.0	9.5	
Apo-AI	rural	37	26.0	142.0	87.0	19.0	ns
	urban	38	26.0	186.0	91.0	24.0	
Apo-B	rural	37	25.0	95.0	36.0	16.0	ns
	urban	38	25.0	112.0	38.0	19.0	

In 10 families from the rural regions (i.e. 27%) and in 11 families from urban regions (i.e. 29%) the atherosclerosis risk factors were present. The mean values of the concentration of triglycerides, total cholesterol and cholesterol of fractions LDL, VLDL, HDL and apolipoproteins in the cord blood serum in the newborn from rural and urban areas with relation to the risk factors of atherosclerosis in the family is presented in Table 3. No statistically significant differences between the mean levels of triglycerides, total cholesterol and cholesterol of fractions LDL, VLDL, HDL and apolipoproteins in the cord blood serum in the newborns from rural and urban areas depending on the risk factors of atherosclerosis in families were confirmed.

**Table 2.** Concentration of lipids, lipoproteins and apolipoproteins in cord blood serum of newborns from rural and urban environments depending on the gender.

Parameters	Rural areas					Urban areas				
	gender	n	M	SD	p	sex	n	M	SD	p
Triglyceride (mg/dl)	male	20	68.0	128.9	ns	m	17	66.7	61.9	ns
	female	17	44.4	15.8		f	21	47.7	26.6	
Total cholesterol (mg/dl)	male	20	57.2	21.3	<0.05	m	17	61.6	20.8	ns
	female	17	67.8	17.5		f	21	71.1	31.7	
LDL- cholesterol (mg/dl)	male	20	29.5	10.5	<0.05	m	17	32.1	12.4	ns
	female	17	38.3	12.1		f	21	38.1	19.9	
VLDL- cholesterol (mg/dl)	male	20	10.1	7.7	ns	m	17	13.3	12.4	ns
	female	17	9.2	3.3		f	21	9.8	5.3	
HDL- cholesterol (mg/dl)	male	20	17.5	6.2	ns	m	17	16.2	8.1	<0.05
	female	17	20.8	6.4		f	21	23.1	9.6	
Apo-AI (mg/dl)	male	20	82.0	22.0	<0.05	m	17	84.0	22.0	<0.05
	female	17	93.0	14.0		f	21	97.1	24.0	
Apo-B (mg/dl)	male	20	37.0	21.0	ns	m	17	39.0	19.0	ns
	female	17	36.0	9.0		f	21	37.3	18.5	

## DISCUSSION

The results of the performed studies confirm that metabolism of the body may be programmed even in foetal life and may depend on the mother's genetic material, and to great extent on the external factors influencing the mother's organism, such as: environment, nutrition during and before pregnancy, health condition, taking of drugs and stimulants, as well as the mother's life style [3, 4]. The health condition of a newborn results from the course of foetal life and decides about the quality of life in adulthood [10, 25]. The exponent of the correct prenatal life of the foetus is the birth weight of the newborns. It has been confirmed that low birth weight and malnutrition during foetal life are risk factors for the development of lipid disorder, cardiac ischaemia, hypertension, obesity, and diabetes during adult life [4, 10, 11, 13, 22].

Birth weight can depend on both maternal and environmental factors. Buka *et al.* have pointed out that differences in maternal characteristics only partially explain the lower birth weights of infants of African-Americans women. It is hypothesized that economic and social features of urban neighbourhoods may further account for these differences [8].

By analysing the birth weight and length of the newborns from rural and urban environments, no statistically significant differences were confirmed.

The disorders of lipids metabolism may be detected very early – as early as in the cord blood serum. The values of concentrations of the studied parameters of lipids metabolism may be the result of the influence of genetic or environmental and genetic-environmental factors. However after evaluating lipid, lipoprotein and apolipoprotein concentration within cord blood serum in the newborns from rural and urban environments, no statistically significant

**Table 3.** Concentration of lipids, lipoproteins and apolipoproteins in cord blood serum of newborns from rural and urban environments depending on risk factors in family.

Parameters	Rural areas					Urban areas				
	Risk factors	n	Mean	SD	p	Risk factors	n	Mean	SD	p
Triglyceride (mg/dl)	yes	10	41.9	15.1	ns	yes	11	59.6	63.0	ns
	no	27	62.6	110.0		no	27	55.6	39.2	
Total cholesterol (mg/dl)	yes	10	60.2	13.3	ns	yes	11	67.4	17.6	ns
	no	27	62.7	22.3		no	27	67.5	31.1	
LDL-cholesterol (mg/dl)	yes	10	32.0	9.7	ns	yes	11	35.7	12.4	ns
	no	27	34.1	12.8		no	27	35.8	19.0	
VLDL-cholesterol (mg/dl)	yes	10	9.4	3.2	ns	yes	11	12.3	12.5	ns
	no	27	9.8	6.8		no	27	11.2	7.8	
HDL-cholesterol (mg/dl)	yes	10	18.8	5.2	ns	yes	11	19.4	7.7	ns
	no	27	19.1	6.9		no	27	20.5	10.4	
Apo-AI (mg/dl)	yes	10	87.0	11.0	ns	yes	11	91.0	16.0	ns
	no	27	87.0	22.0		no	27	92.0	27.0	
Apo-B (mg/dl)	yes	10	33.0	8.0	ns	yes	11	37.0	13.0	ns
	no	27	38.0	19.0		no	27	39.0	21.0	

differences between the mean levels of triglycerides, total cholesterol and cholesterol of fractions LDL, VLDL, HDL and apolipoproteins in the cord blood serum in the newborns from rural and urban areas were confirmed. In neither of the studied environments, no congenital hyperlipoproteinaemias were confirmed. This fact can be explained by the reduction of differences in rural and urban lifestyles which is associated with the bigger migration of people, change in diet in the villages, and the development of the motor industry and mechanization [17, 14].

The results of the conducted studies showed that children from urban rural environments are not characterised by a bigger load of atherosclerosis risk factors than children from rural areas.

The research evaluating the concentration of lipids, lipoproteins and apolipoproteins in the cord blood serum in healthy full-term newborns with relation to the birth weight and also the gestational age of the newborns was conducted. In the cord blood serum of the newborns with low birth weight, higher values of triglycerides, total cholesterol, cholesterol in fraction VLDL and apolipoprotein B were confirmed, as well as the tendency towards lower values of HDL-cholesterol; this is an unfavourable phenomenon from the point of the risk of arteriosclerosis. When analysing the lipids metabolism parameters in the cord blood serum in the newborns with relation to the gestational age, no significant relationships were confirmed [24].

In the cord blood serum, lower concentrations of lipids, lipoproteins and apolipoproteins are observed as compared to the values obtained during the first days, months and years of life. This is confirmed by studies conducted by other authors [12, 23, 30].

Numerous studies for evaluating lipid metabolism in the populations of various countries with different living stan-

dards and dietetic habits have proved the differences in the lipids and lipoproteins concentrations [7, 16, 18].

The concentrations of serum total and HDL cholesterol were measured in rural and urban schoolboys from 16 countries. Mean serum total and HDL cholesterol concentrations were relatively low in the less developed countries and relatively high in those that are more developed. Statistically significant relationships were found between serum total and HDL cholesterol between individuals, between populations, and within populations. The differences between urban and rural regions possibly result from the differences in socio-economic conditions leading to differences in food consumption [18].

The differences in cholesterol concentration which depend upon gender are observed even among children and teenagers. There occurs a higher HDL cholesterol concentration among females. It is stated that females less frequently suffer from cardiovascular disease than males [29].

In our studies, when making analysis of the influence of gender on the concentrations of lipid metabolism parameters in the cord blood serum of the newborns from the urban and rural regions, higher concentrations of total cholesterol, LDL cholesterol and apo-AI in female newborns from rural areas and higher HDL cholesterol and apo-AI in female newborns from urban regions were confirmed.

Anderesen and Johansen agree that in healthy term infants the gender influences the concentration of lipoproteins in blood serum [1]. Hardell noticed this relationship from the moment of birth, and that the female newborns had a higher concentration of cholesterol and its fractions in the cord blood serum than the male newborns, whereas triglycerides concentration maintained on a similar level in both sexes [15]. Zhao *et al.* evaluating the concentration of lipid parameters in cord blood stated that the HDL

cholesterol concentration in male neonates was lower than in female neonates [31]. However, other researchers have not confirmed these dependences [27].

Children from families with premature coronary artery disease, dyslipidemia, or hypertension, and/or two other risk factors should have a lipoprotein profile determined. The second group of higher risk families are those who are exposed to unfavourable environmental factors, such as acquisition by the offspring of the unfavourable characteristics of their parents' lifestyle, e.g. irrational diet, cigarette smoke environment, bad habits like smoking, alcohol, and inactive life style. A positive family history of atherosclerosis risk factors and changes in lipid metabolism are practical indications for defining the lipid profile in their offspring [2, 6, 26]. If the parents have primary hypercholesterolemia, the cholesterol assay in a child should be performed in cord blood serum in order to start early treatment.

When analysing the concentrations of lipids and lipoproteins in cord blood serum in newborns from the families with confirmed risk factors compared to families without that risk, both in the rural and urban regions, no significant differences were confirmed.

However, the children with a positive family history should be included in the prophylactic activities in order to reduce their risk of developing clinical symptoms of cardiac ischaemia [9]. The early detection and treatment of youth at risk for premature coronary artery disease offers the greatest opportunity to decrease morbidity and mortality [19].

## CONCLUSIONS

The studies to evaluate the lipids, lipoproteins and apolipoproteins concentrations in cord blood serum of the newborns from rural and urban regions have not proved any significant differences between the studied groups.

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