

# Relationship Between the Duration of the Breast-Feeding Period and the Lipoprotein Profile of Children at the Age of 13 Years

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## Summary

Selected parameters of lipid metabolism were studied in a group of 76 children aged 12–13 years. The children were divided into 4 subgroups according to the duration of neonatal nutrition (no breast feeding, breast feeding for 3, 6 or more than 6 months). We studied the concentration of total serum cholesterol, its distribution into lipoprotein fractions, the concentration of serum triacylglycerols and apolipoproteins A<sub>1</sub> (Apo A<sub>1</sub>) and B (Apo B). Atherogenic indexes were calculated from the data obtained. The highest cholesterol levels ( $5.20 \pm 0.15 \text{ mmol.l}^{-1}$ ) were found in children who had been breast-fed for more than 6 months, while the highest concentrations of Apo B ( $0.80 \pm 0.07 \text{ g.l}^{-1}$ ) and Apo A<sub>1</sub> ( $1.76 \pm 0.06 \text{ g.l}^{-1}$ ) and the highest Apo B/Apo A<sub>1</sub> ratio ( $0.45 \pm 0.04$ ) were found in children with the shortest period of breast-feeding. No significant sex-related differences in total, VLDL, LDL, HDL cholesterol, triacylglycerols and apolipoproteins were observed.

## Key words

Lipoprotein profile – Children – Early puberty – Breast-Feeding

## Introduction

The present paper links up with the author's previous findings of a longitudinal study on a group of healthy children, related to the lipid parameters in dependence on the duration of the period of breast-feeding. The last examination performed at the age of 10 years showed increasing serum cholesterol levels in children with the longest duration of breast-feeding (Hromadová *et al.* 1991, Štrbák *et al.* 1993).

The relationship between nutritional factors and lipoprotein homeostasis is still a topical problem, particularly in the light of the increased risk of atherosclerosis development due to elevated levels of cholesterol and atherogenic lipoproteins. Nutrition during the early postnatal period may exert a persisting effect on lipid metabolism (Mott *et al.* 1993) and some studies have reported increased metabolic parameters in adults who had elevated cholesterol and lipoprotein levels in childhood (Kallio *et al.* 1993).

The aim of the present study was to investigate the extent to which the duration of breast feeding can

affect lipid metabolism in the period of early puberty, when sex hormones also become to be involved in lipid metabolism (Hromadová 1985, Stožický *et al.* 1991).

## Subjects and Methods

A group of 76 healthy children (40 boys and 36 girls) was studied longitudinally from birth up to 13 years of age. The children were divided into subgroups according to the duration of the breast-feeding period. Group I (n=13, mean body mass (BM)  $38.92 \pm 2.06 \text{ kg}$ , mean body height (BH)  $148.79 \pm 1.82 \text{ cm}$ ) consisted of children who had not been breast-fed at all or had received maternal milk for the first month of life only. The children in groups II (n=19, BM  $45.34 \pm 1.62$ , BH  $154.87 \pm 1.51$ ), III (n=22, BM  $42.21 \pm 2.05$ , BH  $150.95 \pm 1.71$ ) and IV (n=22, BM  $43.66 \pm 2.23$ , BH  $151.31 \pm 1.70$ ), were breast-fed for the period of 1–3, 3–6 and over 6 months, respectively. At the onset of the study, none of the children had a positive family history of lipid metabolism disturbances.

Serum cholesterol and triacylglycerols were determined enzymatically using commercial kits (Lachema, Brno). Lipoproteins were separated using a combination of the classical ultracentrifugation method (Havel *et al.* 1955) followed by the precipitation technique according to Gidez *et al.* (1982). The concentrations of apolipoproteins (Apo B and Apo A<sub>1</sub>) were determined immunoelectrophoretically (Curry *et al.* 1978).

Different risk ratios were calculated from the values obtained and the occurrence of the highest total and LDL cholesterol values and of the lowest HDL cholesterol concentrations in the individual groups was determined.

Data are presented as means  $\pm$  S.E.M. Differences between means of groups were evaluated by the analysis of variance (ANOVA) procedure and by Duncan's test (Duncan 1955).

**Table 1**

Body mass (kg) and height (cm) of 12 to 13-year-old children with different periods of breast feeding

	Group I	Group II	Group III	Group IV
Number of children	13	19	22	22
Breast feeding (months)	<1	1–3	3–6	>6
Body mass (kg)	38.92 $\pm$ 2.06	45.34 $\pm$ 1.63	42.21 $\pm$ 2.05	43.66 $\pm$ 2.23
Height (cm)	145.79 $\pm$ 1.82	154.87 $\pm$ 1.51	150.95 $\pm$ 1.71	151.31 $\pm$ 1.70

Data are means  $\pm$  S.E.M. No statistical differences were found

**Table 2**

Concentration of total, LDL and HDL cholesterol in children aged 12–13 years

	Cholesterol (mmol.l <sup>-1</sup> )		
	Total	LDL	HDL
All (n=76)	4.89 $\pm$ 0.13	3.10 $\pm$ 0.14	1.65 $\pm$ 0.05
Boys (n=40)	4.85 $\pm$ 0.13	3.13 $\pm$ 0.15	1.67 $\pm$ 0.05
Girls (n=36)	4.93 $\pm$ 0.13	3.08 $\pm$ 0.14	1.64 $\pm$ 0.05

No statistical differences were found

## Results

The body mass and height of the participants in the study (n=76) are summarized in Table 1. No significant differences were observed.

In this group of children no significant sex-related differences were found in the concentration of total cholesterol and in the lipoprotein fractions of LDL and HDL (Table 2). The children, who had been breast-fed for the longest period of time, were found to have the highest total serum cholesterol concentration (Table 3). Significant differences ( $p<0.05$ ) were found between the group of children who had been breast-fed for more than 6 months (group IV) and those breast-fed from 1 up to 3 months (group II). The concentration of Apo B was significantly higher in group I (0–1 months) compared to both group II

(1–3 months) and group III (3–6 months), with significance levels  $p<0.01$  and  $p<0.05$ , respectively. Short-term intake of maternal milk resulted in the highest levels of Apo A<sub>1</sub> and also affected the Apo B/Apo A<sub>1</sub> ratio (Table 3). No significant differences among groups in concentrations of VLDL, LDL and HDL cholesterol and triacylglycerols were found. The children breast-fed for more than 6 months (group IV) had the highest incidence of elevated values of total and LDL cholesterol levels and the lowest incidence of low HDL cholesterol values (Table 4). Despite the differences in individual parameters of lipid metabolism between the groups studied, the evaluation of the risk ratios failed to confirm a pronounced effect of the duration of breast feeding on lipid metabolism (Table 5).

**Table 3**  
Concentration of total (TC), VLDL, LDL and HDL cholesterol, triacylglycerols (TGL), apolipoprotein B and A<sub>1</sub> and ApoB/ApoA<sub>1</sub> ratio in the serum of 12 to 13-year-old children with different periods of breast feeding

	Group I	Group II	Group III	Group IV
TC (mmol.l <sup>-1</sup> )	5.05±0.27	4.66±0.13	4.73±0.19	5.20±0.15
VLDL (mmol.l <sup>-1</sup> )	0.09±0.01	0.13±0.01	0.11±0.02	0.13±0.02
LDL (mmol.l <sup>-1</sup> )	3.34±0.31	2.94±0.13	3.02±0.20	3.30±0.17
HDL (mmol.l <sup>-1</sup> )	1.68±0.08	1.63±0.08	1.61±0.05	1.74±0.07
TGL (mmol.l <sup>-1</sup> )	0.83±0.09	0.75±0.04	0.74±0.06	0.78±0.05
ApoB (g/l)	0.80±0.07	0.66±0.03	0.67±0.03	0.71±0.02
ApoA <sub>1</sub> (g/l)	1.76±0.06	1.62±0.05	1.69±0.04	1.64±0.04
ApoB/ApoA <sub>1</sub>	0.45±0.04	0.40±0.01	0.39±0.01	0.43±0.01

Significant differences: cholesterol -  $p < 0.05$  (group II vs IV); ApoB -  $p < 0.01$  (group I vs II) and  $p < 0.05$  (I vs III); ApoA<sub>1</sub> -  $p < 0.05$  (group I vs II), ApoB/ApoA<sub>1</sub> -  $p < 0.05$  (group I vs III)

**Table 4**

Incidence of the highest values of total (TC) and LDL cholesterol (LDL-C) and lowest values of HDL cholesterol (HDL-C) in 12 to 13-year-old children with a different suckling period

Group	% of children in individual groups			
	I	II	III	IV
TC	> 53 %	42 %	27 %	68 %
LDL-C	> 50 %	46 %	33 %	55 %
HDL-C	< 41 %	53 %	66 %	38 %

**Table 5**

Values of atherogenic risk ratios in children aged 12–13 years with different periods of breast feeding. No significant differences were recorded.

	Group I	Group II	Group III	Group IV
<i>Risk ratio</i>				
Chol(T)-chol(HDL)/chol(HDL)	2.10±0.28	1.94±0.13	1.98±0.15	2.05±0.16
Chol (LDL)/chol (HDL)	2.07±0.26	1.86±0.12	1.90±0.14	1.96±0.16
Chol(HDL).100/chol (T)	33.8±2.40	34.8±1.50	34.7±1.60	33.7±1.30
[chol(T)-chol(HDL)].ApoB/ApoA <sub>1</sub> .chol(HDL)	0.76±0.10	0.82±0.07	0.82±0.07	0.91±0.09

## Discussion

The influence of neonatal feeding on lipid metabolic parameters in later age has not yet been established exactly. The problem can be solved only by

long-term studies of representative series of subjects with different periods of breast feeding. Our group of 76 healthy children was studied from birth and was divided into subgroups according to the duration of the breast-feeding period. The aim of this study was to

investigate children at their present age of 12–13 years and to verify whether at this age, when sex hormones become markedly involved in lipid metabolism (Hromadová *et al.* 1991, Boulton 1994), the differences in some lipid parameters found at earlier examinations (Hromadová *et al.* 1991, Štrbák *et al.* 1993) still persist, or have undergone some changes.

An international comparative study showed similar levels of serum cholesterol for all children on a Western diet, with a mean value of about 4.5 mmol/l for prepubertal age (Knuiman *et al.* 1980, Boulton 1994). Somewhat higher values were reported for the Slovak population (Randušková *et al.* 1987, Hromadová *et al.* 1991, Štrbák *et al.* 1993, Rašlová and Hučková 1995). In the present study of 12 to 13-year-old children, the mean serum cholesterol level was  $4.89 \pm 0.13$  mmol/l. This slightly higher mean value might be explained by the high cholesterol diet of the Slovak population and/or by genetic factors influencing the levels of cholesterol (Poledne *et al.* 1993, Rašlová and Hučková 1995). The highest serum cholesterol concentration in our study was found in children who had been breast-fed for more than 6 months ( $5.2 \pm 0.2$  mmol/l). As the highest concentration of total serum cholesterol was also found in this group at the age of 10 years (Hromadová *et al.* 1991, Štrbák *et al.* 1993) and which still persists, it is possible to predict that this situation is connected with the character of neonatal nutrition. Children with the longest period of breast-feeding had also the highest rate of elevated total and LDL cholesterol values exceeding the calculated mean value for the given age group. With respect to Frederickson's phenotype classification of hyperlipoproteinaemia, these are borderline values and their significance for the further development of the lipid profile is rather questionable. Moreover, only 38 % of these children (group IV) had HDL cholesterol concentrations below the mean value determined for the corresponding age group. Apo B/Apo A<sub>1</sub> ratios and other risk indexes were not significantly changed. However, some studies reported that a childhood cholesterol level above 4.55 mmol/l had a positive predictive value of 47 % for adult

cholesterol levels of 5.2 mmol/l or higher (Stuhldreher *et al.* 1991, Mott *et al.* 1993, Wong *et al.* 1993). Some studies have demonstrated highest mortality rates from ischaemic heart disease in men who had been breast-fed for the longest period (Barker and Martyn 1992, Fall *et al.* 1992).

According to our present findings, it seems that shortlasting breast-feeding (group I) was associated with a significant increase of Apo B. The most marked differences were found between this group and the group of children breast-fed for 1–3 months ( $p < 0.01$ ) and for 3–6 months ( $p < 0.05$ ). Although Apo B has been considered to be one of the risk factors for premature atherosclerosis (Wilcken *et al.* 1993), several authors found that Apo B/Apo A<sub>1</sub> ratio represents the best marker in subjects below the age of 20 years (Widhalm *et al.* 1992, Rašlová and Hučková 1995). In our study, this parameter was highest in the group of children breast-fed for the shortest period of time, despite their high Apo A<sub>1</sub> concentrations.

Based on the longitudinal 13 years follow up study investigating the development of lipid metabolism in children with different periods of breast feeding, the following tentative conclusions could be drawn:

- the mode of neonatal nutrition may to a certain extent affect the lipid profile of children even at the time of puberty;
- the results obtained so far seem to suggest that breast feeding of less than of 6 months would result in an optimal lipid profile;
- only further investigations of the series studied will show whether the found differences will be persistent.

The dietary regimen and life style of the children's families have also to be taken into account, as these factors contribute substantially to the whole lipid metabolism and lipid profile.

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