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ORIGINAL ARTICLE

Assessment of Serum Lipid Profile in Infants of Diabetic Mothers

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ABSTRACT

Background: Diabetes mellitus is a serious condition that affects lipoprotein metabolism and fetal growth. Diabetic mothers' lipid profiles can change, resulting in multi-system problems and influencing their prognosis. **Aim:** This study aimed to measure the serum lipid profile in infants of diabetic mothers and their mothers and assess their relations to Infant of diabetic mother (IDM) complications if present. **Methods:** This study was a case-control study conducted in the neonatology unit of the Pediatrics Department at Zagazig University Children's Hospital and Obstetric Departments. It was conducted on 30 infants (15 IDM and 15 normal babies included as a control group) and their mothers (15 IDM mothers and 15 normal mothers). All patients had a thorough history-taking process for mothers as well as a full clinical examination, Laboratory investigations for both mothers and neonatal (case and control groups) included Serum lipid profile, Triglycerides, and Cholesterol. **Results:** There was a statistically significant increase in the mean weight of infants of diabetic mothers compared to infants of normal mothers. There was an increase in mean LDL, Cholesterol, and TG among diabetic mothers compared to normal mothers but with no statistically significant differences. There was a statistically significant increase in low-density lipoprotein (LDL), cholesterol, and triglyceride in diabetic mothers compared to infants of normal mothers. **Conclusions**: Serum cholesterol, triglycerides, and LDL levels are higher in diabetic mothers which may be reflected in the metabolism and growth of the fetus. **Keywords:** Diabetes mellitus; Lipid Profile; Infant of diabetic mother

INTRODUCTION

Infants of diabetic mothers (IDMs) are thought to be at high risk for microvascular and macrovascular disorders, delivery trauma, tachypnea in neonates, RDS, and jaundice **[1]**.
Variations in the growth hormone/insulin-like growth factor-1 axis are among the risk factors for heart disease. Growth hormone over- and under-secretion are also thought to raise the risk of cardiovascular illnesses **[1].**

Macrosomia is the primary consequence of diabetes on the developing fetus. In this instance, the hyperglycemia of the mother causes an increase in the fetal insulin level. IDM is characterized by fetal defects such as sacral agenesis, renal dysplasia, and short left colon syndrome, as well as macrosomia, plethora, neonatal hypoglycemia (25–50%), neonatal hypocalcemia, polycythemia (30%), neonatal jaundice, and cardiomegaly (30%) resulting from ventricular septal hypertrophy) **[2].**

Adverse maternal or newborn outcomes are linked to gestational diabetes mellitus (GDM). The risk of birth deformities, premature births, macrosomia, congenital defects, preeclampsia, hypertension, and cesarean deliveries are among these unfavorable consequences. Congenital abnormalities account for 6–10% of cases in IDM. Lipid profile alteration is also thought to happen in GDM. Women with GDM are significantly more likely to have long-term morbidity and mortality from cardiovascular diseases **[3].**

Macrosomic babies may exhibit hypertriglyceridemia and high levels of very low-density lipoprotein (VLDL) due to changes in glucose and lipoprotein levels brought on by the mother's diabetes mellitus **[4]**.

Macrosomia at birth and elevated lipoprotein levels that may persist after delivery are associated with anomalies in lipoprotein composition and concentration, which are responsible for adult atherosclerosis and diabetes **[1].**

Since lipoprotein lipase (LPL) converts most VLDL to LDL, elevated levels of low-density lipoprotein (LDL) are also seen in macrosomic newborns **[5].**

Adult atherosclerosis's clinical manifestations have their origins in childhood and are linked to early atheromatous changes in the aorta. Advances in technology and sonography can now identify early vascular changes linked to atherosclerosis in peripheral vessels **[6].** This study aimed to measure the serum lipid profile in infants of diabetic mothers and their mothers and assess their relations to Infant of diabetic mother (IDM) complications if present.

METHODS

This case-control study was carried out at the Neonatal Intensive Care Unit of Pediatrics, Maternity Emergency Hospital in Zagazig University Hospitals, between January 2019 to March 2020. The inclusion criteria were for Mothers Diabetic mothers (Type 1, type 2, gestational diabetes), For Newborns; Newborns full term (37- 41) weeks, both males and females delivered either vaginal or cesarean sections, admitted to the hospital in the first 3 days of life, no oral feeding for 6 hours.

Exclusion criteria for Mother's history of diseases other than diabetes mellitus, for Newborns: Preterm (< 37 weeks), out of range (beyond the first three days of life), refusal of parents to share in the study, multiple congenital anomalies.

Methodology:

All patients had a thorough history-taking process for mothers including maternal age, blood group, multiparty, nutritional state, maternal disease during pregnancy, type of diabetes, controlled or not, last HBA1C, maternal drug intake, maternal infection during pregnancy, history of trauma or antenatal hemorrhage, antenatal follow up and serology. Family history consanguinity, order in family previous sibling stillbirth or sibling with congenital anomalies.

Mode of delivery, place of delivery complicated or not, premature rupture of membranes (PROM), oligohydramnios or polyhydramnios, outcome of pregnancy, gestational age, weight at birth.

Post-natal need for resuscitation, active, pink, pallor, bleeding, seizures.

Detailed clinical examination of Mothers; Vital signs, Weight, body mass index (BMI), Age.

Neonates; estimation of gestational age. Anthropometrics measurement, Vital signs.

Detailed systemic examination (chest, heart, abdomen, neurological), Head, neck, back, and genitalia examination.

Laboratory investigations for neonates Routine Labs, CBC (complete blood count), C - reactive protein, liver function test, kidney function test, serum electrolytes, total serum bilirubin, random blood sugar and follow up.

For mothers; HBA1C

For both mothers and neonatal (case and control groups) included Serum lipid profile, very low density lipoprotein VLDL, high density lipoprotein HDL, LDL, Triglycerides, Cholesterol.

Triglyceride investigation material, Triglyceride–Gpo. HDL investigation material -HDL-cholesterol. Cholesterol investigation material Cholesterol.

A spectrophotometer (PD–303, Apel, Japan) with a 500 nm wavelength was used to quantify cholesterol. first using distilled water to calibrate the measurements. The same technique used for measuring cholesterol was also used to measure TG. In order to calculate HDL, we combined 50µl of the HDL material with 1/2 milliliter of the neonates' serum in a test tube and allowed it to sit for 10 minutes. After calibrating the device with distilled water and replacing the blank with 1 milliliter of the cholesterol substance, the result was multiplied by the same cholesterol factor.

Ethics Considerations:

This study was ethically approved by the Institutional Reviewer Board (IRB #4450) in the Faculty of Medicine, Zagazig University Hospital, and parental consent from every case of their caregivers that participated in this research was taken. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

The Statistical Program for Social Science (SPSS) (version 24) was used to code, enter, and process the data on a computer. Following tabular and diagrammatic representation of the data, the results were interpreted. We used the following descriptive statistics: mean, standard deviation, range, frequency, and percentage. The association variables for categorical data were tested using the Chi-Square Test X². The statistical significance of the difference between two population means in a study including independent samples was evaluated using the Student's t-test. The p-value was considered P-value ≤ 0.05 significant.

RESULTS

Table 1; showed that there was statistical significant increase in age and BMI of diabetic mothers compared to normal mothers. There was no statistical significant difference between diabetic mothers and normal mothers in mode of delivery.

Table 2; showed that 66.7% of the studied diabetic mothers had gestational diabetes and 80% of them control it (mean HbA1c was 6.19%).

Table 3; showed that there was increase in mean LDL, Cholesterol and TG among diabetic mothers compared to normal mothers but with no statistical significant difference.

Table 4; showed that there was no statistical significant differences between infants of diabetic mothers and infants of normal mothers in CBC results. But there was a statistical significance decrease in random blood sugar RBS of infants of diabetic mothers compared to infants of normal mothers.

Table 5; showed that there was no statistical significant difference between infants of diabetic mothers and infants of normal mothers in any of laboratory findings.

Table 6; showed that there was a statistical significant increase in LDL, cholesterol and triglyceride of infants of diabetic mothers compared to infants of normal mothers.

Table 7; showed that there were +ve significant correlations between infant weight and the infant's cholesterol and TG and with the mother's age and HbA1c. There were also significant correlations between infant LDL and both the infant's TG & cholesterol. Finally, there was a significant correlation between an infant's TG & cholesterol.

Among neonatal cases, we found two congenital cardiac diseases (PDA and HOCM (hypertrophied cardiomyopathy), two cases of RDS (respiratory distress syndrome), and two cases of GI malformations (bowel atresia and meningomyelocele). Despite the presence of congenital anomalies among IDM cases, the collected data of this study reported that there was no statistically significant difference between both groups (p>0.05). This finding most probably is due to the small sample size.

Table (1) Demographic data of the maternal groups:

Variable	Diabetic mothers (n=15)		Normal mothers (n=15)		T	P
Age: (year) Mean ± SD Range	32.80 ± 5.10 25 – 42		28 ± 7.05 18 – 40		2.14	0.04*
Weight: (Kg) Mean ± SD Range	78.33 ± 11.72 63 – 100		74.73 ± 7.53 67 – 90		1.00	0.33 NS
BMI: (Kg/m^2) Mean ± SD Range	30.07 ± 3.88 24.4 – 36.9		27.58 ± 2.53 23.70 – 31.1		2.08	0.04*
	Diabetic mothers (n=15)		**Normal mothers (n=15)**		**χ2**	**P**
	N	**%**	**N**	**%**		
Mode of delivery: **CS** **NVD**	12 3	80 20	12 3	80 20	0	1 NS

Sd: Standard deviation t: Independent t test *: Significant ($P<0.05$) $\chi 2$: Chi square test
NS: Non significant ($P>0.05$)

CS: cesarean section BMI: body mass index NVD: normal vaginal delivery

Table (2) Types of diabetes among the diabetic maternal group:

Variable	Diabetic mothers (n=15)	
	N	%
Type of diabetes: **Known diabetic:** **Type I diabetes Type II Diabetes-** **Gestational diabetes**	5 2 3 10	33.3 13.3 12 66.6
Control: **Controllable Uncontrollable**	12 3	80 20
HbA1c: (%) **Mean ± SD Range**	6.19 ± 0.83 5 – 8	

***HbA1: glycosylated hemoglobin HDL: high-density lipoprotein LDL: low-density lipoprotein**

Table (3) Lipid profile of the maternal groups**:**

Variable	Diabetic mothers (n=15)	Normal mothers (n=15)	Test	P
HDL: (mg/dl) Mean ± SD Range	40.20 ± 7.92 31 - 56	41.40 ± 10.93 28 – 59	t 0.34	0.73 NS
LDL: (mg/L) Mean ± SD Range	105 ± 23.31 50 - 142	97.17 ± 28.67 39.5 - 135	t 0.82	0.42 NS
Cholesterol: (mg/dl) Mean ± SD Range	175.13 ± 50.85 193(80 – 273)	158.73 ± 46.35 180(82 – 213)	t 0.92	0.36 NS
Triglyceride:(mg/dl) Mean ± SD Median (Range)	188.47 ± 95.81 188(84 – 498)	168.4 ± 44.06 180(83 – 220)	MW 0.19	0.85 NS

Sd: Standard deviation t: Independent t-test MW: Mann Whitney test NS: Nonsignificant ($P>0.05$)
HDL: high-density lipoprotein LDL: low-density lipoprotein

Table (4) Random blood sugar and Complete blood count of the infants of diabetic mothers and infants of normal mothers:

Variable	Infants of Diabetic mothers (*n*=15)	Infants of normal mothers (n=15)	T	P
RBS*: (mg/dl) *Mean ± SD* *Range*	88.93 ± 32.08 24 - 123	112.13 ± 19.24 86 - 154	**2.40**	**0.02***
Hb: (gm/dl) *Mean ± SD* *Range*	15.73 ± 1.98 13 - 20	15.2 ± 1.78 12 - 18	0.78	0.45 NS
WBCs: ($x10^3/mm^3$) *Mean ± SD* *Range*	10.93 ± 1.91 9 - 15	10.73 ± 1.58 8 – 13	0.31	0.76 NS
Platelets: ($x10^3/mm^3$) *Mean ± SD* *Range*	212.33 ± 54.54 150 - 320	230.33 ± 55.05 160 - 350	0.90	0.38 NS

Sd: Standard deviation t: Independent t-test NS: Nonsignificant (P>0.05) *: Significant (P<0.05)

RBS: Random blood sugar CBC: Complete blood count

Table (5) Laboratory findings among the infants group:

Variable	Infants of Diabetic mothers (*n*=15)		Infants of normal mothers (n=15)		χ^2	P
	N	%	N	%		
CRP: *-ve* *+ve*	15 0	100 0	12 3	80 20	3.33	0.07 NS
Electrolyte: *Normal* *Abnormal*	13 2	86.7 13.3	14 1	93.3 6.7	0.37	0.54 NS
KFT*: *Normal* *Abnormal*	15 0	100 0	15 0	100 0	0	1 NS
LFT*: *Normal* *Abnormal (High TSB)*	15 0	100 0	12 3	80 20	3.33	0.07 NS

χ^2: Chi-square test NS: Non-significant (P>0.05) *: Significant (P<0.05)
*KFT: kidney function test. *LFT: liver function test. *CRP: c reactive protein

Table (6) Lipid profile of the infants groups:

Variable	Infants of Diabetic mothers (*n*=15)	Infants of normal mothers (n=15)	Test	P
HDL: (mg/dl) *Mean ± SD* *Median (Range)*	36.87 ± 6.83 28 – 51	37.67 ± 11.04 22 - 51	T 0.24	0.81 NS
LDL: (mg/L) *Mean ± SD* *Median (Range)*	100.8 ± 32.42 104 (48 – 155)	75.47 ± 29.01 77 (30 – 106)	**MW** **2.01**	**0.04***
Cholesterol: (mg/dl) *Mean ± SD* *Median (Range)*	176.60 ± 25.88 133 – 221	141.93 ± 41.41 71 - 188	**T** **2.75**	**0.01***
Triglyceride: (mg/dl) *Mean ± SD* *Median (Range)*	140.93 ± 41.88 90 – 200	110.13 ± 29.01 58 - 177	**T** **2.34**	**0.03***

Sd: Standard deviation MW: Mann Whitney test t: Independent t-test NS: Nonsignificant (P>0.05)
*: Significant (p<0.05) *LDL: low-density lipoprotein *HDL: high-density lipoprotein

Table (7): Correlation between infant weight and lipid profile and different parameters of the studied groups:

Variable		Infant weight	Infant HDL	Infant LDL	Infant Cholesterol	Infant TG
Infant HDL	**r**	0.054	----	-0.048	0.104	-0.073
	P	0.775	----	0.802	0.584	0.700
Infant LDL	**r**	0.211	-0.048	----	0.359	0.396
	P	0.263	0.802	----	0.045*	0.029*
Infant Cholesterol	**r**	0.381	0.104	0.359	----	0.573
	P	0.039*	0.584	0.045*	----	<0.001**
Infant TG	**r**	0.446	-0.073	0.396	0.573	----
	P	0.014*	0.700	0.029*	<0.001**	----
Mother Age	**r**	0.375*	0.280	0.109	0.263	0.437*
	P	0.041	0.133	0.565	0.160	0.016
Mother BMI	**r**	0.379	-0.139	0.086	0.133	0.285
	P	0.034*	0.464	0.651	0.485	0.127
Mother HBA1C	**r**	0.361	-0.055	0.196	0.245	0.237
	P	0.044**	0.847	0.485	0.378	0.395

Variable		Infant weight	Infant HDL	Infant LDL	Infant Cholesterol	Infant TG
Mother HDL	**r**	-0.086	0.088	-0.280	-0.192	0.208
	P	0.652	0.644	0.138	0.321	0.270
Mother LDL	**r**	-0.077	0.049	0.032	0.041	0.149
	P	0.687	0.798	0.867	0.831	0.432
Mother Cholesterol	**r**	0.261	-0.075	-0.072	-0.003	0.200
	P	0.163	0.694	0.707	0.985	0.289
Mother TG	**r**	0.023	-0.015	-0.021	-0.002	0.190
	P	0.906	0.935	0.913	0.993	0.315
Infant RBS	**r**	-0.174	0.028	-0.173	-0.254	-0.053
	P	0.358	0.882	0.360	0.175	0.779
Infant Hb	**r**	0.241	0.190	-0.004	0.183	0.114
	P	0.199	0.313	0.982	0.332	0.548
Infant WBCs	**r**	0.213	0.131	-0.017	0.145	-0.037
	P	0.259	0.489	0.930	0.446	0.847
Infant Platelets	**r**	-0.036	-0.130	0.171	-0.111	0.020
	P	0.849	0.493	0.366	0.560	0.916

r: Pearson's correlation coefficient NS: Nonsignificant (P>0.05) *: Significant (P<0.05) **: Highly significant (P<0.001)

DISCUSSION

Diabetes has been considered an important factor in altering maternal metabolism and complicating fetal development, regardless of diabetic type. Diabetes mellitus is also associated with alterations in lipid and serum lipoprotein levels. Also, GDM may alter lipoprotein metabolism by promoting serum TAG and apolipoprotein B (apo B) concentrations (Rosario et al., 2008). The present study aimed to investigate the serum lipid profile in infants of diabetic mothers and their mothers and assess their relations to IDM complications if present.

Regarding maternal age in this study, results showed that there was a statistically significant increase in the age of diabetic mothers compared to normal ones (32.80 ±SD 7.05).

This was consistent with **Bener et al [4]** finding that DM was more common in those over 35 years. This conclusion was consistent with the findings of **Pociot and Lernmark [7]**, who discovered that mothers with diabetes had a statistically significant higher average maternal age than moms without the disease

Regards for BMI, the results of the present study showed that there was a statistically significant increase in BMI of diabetic mothers (30.07 ± SD 3.88) compared to normal mothers (27.58± SD 2.53).

This was consistent with the findings of **Schäfer-Graf et al [8],** who sought to explain how maternal lipids and glucose affected the intrauterine metabolic environment and the growth of the fetus in pregnancies involving gestational diabetes mellitus (GDM). Maternal serum and cord blood were tested for serum triglycerides (TGs), cholesterol, free fatty acids (FFAs), glycerol, insulin, and glucose. They discovered that, as compared to moms without diabetes, mothers with diabetes had a statistically significant higher BMI.

Additionally, **Pociot and Lernmark [7]** concluded that DM mothers had higher BMIs than non-DM mothers.

This finding was consistent with **Al-qahtani's [9]** evaluation of the outcomes of pregestational and gestational diabetes women. He discovered that GDM affected the majority of the diabetic women (69.5%).

The current result was consistent with that of

Opara et al. [10], who in research on the offspring of diabetic mothers discovered that women with gestational diabetes accounted for 60% of the IDMs, while mothers with pregestational diabetes accounted for 40%.

Additionally, **Pociot and Lernmark [11]** 's conclusion that DM moms had higher BMIs than non-DM mothers is supported by these data.

In the present work, it was found that 33.3% of the studied diabetic mothers had known diabetes and 66.6 % had gestational diabetes.

This finding is consistent with **Al-qahtani's [2]** evaluation of the outcomes of pregestational and gestational diabetes women. He discovered that GDM affected the majority of the diabetic women (69.5%).

The current result is consistent with that of **Opara et al. [10],** who in research on the offspring of diabetic mothers discovered that women with gestational diabetes accounted for 60% of the IDMs, while mothers with pregestational diabetes accounted for 40%.

Furthermore, **Stanescu and Stoicescu [16]** discovered a rise in the percentage of GDM among preexisting diabetic moms in a study done to evaluate the hypoxic prenatal suffering of newborns from mothers with diabetes.

Regarding the mode of delivery, there was no statistically significant difference between diabetic mothers and normal mothers as 80% of deliveries in both groups were C.S. and 20% were normal deliveries (p>0.05).

This is consistent with the findings of **Opara et al. [10],** who discovered no statistically significant difference in the mode of delivery between mothers with diabetes and moms without the condition.

A similar outcome was seen in the study by **Rosario et al [12],** wherein C.S. was the technique of delivery in 57.8% of diabetic women.

According to **Begum et al [3]** and **Wahabi and Fayed [17],** there was a higher percentage of C.S. deliveries than normal deliveries in diabetic moms.

Regarding laboratory data, there was a statistically significant decrease in RBS of infants of diabetic mothers (88.93±SD 32.08) compared to those of normal mothers (112.13±SD 19.24).

This finding was consistent with research by **Lindegaard et al. [8]** which reported no statistically significant differences in CRP, urea, creatinine, SGOT, and SGPT between children of mothers with diabetes and children of healthy mothers.

Despite the presence of congenital anomalies among IDM cases, the collected data of this study reported that there was no statistically significant difference between both groups (p>0.05). This finding most probably is due to the small sample size.

This finding conflicts with research by **Shamaoon et al [6],** which found that compared to normal infants, infants of diabetic mothers have a 2-12% higher risk of developing congenital abnormalities.

Furthermore, this conclusion deviates from that of **Begum et al [3],** who discovered that congenital abnormalities were more common in IDMs than in non-IDMs.

The present study showed that there was an increase in mean LDL, Cholesterol, and TG among diabetic mothers compared to normal mothers but with no statistically significant differences. (p>0.05).

This finding is consistent with research conducted by **Schaefer-Graf et al. [15],** who examined the possible influence of maternal lipids and glucose on fetal metabolic parameters and growth in pregnancies with normal glucose tolerance versus pregnancies with diabetes. They discovered that there was no difference in the amounts of triacylglycerol, free fatty acids, or cholesterol between the control and diabetic pregnancies.

This conclusion also agreed with **Jin Y et al. [7]** finding that maternal TG was greater in GDM moms than in normal mothers.

As regards infant groups, there was a statistically significant increase in LDL (100.8±SD 32.42), cholesterol (176.60 ±SD 25.88), and triglyceride (140.93 ± SD 41.88) of infants of diabetic mothers compared to infants of normal mothers.

According to a study by **Almusawi [1],** diabetes moms' TG and LDL levels were noticeably greater than those of healthy mothers.

The current investigation was conducted in conjunction with **Lindegaard et al. [8],** who discovered that their IDMs had higher plasma LDL and cholesterol levels.

As regards HDL, the present study showed no statistically significant difference between babies with diabetes moms in contrast to babies with healthy moms.

In the present study, there were positive significant correlations between infant weight and infant‟s cholesterol and TG.

Also, fetal triglyceride and cholesterol levels were positively correlated with newborn birth weight (p=.0446, r=0.0140) (p=0.039, r=0.381) respectively.

This outcome was consistent with the findings of

Schaefer-Graf et al. [15], who found a favorable relationship between baby triglycerides and birth weight. Additionally, the same outcome was reported by **Mossayebi et al. [9]** in their investigation.

In the present study, there were no statistically significant correlations between infant weight and infant‟s LDL (p=0.263, r=0.211).

Almusawi [1] showed a high positive connection between LDL levels and newborn weight (P<0.001, r=0.653), which contradicts our findings.

CONCLUSIONS

We can conclude that Serum cholesterol, triglycerides, and LDL levels are higher in diabetic mothers which may be reflected in the metabolism and growth of the fetus. Infant of diabetic mothers has higher LDL, TG, and Cholesterol that may affect lipid profile later on in life making them liable to cardiovascular diseases and atherosclerosis. We recommend measuring the serum lipid profile of the newly delivered infants to diabetic mothers to demonstrate any increase in serum lipid profile, so that infants with high serum lipid levels may benefit from diet modification and close monitoring of their serum lipid status. Raise the awareness of the physician regarding this problem. Future multicenter. Studied.

Conflicts of Interest

The authors report no conflicts of interest.

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None declared

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