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Determination of the Lipid Profile of Cord Blood in Neonates and its Correlation with Maternal Age in Iran

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ABSTRACT

Background: Cardiovascular diseases (CVDs) are the leading cause of mortality in Iran; with dyslipidemia as an important contributing risk factor.
Objectives: To assess the early onset of dyslipidemia, our goal was to determine lipids and lipoproteins levels in cord blood and their correlation with maternal age as a first study in Iran.
Patients and Methods: This cross sectional study was done on the cord blood of 243 healthy, full-term newborn infants (114 females and 129 males). The blood was sampled from the umbilical cord immediately after a normal delivery. The serum was tested in order to determine the lipid profile including total cholesterol (TC), triglycerides (TG) and high density lipoprotein-cholesterol (HDL-C). Low density-lipoprotein (LDL-C) was computed by Friedewald equation.
Results: A statistically significant negative correlation was observed between cord blood HDL-C and maternal age ($r = -0.18$, $P < 0.01$). There was no relationship between other lipids and lipoproteins with maternal age. Our findings also showed the TC, TG and LDL-C mean level were significantly more and the mean level of HDL-C was significantly lower than reference value. Additionally, the mean of TC and LDL-C in female neonates were significantly more than the male ($P < 0.01$). Also, there was no correlation between cord blood lipids and lipoproteins with birth weight and maternal body mass index (BMI).
Conclusions: In a current study based on increasing maternal age, the HDL-C level in cord blood was decreased which is an independent risk factor for CVDs in adulthood.

Keywords: Lipid, Lipoprotein, Cord blood, Gender, Maternal Age

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Implication for health policy/practice/research/medical education:
According to the result of this study, we recommend early screening of neonates of mothers with advanced age regarding for lipid profile.

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1. Background

Cardiovascular diseases (CVDs) are the largest single contributor to global mortality and will continue to dominate mortality trends in the future (1). Nowadays, age-adjusted CVDs mortality is higher in major low and middle income countries than in developed countries (2). Atherosclerosis is considered as a major cause of CVDs; it is a process that begins early in life and progresses silently for decades (3). In adults, increased low density lipoprotein cholesterol (LDL-C) and reduced high density lipoprotein cholesterol (HDL-C) levels are associated with atherosclerotic lesion, with its prodromal stages formed early in life (4-6). Children with high level LDL-C at birth might be more liable to high lipoprotein serum levels as they reach adulthood (7, 8). In North America every child over the age of 3 years old has some degree of aortic fatty streaks (9). Extensive epidemiological evidence supports the relationship between both genetic and maternal factors such as hypercholesterolemia, diet, mode of delivery, length of pregnancy and pre-eclampsia with the cord blood lipids and lipoprotein profiles (5, 10-18). Additionally, the fetal life is affected by maternal age (19, 20).

2. Objectives

Since no study has been performed in this regard, our objective was to determine the relationship between lipids and lipoproteins profile in the cord blood of normal full-term newborns in correlation to maternal age.

3. Patients and Methods

This is a cross sectional study on the umbilical cord blood of 243 (114 females and 129 males) normal full-term newborn infants who were delivered vaginally. The subjects were selected from the live born neonates who were delivered in hospitals affiliated with the Ahwaz Jundishapur University of Medical Sciences in Iran. Mothers and neonates with any medical and obstetric complication were excluded from the study. Maternal body mass index (BMI) was computed by the pre-conception and the final weight in pregnancy. The other data was obtained by interview and maternal obstetric records. Gestational age of newborns was between 37-42 weeks and their weight (in grams) was measured using a neonate scale (Seca). Blood was sampled from the umbilical cord immediately following normal delivery. Serum lipids profile including total cholesterol (TC), triglycerides (TG) and high density lipoprotein-cholesterol (HDL-C) measured by an enzymatic method using an autoanalyser (Hitachi, Tokyo, Japan). Low density-lipoprotein (LDL-C) was computed by Friedewald equation (LDL-C = TC − (HDL-C + TG/5)).

3.1. Statistical Analysis

For statistical analysis t-test and analysis of variance (ANOVA) have been used. Additionally, the Pearson correlation test was used for determining the relation between cord blood lipids and lipoproteins with birth weight, maternal BMI and maternal age. The significance level considered as $P < 0.05$.

4. Results

The baseline characteristics of mothers, neonates and cord blood lipid profile are presented in (Table 1). A significant negative correlation was observed between cord blood HDL-C level and maternal age ($r = -0.18$, $P < 0.01$) (Table 2). This correlation remained significant even after adjusting for the pre-conception BMI and parity. Furthermore, there was no correlation between other cord blood lipids and lipoproteins levels with maternal age. Additionally, the mean levels of TC and LDL-C in females were significantly more than the male neonates ($P < 0.01$) and the mean levels of HDL-C and TG were greater in male neonates but the difference was not significant (Table 3). There was no correlation between cord blood lipids and lipoproteins levels with birth weight. Our findings also indicated the mean level of TC, TG and LDL-C were significantly more and the mean level of HDL-C was significantly lower than reference values (Table 4) (21).

Table 1. Characteristics of the Study Population and Cord Blood Lipids and Lipoproteins Levels (n = 243)

	No.	Mean ± SD	Range
Mother			
Maternal age, y	243	24 ± 5.20	14 - 41
Preconception BMI, kg/m²	243	25.90 ± 3.99	16.44 - 38
Pre-delivery BMI, kg/m²	243	27.67 ± 4.04	17.68 - 39.86
Parity at entry		2.32	1-9
1	95		
2	60		
3	44		
> 3	44		
Neonates			
Birth weight ,g	243	3233 ± 418	2150 – 4950
Gender			
Male	129		
Female	114		
Cord Blood Lipids and Lipoproteins			
TC, mg/L		81.02 ± 19.75	40-200
LDL-C, mg/dL		48.92 ± 16.34	11-133
HDL-C, mg/dL		25.09 ± 7.34	15-75
TG , mg/dL		42 ± 29.10	17-300

Abbreviations: BMI, body mass index; HDL, high density lipoprotein; HDL-C, high density lipoprotein cholesterol; LDL, low density lipoprotein; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides

Table 2. Correlation Coefficient between Umbilical Cord Blood Lipid Levels and Maternal Age

Lipid	Correlation coefficient	*P* Value
TC	0.063	0.33
LDL-C	-0.02	0.76
HDL-C	-0.18	0.006
TG	-0.1	0.09

Abbreviations: HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides

Table 3. Comparison of Lipids and Lipoproteins Levels between Subjects and Reference Value

Lipid	Subjects Mean ± SD n = 243	Reference values	*P* Value
TC, mg/dL	81.02 ± 19.75	68	0.0001
LDL-C, mg/dL	48.92 ± 16.34	29	0.0001
HDL-C, mg/dL	25.09 ± 7.34	35	0.0001
TG, mg/dL	42 ± 29.10	34	0.0001

Abbreviations: HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides

Table 4. Comparison of Lipids and Lipoproteins Levels According to Gender

Lipid	Male Mean ± SD	Female Mean ± SD	*P* Value
TC, mg/dL	78.17 ± 18.44	84.26 ± 20.74	0.016
LDL-C, mg/dL	46.20 ± 15.46	51.94 ± 16.92	0.007
HDL-C, mg/dL	25.27 ± 8.54	24.89 ± 5.73	0.691
TG, mg/dL	42.28 ± 32.75	41.67 ± 24.46	0.871

Abbreviations: HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides

5. Discussion

The lipids and lipoproteins levels in the maternal blood increase appreciably during pregnancy (23). Despite this variation, the TC, TG, and lipoproteins levels in the cord blood are lower than in adults and the relative proportion present in HDL-C as opposed to LDL-C is much higher (24-28). Evidence has shown that the maternal lipid levels are affected by maternal factors such as BMI, maternal weight gain, diet, pre-pregnancy lipid levels, parity, mode of delivery and various medical complications of pregnancy that may have significant impacts on lipid metabolism and plasma levels (13, 14, 17, 23, 29, 30). This change to maternal lipoprotein levels could influence cord blood lipid levels (30). In the present study, all the subjects had an uncomplicated pregnancy and a normal vaginal delivery. In our findings, the mean of TC, LDL-C and TG levels were significantly higher and the mean level of HDL-C was significantly lower than the previous studies (28, 31). Also the mean levels of TC, LDL-C were significantly higher and the mean levels of TG and HDL-C were significantly lower than the study in the center of Iran by Kelishadi and et al. (Table 5) (22). The intake of high calorie foods during pregnancy (particularly saturated fats) could induce maternal hypercholesterolemia; which may have an effect on the lipid metabolism of the fetus (10, 12, 32). Additionally, in the Iranian population, the mean of cholesterol consumption was high (about 500mg/day), and also the mean of TC levels, particularly in females, was higher (210 ± 10 mg/dL) than in previous studies (33, 34). The pattern of lipid profiles in the cord blood of the study group may be due to the intake of fat-laden foods by mothers in this community.

Table 5. Comparison of Lipids and Lipoproteins Levels between Subjects and Kelishadi Study with Reference Values(22).

Lipid	Subjects Mean ± SD n = 243	Reference values	Kelishadi Mean ± SD n = 322
TC, mg/dL	81.02 ± 19.75	68	76.9 ± 28.9
LDL-C, mg/dL	48.92 ± 16.34	29	34.1 ± 11.7
HDL-C, mg/dL	25.09 ± 7.34	35	30.1 ± 9.4
TG, mg/dL	42 ± 29.10	34	67.5 ± 20.1

Abbreviations: HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglycerides

We also demonstrated a negative correlation between maternal age and HDL-C in the cord blood, a pattern that has not been shown in previous studies. During the last 3 decades, there has been an increasing trend toward delayed childbearing among women in the developed and developing world (19). Pregnant women aged 35 years or older experience an increased risk of complications in pregnancy as compared to younger women (35). Former studies reported that pregnancy causes adverse effects on the maternal HDL-C level (29, 36-38), but we did not find any study regarding relationship of parity and lipid profile in cord blood. Although the parity was higher in older women compared with women who were younger, the highest occurrences of most of obstetric and fetal complications were significantly higher among older multiparas(39). Moreover, it is known that aging is a significant factor affecting changes in the lipid profile. It seems that the higher maternal age might have an independent effect on the HDL-C level in cord blood.

Gender differences in lipid profile have been demonstrated repeatedly in adults (40, 41). This is also noticeable in children (42). There are several studies which demonstrated these differences are already apparent at

birth (22, 31). These studies showed that TC, HDL-C, LDL-C and TG levels have been higher in female versus male neonates (43). Our findings also revealed that the mean of TC and LDL-C in females were significantly more than male neonates. We found a significant negative correlation between maternal age and HDL-C level in cord blood. This finding may have negative implications on future cardiovascular health. However, determination of this relation needs to be explored in future longitudinal studies. Lipid profile has been determined in the cord blood of normal neonates and can be used as reference values for future studies.

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