

Research article

Umbilical cord serum lipid profile of healthy neonates- A single center study from rural Tamil Nadu, IndiaNarayanaswamy A. G.¹, Meenakshi. K.¹, Porchelvan S.², Vinoth Kumar J.¹, Bavya S.³, SharanyaShre E.S.⁴¹Department of Cardiology, ²Department of Biostatistics, ³Department of Obstetrics and Gynecology, Saveetha Medical College and Hospital, Thandalam, Chennai 602105, Tamil Nadu, India⁴Dr. VRE Research Laboratories, 1026, 76th Street, 12th Sector, K. K. Nagar, Chennai 700078, Tamil Nadu, India

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Corresponding author: A.G. Narayanaswamy. Email: agncard@yahoo.co.in

ABSTRACT

Introduction and Aim: Umbilical cord lipid profile of neonates might help facilitate the assessment of risk of developing atherosclerotic disorders later in life. This study prospectively measures the cord blood lipid profile of healthy newborn at birth in medical college hospital in rural Tamil Nadu.

Materials and Methods: Consecutive full-term newborns (n=105) were enrolled for this study. Umbilical cord blood sample was collected from placental end of the cord immediately after delivery of placenta of each baby and sent to the lab for lipid profile estimation.

Results: In the newborns born to non-diabetic mothers, the mean cord blood total serum cholesterol (TC) was 73.31mg %, triglyceride (TGL) was 51.50mg %, high-density lipoproteins (HDL) 24.62 mg % and low-density lipoproteins (LDL) 51.73 mg %. Amongst newborns born to diabetic mothers, the mean TC was 113 mg % (P = 0.001), TGL 98.08mg% (P = 0.045) HDL 28.75 mg% (P = 0.130) LDL 73.48mg% (P = 0.007). Umbilical cord blood lipid profile did not show any significant sex-dependent difference. There was no statistical difference in lipid values between appropriate for gestational age (AGA) and small for gestational age (SGA). Birth weight had a negative correlation to cord blood serum TC and TGL values and showed no correlation to HDL and LDL values. Other parameters including head circumference, length of newborn at birth also showed no correlation to lipid profile. Total cholesterol, TGL and LDL were significantly elevated in newborns born to diabetic mothers. There was no statistical difference in cord blood lipid profile of babies born to mothers who were hypertensive.

Conclusion: Infants born to diabetic mothers tend to have significantly elevated lipid values at birth and must be followed regularly later in life to diagnose and treat dyslipidemia and diabetes, to prevent onset of premature atherosclerotic coronary artery disease in this population.

Keywords: Cord blood lipid; neonates; diabetic mothers.

INTRODUCTION

The pathogenesis of atherosclerosis has been described to begin early in life if the newborns have a high lipid concentration in the blood (1). Additionally, it is observed that babies who are born pre-term may have an increased risk of developing coronary artery disease later in their life (2-5). In general population, the serum levels of total cholesterol (TC), triglycerides (TGL) and its subtypes-LDL (Low-density lipoprotein) and HDL (high density lipoprotein) have been widely studied and documented. Normal values have been established in both adults and children in developed countries (3,6). However, specific to full-term newborns, several studies have reported a wide variation in the estimates of cord blood lipid values (2, 7-10). These varying estimates are not in alignment with the international reference standard. Despite these observations, such studies measuring cord blood lipid values are scarce for newborn infants in developing countries. Hence, standard cord blood

lipid values in neonates are not available, especially for the rural Indian population. Given the fact that India's rural population is far higher than urban and the increasing trend in the prevalence of atherosclerotic coronary artery disease in the rural population, it is essential to have plans to decrease the incidence(11). This will facilitate implementation of measures to enhance awareness, instituting preventive healthcare to monitor children with hyperlipidemia throughout their adult life and to take proactive healthcare measures. The aim of this study is to measure the umbilical cord blood lipid levels of newborn at birth. The lipid profiles are evaluated for any correlation with mother's status of diabetes and hypertension compared to a control group of normal healthy mothers.

MATERIALS AND METHODS

A prospective observational study, conducted during a period of three months from (July 2020, to October 2020) in a total of 105 full-term neonates delivered normally or by LSCS (Lower segment cesarean

section) in a medical college hospital in rural Tamil Nadu. This study was approved by the Institutional Ethics Committee of Saveetha Medical College hospital. The nature of the study was explained in appropriate native language to the respective mothers of the included newborns prior to obtaining an informed written consent.

Birth weight of the naked baby was measured within two hours of delivery to an accuracy of ± 0.1 kg. The crown to heel length was measured using an infant meter to the nearest 0.1cm. BMI (body mass index) was calculated as $\text{weight(kg)} / \text{height (cm}^2\text{)}$. Maturity was assessed by the New Ballard Scale at birth and was also correlated with the first trimester dating scan of mother.

Inclusion criteria

All pregnant ladies enrolled in the antenatal clinic of the hospital.

All consecutive full-term newborns delivered in the hospital.

Exclusion criteria

Pregnant ladies not enrolled in the antenatal clinic of the hospital were excluded. All neonates who were not diagnosed to be full-term at birth were excluded from the study.

Blood sample collection

Cord blood sample was collected from the placental end of the umbilical cord immediately after delivery of placenta of each baby. Five ml of blood was drawn using a syringe and 23G needle, collected into a clear bottle and was allowed to clot. The details of each full-term baby including the name, identity details (IP no.) of the mother, mode of delivery, presence and duration of maternal diabetes or hypertension, neonatal anthropometric data and maturity assessment were tabulated on a Microsoft excel sheet.

Outcome measures

Lipid profile estimation of the cord blood was done using standard methods followed in the clinical biochemistry laboratory of Saveetha Medical College hospital. Briefly, TC and TGL were measured by cholesterol oxidase- peroxidase and glycerophosphate oxidase- peroxidase enzymatic method using Vitros 5600 Integrated dry chemistry fully automated analyzer. HDL- cholesterol were measured after precipitation of non-high lipoproteins with Phosphotungstic acid (PTA) and magnesium chloride (MgCl_2). LDL- Cholesterol, VLDL- cholesterol was calculated using Friedwald's formula(12).

Statistical analysis

Statistical analysis was performed using SPSS software version 16.0. Continuous data were expressed as mean \pm standard deviation (SD). The student's t-test and Mann-Whitney test were applied for comparison of mean values wherever appropriate. The relationship between cord blood lipid profile, and birth weight and gestational age was determined by the Mann Whitney regression test. Spearman correlation coefficient was used to find a correlation between these variables. The significance level was set at $\alpha = 0.05$.

RESULTS

Most newborns (n=80) 76.27% were delivered by LSCS. The age of the mother varied between 18 to 35 years with a mean age of 26.05 years. Diabetes was diagnosed in ten pregnant women during the first month of their pregnancy and in two women during the last two months prior to delivery. Only one pregnant woman had been diagnosed to be hypertensive prior to pregnancy and was on medications. Ten (9.5%) of the pregnant mothers experienced pregnancy induced hypertension.

Influence of child specific parameters on the cord lipid profile

The mean birth weight of these newborn was 2.89 kg (1.11 kg to 4.17 kg). There is an inverse correlation observed between birth weight and the cord blood levels of TC and TGL (Fig. 1 and 2). The other lipid parameters such as HDL and LDL did not show any significant variation with birth weight (Fig. 3 and 4). The sex of the newborn, BMI or length or head circumference of the neonates did not seem to have any major influence on the cord blood lipid blood profile of the neonates (Fig. 5 and Table 4).

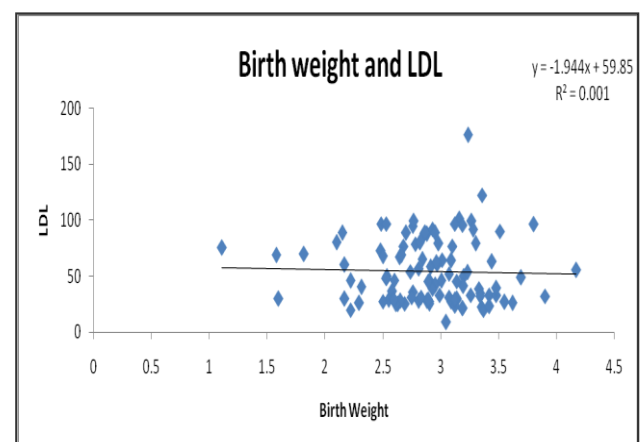


Fig. 1: Birthweight has no correlation with serum low density lipoprotein

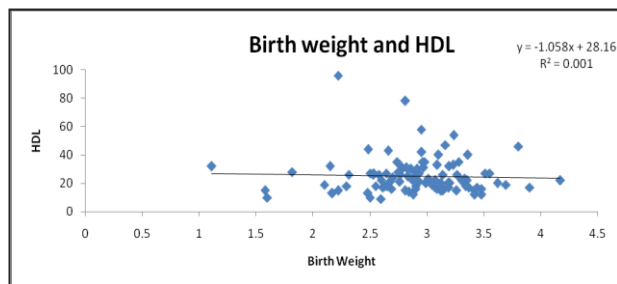


Fig.2: Birth weight has no correlation with Serum high density lipoprotein

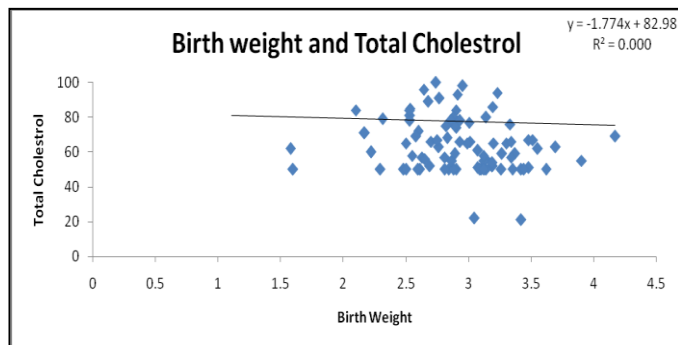


Fig. 3: Birth weight is inversely related to cord blood cholesterol values

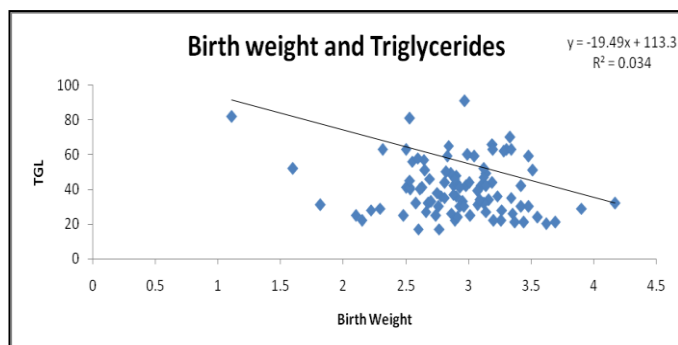


Fig.4: Birth weight is inversely related to cord blood TGL values

Comparing the cord lipid profiles of neonates born to mothers less than or more than 26 years of age did not indicate a statistically significant difference on the influence of the mother's age on cord blood profiles

Influence of mother specific parameters on the cord lipid profile

Incidence of diabetes amongst pregnant mothers had shown influence on lipid parameters (Fig. 6). Significantly higher levels of TC (113 ± 51 ; $P=0.001$), TGL (98 ± 70 ; $P=0.045$) and LDL (73 ± 27 ; $P=0.007$) were noted in the neonates born to mothers who were diabetic during their pregnancy compared to neonates born to non-diabetic mothers (Table 1). HDL values did not vary significantly with the diabetic status of the pregnant mothers (Table 2). Hypertension that was diagnosed in ten mothers who were not diabetic during the last two months of pregnancy did not influence the umbilical cord blood lipid profiles of the neonates (Table 3). A similar effect of diabetes was observed in the two mothers who had pregnancy induced hypertension and diabetes with statistically significant difference in the umbilical cord blood profiles of the neonates.

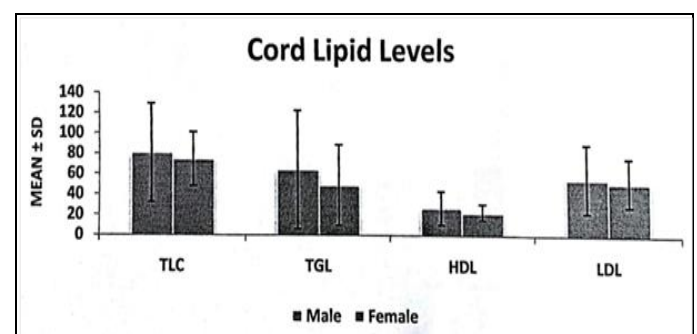


Fig. 5: Gender-wise cord blood lipid values in newborn

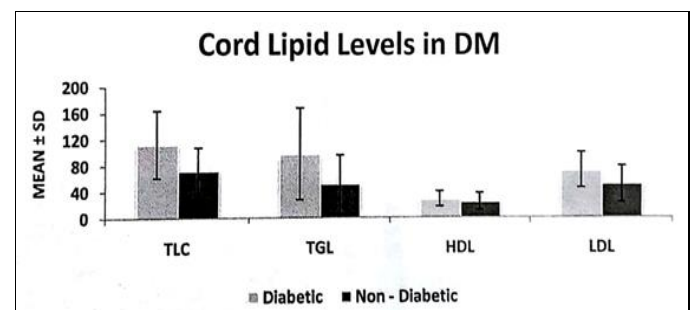


Fig. 6: Cord blood lipid values in neonates born to diabetic mothers

Table1: Lipid levels in neonates born to non- diabetic and diabetic mothers

Parameters	Non-Diabetic mothers (n = 93) Mean \pm SD (mg%)	Diabetic mothers (n= 12) Mean \pm SD (mg%)	p-value
TC	73.31 \pm 34.629	113 \pm 51.204	.001**
TGL	51.53 \pm 44.614	98.08 \pm 70.541	.045*
HDL	24.62 \pm 12.983	28.75 \pm 11.585	.130
LDL	51.731 \pm 28.0584	73.483 \pm 27.2646	.007**
VLDL	15.062 \pm 9.4479	16.900 \pm 12.0500	.706

*, ** indicates statistical significance at $p < 0.05$ and $p < 0.01$, respectively.

TC- Total cholesterol; TGL- serum triglycerides; HDL- high density lipoprotein; LDL- low density lipoprotein; VLDL- Very low-density lipoprotein; SD- Standard deviation

Table2: Lipid level in neonates small for gestational age (SGA) and appropriate for gestational age(AGA)

Parameters	SGA (n=16) Mean \pm SD (mg%)	AGA (n= 89) Mean \pm SD (mg%)	p-value
TC	79.81 \pm 35.85	77.49 \pm 39.39	0.775
TGL	91.25 \pm 80.47	50.66 \pm 40.06	0.170
HDL	25.69 \pm 21.09	24.99 \pm 10.91	0.257
LDL	56.24 \pm 24.76	53.85 \pm 29.45	0.640
VLDL	19.93 \pm 12.31	14.43 \pm 9.01	0.074

TC- Total cholesterol; TGL- serum triglycerides; HDL- high density lipoprotein;
LDL- low density lipoprotein; VLDL- Very low-density lipoprotein; SD- Standard deviation

Table3: Maternal hypertension has no correlation with lipid levels

Lipid parameter	Prevalence of Hypertension (n)	Mean \pm SD	p-value
TC			
Yes	11	90.73 \pm 39.96	.105
No	94	76.34 \pm 38.51	
TGL			
Yes	11	71.73 \pm 60.04	.470
No	94	55.11 \pm 48.86	
HDL			
Yes	11	24.82 \pm 9.79	.785
No	94	25.13 \pm 13.20	
LDL			
Yes	11	65.31 \pm 26.39	.068
No	94	52.92 \pm 28.80	

TC- Total cholesterol; TGL- serum triglycerides; HDL-high density lipoprotein;
LDL- low density lipoprotein

Table 4: Anthropometry at birth has no correlation with cord lipid levels

Anthropometry (n= 105)	TC	TGL	HDL	LDL
Length at birth				
Correlation Coefficient	-.109	-.103	-.098	-.120
P-Value	.127	.146	.169	.087
Head Circumference at birth				
Correlation Coefficient	-.145	-.157	-.002	-.024
p-Value	.533	.424	.975	.739

TC- Total cholesterol; TGL- serum triglycerides; HDL- high density lipoprotein;
LDL- low density lipoprotein; Correlation is significant at the 0.01 level (2- tailed)

DISCUSSION

In this prospective, observational study conducted in 105 neonates, we have obtained estimates for umbilical cord blood lipid levels in neonate population of rural India. Further, we have identified mother's diabetic status to influence the cord blood lipid profiles.

In our study the mean TC, TGL and LDL were significantly elevated in neonates born to diabetic mothers. In coherence with the results from previous

studies (2,7,13), HDL levels, though elevated, does not seem to vary significantly with the diabetic status of the mothers. Another study (2) observed significantly elevated levels of LDL in infants of diabetic mothers ($P < 0.05$). Fordyce *et al.*, (7) found higher levels of LDL and lower levels of HDL in newborn of diabetic mothers with no significant difference in the serum TGL between the two groups.

In our study the mean TC was 73.31mg%, like those reported by other studies from India (5,14). Few other studies have reported values of TC ranging

from $64 \pm 19\text{mg\%}$ (15) to $105.6 \pm 17\text{mg\%}$, respectively (3). The mean TGL reported in our study is 51.53mg\% . This falls within the median range of low (33mg\% and 42mg\%) (3) and high values (67.5mg\% , 81.4mg\%) (2) reported by other studies. While a study from Nigeria, the cord blood TGL was 22mg\% and LDL was 39.4mg\% , values much lower than our study (8), higher TGL levels were reported in Iranian newborns (9,10). The high TGL in these studies has been partly attributed to a high prevalence of vitamin D deficiency (9,10). The values of HDL and LDL in our study were like the reported values by other studies (5,16). The characteristics of the child including sex, BMI, head circumference does not seem to influence the cord blood lipid profile. Similar observations were noticed in Nigerian neonates (8). Birth weight has an inverse correlation with the TC and TGL levels (Fig. 3 and 4). However, the HDL and LDL values had no correlation to birth weight (Figs. 1 and 2).

There is no statistical difference in the lipid profile values between the neonates who were AGA (appropriate for gestational age) or SGA (small for gestational age) (Table 2) in our study. In the literature, there has been mixed observations regarding these findings. Diaz *et al.*, found that SGA babies are more often hyperglyceridemic and hypercholesteremic when compared to AGA (17). Study by Magon *et al.*, found that TC was significantly low in SGA babies when compared to AGA ($P < 0.05$) (18). Other lipid values except HDL were found to be lower though not statistically significant. Our cord blood lipid values for SGA were like the study by Gupta *et al.*, (19). This is different to the findings from the study by Lobo *et al.*, (20), (SAGA- ACT study) where they found significantly higher levels of TC, TGL and LDL in SGA babies (17).

Although the current study has its limitations pertaining to small sample size and assessment of few biochemical parameters, it provides estimates of cord blood lipid levels in a real-life setting of a rural population in India. The study measures in detail the TC, TGL, LDL, HDL in neonates from rural India. This study could bring to attention that gestational diabetes prevailing amongst rural pregnant women and the associated lipid abnormalities are observed in neonates born to these mothers, making them potentially carry an elevated risk for atherosclerosis right from an early age. There is an urgent need to follow up such children longitudinally over the decades and to take proactive early lifestyle modification measures.

CONCLUSION

Maternal diabetes including pregnancy induced diabetes rather than the parameters of the child at birth, seems to contribute to elevated cord blood lipid

profiles in newborns. Therefore, neonates born to diabetic mothers must be monitored regularly for dyslipidemia throughout their life. This awareness could help prevent or minimize the onset of premature atherosclerotic coronary artery disease in our rural population.

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CONFLICT OF INTEREST

Authors declare that there is no conflict of interest for this study.

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