Type of the Paper (Article)

Relationship between Maternal Blood Lipid Levels and Maternal Fat Levels in Type 2 and Gestational Diabetes

Abd ELsamie A. Abd Elsamie[1], Sahar M. Y. El Baradie[1], Ayman M. Abd El Wahab[1*], Howaida A. Abd Elrasoul[2], and Mohamed S. Bakry[1]

[1] Department of Obstetrics and Gynecology, Faculty of Medicine, Fayoum University, P.O. 63514, Fayoum, Egypt.

[2] Department of clinical pathology, Faculty of Medicine, Fayoum University, P.O. 63514, Fayoum, Egypt.

* Correspondence: Ayman M. Abd El Wahab, ayman82909@gmail.com; (002) 01119771928.

Abstract:

Introduction: Diabetes increases the risk of morbidity and death in pregnant women and newborns. One of the most frequent perinatal issues in diabetic pregnancies is fetal macrosomia, especially in mothers with poor glycemic control.

Aim of the study: This study aimed to ascertain the relationship between neonatal B.W. and maternal blood lipid levels, specifically T.C. and T.G. levels. Additionally, the capacity of T.G. and T.C. levels to forecast macrosomia was examined.

Subjects and Methods: 150 pregnant women, 75 of whom had type 2 diabetes and 75 of whom had gestational diabetes, participated in this observational cohort research at a third trimester GA of 29 to 40 weeks. The lipid parameters listed below were measured.

Results: Age, height, weight, B.M.I., F.B.G., 2HPPBG, HbA1c, parity LDL, newborn weight, and gestational age are not significantly different between the type 2DM group and the G.D.M. group ($P > 0.05$). On the other hand, there was a statistically significant difference in T.C., T.G., and HDL between the type 2 DM and G.D.M. groups. In the type 2DM group,

Conclusions: This study showed the value of assessing fasting serum T.G. levels throughout the third trimester of pregnancy, which is strongly linked with neonatal B.W. and may be used as a standalone predictor of fetal macrosomia at term in type 2 DM and G.D.M.

Keywords: Fetal birth weight; lipid profiles; glycated hemoglobin A.

1. Introduction

The metabolic disorder known as diabetes mellitus (D.M.) is characterized by hyperglycemia brought on by impaired insulin synthesis, insulin action, or both. Consequences of diabetes' continuous hyperglycemia include damage to, dysfunction in, and failure of several organs, including the heart, kidneys, eyes, nerves, and blood vessels [1].

The International Diabetes Federation estimates that 415 million people worldwide had diabetes diagnoses in 2015, and this is expected to increase to 640 million by 2040. According to estimates, half of diabetes patients are unaware of their condition, which increases their risk of developing diabetic complications. Conversely, the cost of managing diabetes could be high in terms of money spent and lives lost. Although diabetes and its complications accounted for more than 12% of all medical spending worldwide in 2015 [2], there were over 5.0 million deaths due to the disease.

The most common metabolic disorder during pregnancy is diabetes mellitus. There are two clinical subtypes of gestational diabetes mellitus: pre-gestational diabetes mellitus (PGDM) and gestational diabetes mellitus (GDM) [3].

Neonatal birth weight is an important indicator of neonatal and maternal sickness and mortality (B.W.). Therefore, accurate B.W. predictions might be useful for determining future obstetric care. Additionally, avoiding B.W. abnormalities would stop the long-term effects on the progeny [4].

Maternal euglycemia does not guarantee fetal macrosomia won't occur, and meticulous glycemic control sometimes falls short of preventing macrosomia [5]. This is true despite the strong correlation between macrosomia and the incidence of diabetes in pregnant women. Glucose may not be excessive fetal growth's only nutritional or metabolic component. Such a tempting option may be offered by serum lipid levels demonstrating significant physiological changes during pregnancy [6].

Macrosomia, preterm delivery, and preeclampsia have all been linked to aberrant lipid metabolism. Furthermore, it is proposed that the "mixture" of maternal nutrients (lipids, glucose, and amino acids) modifies the fetal metabolic environment, impacting future diabetes, obesity, and neurocognitive development in the progeny ("fuel-mediated teratogenesis") [7].

The purpose of this study is to determine whether maternal blood lipids are related to foetal and neonatal weight in pregnant women with type 2 diabetes and gestational diabetes (G.D.M.), with an emphasis on intergroup variability and macrosomia development.

2. Subjects and methods

2.1. Subjects

Between August 2019 and December 2020, Fayoum University Hospital conducted a cohort study.

Inclusion criteria

1. Singleton pregnancies of gestational age (29-40) week.
2. The neonates were delivered at Fayoum University Hospital.
3. Type 2 diabetes is diagnosed when an individual has been cured with oral glucose-lowering medications before conception, shifted to insulin before or during pregnancy, and has HbA1c less than 6%.
4. OGTT was used to identify GDM in the second trimester of pregnancy.

Exclusion criteria

1. All conditions possibly associated with fetal growth restriction due to placental insufficiency rather than metabolic factors, e.g.:
   - Women with thyroid disorders.
   - Women with systemic lupus erythematosus.
   - Women with antiphospholipid syndrome.
2. Women who delivered before the 37th-week gestation.
3. Cases of congenital fetal malformations (suspected during pregnancy or detected postpartum) and cases with multiple pregnancies.
4. Cases with familial hyperlipidemia.
5. Cases with BMI more than 30 k/m^2.

2.2. Study design

At Fayoum University Hospital, all singleton pregnant women and newborns are delivered. Before or during early pregnancy, patients were treated with oral glucose-lowering medications before conception and then switched to insulin.

OGTT was used in the second trimester of pregnancy to diagnose GDM. It was performed in the morning after an overnight fast of 8-12 hrs. The OGTT was performed in the morning following an 8-12 hour fast. G.D.M. is diagnosed when at least one exceptionally high plasma glucose result is achieved during the 75g OGTT. Furthermore, the glucose levels in the venous blood were measured. The most current International Association of Diabetes in Pregnancy Study Group (IADPSG) criteria (International Association of Diabetes and Pregnancy Study Groups Consensus Panel) categorize glucose tolerance.

Informed consent

Following a detailed explanation of the testing methods, all patients consented to participate in the study.

2.3. Measurements

All pregnant women had their age, B.M.I., lipid parameters, glycated hemoglobin, parity, gestational age, and newborn birth weight assessed. One of the maternal hyperglycemia indicators (HbA1c) evaluated was glycosylated hemoglobin. HbA1c was computed using a reference range of 6% or below [8].

2.4. Statistical Methods

Statistical calculations were conducted at the significance levels of 0.05, 0.01, and 0.001 using the SPSS (statistical program for the social sciences version 26.00). Statistical software refers to computer programs that are specifically designed to perform statistical analysis and data manipulation tasks.

3. Results

The study population consisted of 150 pregnant women, and there was no statistically significant difference in age, height, weight, B.M.I., F.B.G., 2HPP.BG, parity, or HbA1c between the type 2 DM and G.D.M. groups (*P > 0.05*) (**Table 1 and Figure 1**).

Table 1.: Basic characteristics of women with type 2DM and women with GDM.

Basic characteristics		**Type 2 DM (N=75)**		**GDM (N=75)**		**P-value**
Age (years)		29.00		28.00		0.231* (NS)
BMI (Kg/m^2)		28.00		27.30		0.196* (NS)
F.B.G (mg/dl)		124		120		0.487 * (NS)
2HPP.BG (mg/dl)		161		156		0.170 * (NS)
HbA$_{1c}$ (%)		5.90		5.90		0.61* (NS)
		N	**%**	**N**	**%**	**P-value**
Parity	**Primigravida**	21	28.0 %	18	24.0 %	0.577** (NS)
	Multipara	54	72 %	57	76 %	

- *Ns = non-significant at p value > 0.05. * = Mann Whitney as median, **= chi square*

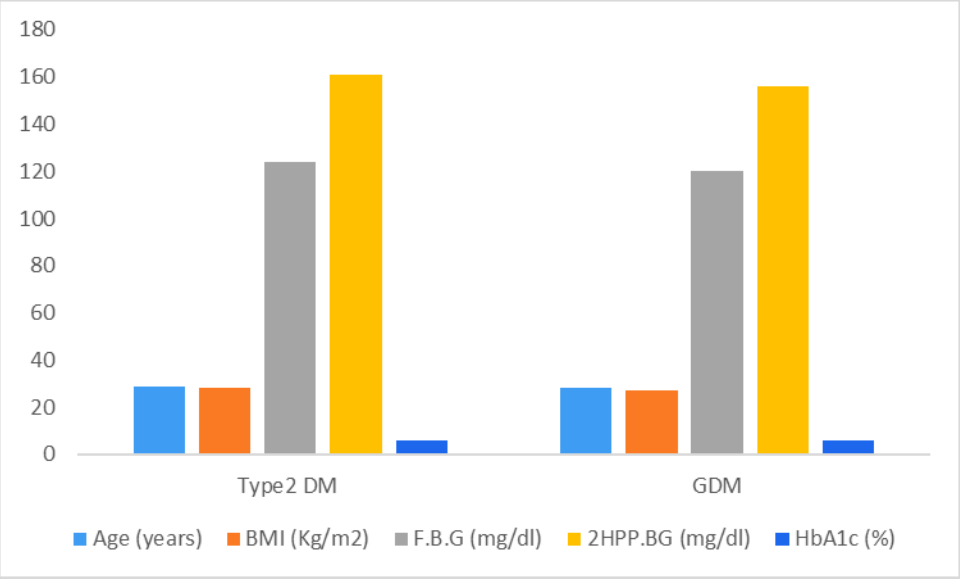

Figure 1.: Basic characteristics of women with type 2DM and GDM.

According to **Figure 2**, the type 2 DM and GDM groups do not have significantly different LDL levels. Conversely, type 2 DM and GDM showed statistically significant differences in TC, TG, and HDL.

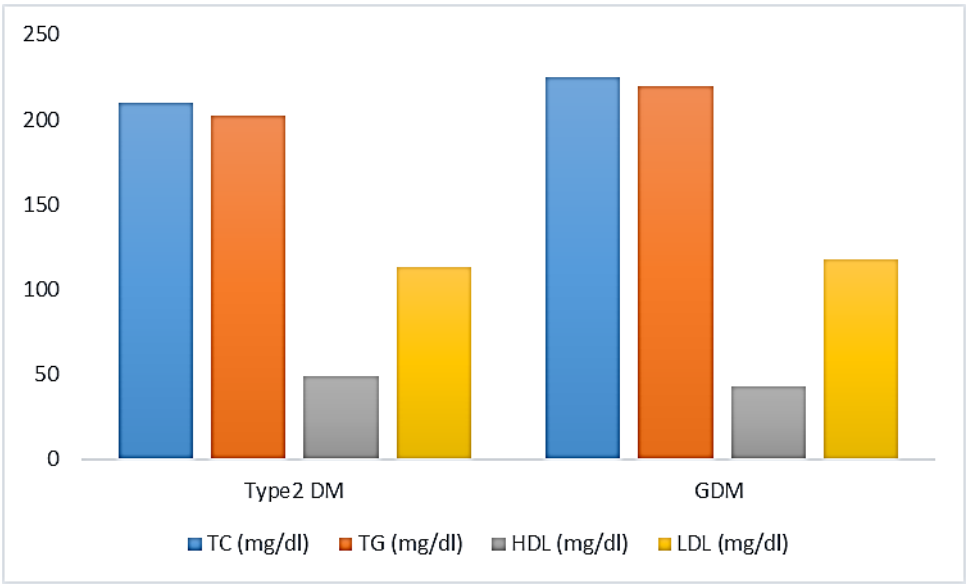

Figure 2.: Comparison between the type 2 DM and GDM groups regarding TC, TG, HDL, and LDL.

Based on **Figure 3**, there are no statistically significant differences between type 2 DM and GDM when it comes to infant weight and gestational age.

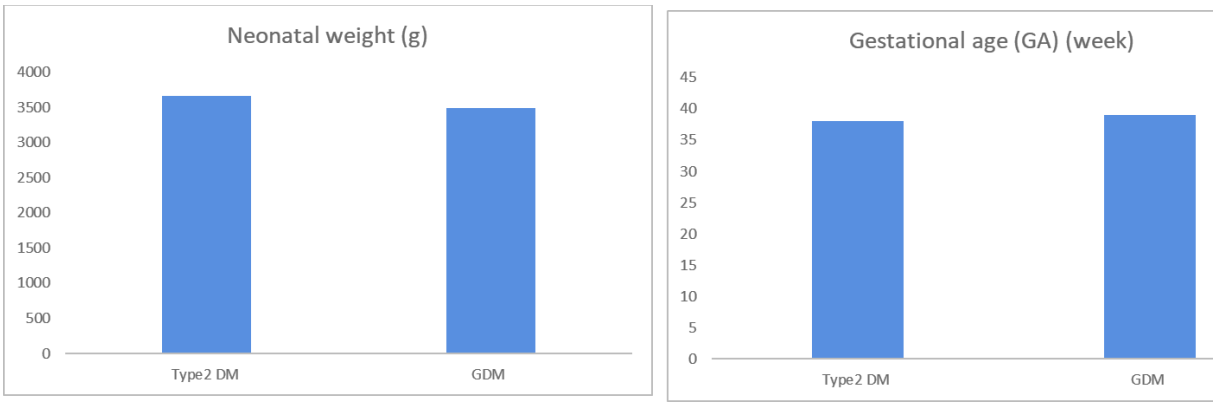

Figure 3.: Comparison between type 2 DM and GDM groups regarding GA, and neonatal weight.

4. Discussion

There is considerable debate on the positive effects of rigorous glycemic control on fetal BW management throughout pregnancy. While some studies have shown that dietary counselling and at-home blood glucose monitoring reduce the occurrence of macrosomia [9], others have demonstrated that tight glucose control is ineffective in preventing fast development and may even lead to growth limitation [10]. Another opinion is that beginning intensive glycemic control before 32 weeks of pregnancy and not after is necessary [11].

According to Brisson et al. [6], it is essential to address various factors related to metabolic syndrome during pregnancy and assess their individual and combined impacts on BW.

Hypertriglyceridemia is a key component of the insulin resistance syndrome in non-pregnant women. Additionally, diabetic women were shown to have hyperlipidemia, including hypertriglyceridemia, during their pregnancies. This condition was linked to reduced insulin sensitivity, obesity, and, ultimately, a baby's BW with a higher risk of developing macrosomia [12, 13]. Therefore, inhibiting TG synthesis offers an effective technique for treating human obesity and diabetes. It may also work to control the

infant BW in diabetic mothers in addition to tight glucose management [9].

The current research examined the relationship between maternal fasting TG, TC, LDL, and HDL cholesterol plasma concentrations at GA 29–40 weeks in the third trimester and neonatal BW.

We found that maternal cholesterol and triglyceride levels in the third trimester of pregnancy were significant predictors of macrosomia in this cohort study of pregnant women with type 2 diabetes and gestational diabetes, independent of maternal BMI and HbA1c, maternal age, parity, previous history of delivering macrosomic newborns, and serum HDL levels in pregnant women with controlled DM values.

Furthermore, Son et al. [13] found in a retrospective analysis that maternal fasting TG at 24-28 weeks' gestation is an independent predictor for term LGA in women with GDM ($p = 0.002$). With a sensitivity of 48% and a specificity of 83.5%, they were able to detect a new cut-off value of 295 mg/dl.

After controlling for maternal age and HbA1C, Göbl et al. (2010) discovered a strong correlation between TG in the third trimester and LGA babies, particularly in type I DM [14]. According to Vrijkotte et al. (2011), increased maternal TG in the first trimester was linked to higher BW in a large sample of non-diabetic women ($n = 2502$) [12].

Similar to the findings of [12, 13], the current research found no association between newborn BW and maternal serum, neither HDL nor LDL.

Conclusion

This study showed the value of assessing fasting serum TG and TC levels throughout the third trimester of pregnancy, which is positively linked with neonatal BW and may be used as a standalone predictor of fetal macrosomia at term in people with type 2 diabetes and gestational diabetes. Identifying pregnant women who will deliver LGA children may be aided by maternal serum TG and TC levels that are assessed in maternal blood during the third trimester of pregnancy. Additionally, we may avoid macrosomia in type 2DM and GDM pregnancies by appropriately managing the lipid profile.

Acknowledgment: The authors would like to sincerely thank all the participants and their parents for their invaluable contributions to this study.

Ethical approval and consent to participate: The methods conducted in studies involving human volunteers adhered to the ethical criteria set by the institutional and national research committees.

Funding: This research is not funded.

Conflicts of Interest: All authors have declared conflicts of interest.

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