Changes in serum TG level during pregnancy and its association with postpartum hypertriglyceridemia: a population-based prospective cohort study

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Abstract

Objectives: To characterize triglyceride (TG) changes from pregnancy to postpartum, associations between them and effects of pre-pregnancy body mass index (pre-BMI) and gestational diabetes mellitus (GDM). Design: Prospective cohort study. Setting: FUXING Hospital, Beijing, China. Population: 908 pregnant women. Methods: Serum lipids at gestational week 6-8, 16, 24, 36 and 42 days postpartum were measured. Associations between gestational and postpartum TG were analyzed by stepwise multiple liner regression, linear mixed-effect model and logistic regression. Cutoff points were calculated by receiver operating characteristic (ROC) curves. Main Outcome Measures: hypertriglyceridemia at 42 days postpartum. Results: TG increased with gestational weeks and decreased until 42 days postpartum. TGs at 6-8th, 16th, 24th, 36th gestational week and TG trend of change were positively associated with higher risk of postpartum hypertriglyceridemia [OR 4.962, 95% CI (3.007-8.189); OR 3.201, 95% CI (2.222-4.612); OR 2.484, 95% CI (1.853-3.329); OR 1.979, 95% CI (1.597-2.452); OR 11.660, 95% CI (6.018-22.591)]. Serum TG cut-offs were found as 1.12, 1.93, 2.35 and 3.08 mmol/L at studied gestational week, respectively. The risk of postpartum hypertriglyceridemia for women with normal pre-BMI and non-GDM was higher than overweight and obese group and GDM group, respectively. Conclusions: Gestational TG is a risk factor of postpartum hypertriglyceridemia, and is more significant among pregnant women with normal pre-BMI and without GDM. TG measurement and control is essential during pregnancy. Funding: National Natural Science Foundation of China (No. 81872608 and No.8207121162). Keywords: TG, Pregnancy, Postpartum, Hypertriglyceridemia, Pre-BMI, GDM. Tweetable abstract: Gestational TG increases risk of postpartum hypertriglyceridemia.

Introduction

Gestational lipids increase throughout pregnancy as a physiological response to adapt gestation.[1] TG level increased significantly from the first trimester to the third trimester contributing to maternal energy storage and fetal growth.[2] However, dyslipidemia in pregnancy is closely associated with the development of pregnancy complications such as GDM,[3] hypertensive disorders of pregnancy (HDP)[4] and intrahepatic cholestasis of pregnancy (ICP).[5] Elevated TG level can lead to hypertriglyceridemia,[6] which is one of the most severe dyslipidemia and has been proved to cause cardiovascular disease and metabolic disorders.[7-9] However, threshold of gestational TG level and the postpartum outcome of the TG elevation during gestation is unclear.

Puerperium refers to the period of time that organs and systems of puerpera require to return to or approach a normal state of non-pregnancy, usually lasts 42 days. Therefore, blood lipid test at 42 days postpartum is of great significance to evaluate the recovery of puerpera and predict the risk of future disease. It was

found that the prevalence of postpartum dyslipidemia in women with GDM was significantly higher than non-GDM women, which suggested the importance to explore the association between lipid levels during pregnancy and postpartum.[10]

Many factors affect serum lipids levels. For pregnant women, pre-BMI is a major threat. Studies have found that overweight and obese pregnant women have higher TG level than normal women throughout gestation.[11] But it is not clear whether the effect of pre-BMI on gestational TG will continue to postpartum.

This prospective study aimed to characterize changes in serum TG level from pregnancy to postpartum and investigate the association of gestational TG with the risk of postpartum hypertriglyceridemia; also to select TG cutoff points of each gestational week; moreover, we investigated whether pre-BMI or GDM affects such an association.

Methods

Study population

The prospective cohort was recruited in FUXING Hospital affiliated to Capital Medical University in Beijing, China from November 2018 to January 2020. Inclusion criteria were: 1) naturally conceived; 2) singleton pregnancy. Exclusion criteria were: 1) women with diabetes before pregnancy; 2) women with autoimmune disease; 3) women who take drugs that affect lipid metabolism. Finally, a total of 908 participants were enrolled in this study. They were followed from recruitment to 42 days postpartum. This study was approved by the Ethics Committee of Capital Medical University (2012SY29) and abide by the Declaration of Helsinki principles, and all participants have signed the informed consent after being fully informed at the first visit. This work was supported by the National Natural Science Foundation of China [No. 81872608 and No.8207121162].

Data collection

The demographic information and baseline characteristics including age, pre-pregnancy weight and height (pre-BMI calculated, kg/m^2), final weight at delivery, blood pressure, gravidity, parity, history of disease (cardiovascular disease, diabetes mellitus, chronic hypertension and etc.), degree of education, profession, smoking and drinking habits, was collected by questionnaire. According to China cutoff points, pregnant women were classified as low weight (BMI $<$ 18.5 kg/m^2), normal weight (18.5 kg/m^2 [?] BMI [?] 23.9 kg/m^2) or overweight & obese (BMI [?] 24.0 kg/m^2). Gestational weight gain (GWG) was calculated as the difference value between final weight at delivery and pre-pregnancy weight. Gestational age was determined by combination of the last menstrual period and the early first trimester ultrasound. The diagnosis of GDM was made by the criterion of the International Association of the Diabetes and Pregnancy Study Groups (IADPSG): one or more of the following values is met or exceeded in the 75g Oral Glucose Tolerance Test (OGTT): fasting glucose, 5.10 mmol/L; 1-h glucose, 10.00 mmol/L; 2-h glucose, 8.50 mmol/L.

Lipid measurement

Fasting blood samples were collected at gestational week 6–8, 16, 24 and 36, and non-fasting blood samples were collected at 42 days postpartum. Serum TG, total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and glucose levels were measured by the Hitachi type 7180 automatic biochemical analyzer (Hitachi High-Tech Science Systems Corporation, Yokohama, Japan) at the laboratory of Fuxing Hospital affiliated to Capital Medical University.

Outcomes

The major outcome is hypertriglyceridemia at 42 days postpartum. As the diagnosis of Chinese adults fasting dyslipidemia is not suitable for non-fasting blood samples of pregnant women at 42 days postpartum, we defined hypertriglyceridemia as serum TG level [?] the 75 percentiles (P_{75}) of all participants at 42 days postpartum.

Statistical analysis

All data were analyzed with Stata 16.1 (Stata Corp, College Station, TX, USA) and SPSS 25.0 software (SPSS, Chicago, IL, USA). Continuous variables were presented as mean ± SD and categorical variables were presented as numbers (proportion). The comparisons of serum TG levels among different periods and among groups were performed by one-way ANOVA for continuous variables. Bonferroni test was used for pairwise comparisons if homogeneity of variance is satisfied, and Tamhane T2 test was used otherwise. Pearson correlation and stepwise multiple liner regression analysis were carried out to analyze the associations between serum TG levels during pregnancy and 42 days postpartum. Serum TG level at 42 days postpartum was the dependent variable. Serum TG level at each gestational week, age, GWG, pre-BMI, GDM and gestational age were the independent variables. If α [?] 0.05, the variable was entered into the model, and the variable was ruled out if α [?] 0.10. A two-stage approach [12] was carried out to analyze the associations between TG trend of change during pregnancy and TG level and hypertriglyceridemia at 42 days postpartum. In the first stage, a linear mixed-effect model (LME) was constructed for TG as a function of gestational week at sampling and predicted the best linear unbiased predictor (BLUP) of random intercept and slope. The predicted intercept represents the mean TG level at the 6-8th gestational week. The predicted slope represents the trend of TG level changes throughout gestation. Secondly, the BLUP estimates of intercept and slope were used as predictors in the linear and logistic regression models including TG level at 42 days postpartum and hypertriglyceridemia as the outcomes, respectively. The odds ratios (ORs) and 95% confidence intervals (95% CIs) of postpartum hypertriglyceridemia in association with gestational TG levels were calculated by using logistic regression analysis. The model was adjusted for age, GWG, pre-BMI and GDM. Cutoff points of serum TG level at each gestational week were chosen by the point nearest to the top-left most corner of the receiver operating characteristic (ROC) curves, which was selected by the biggest Youden Index [13]. Sensitivity, specificity, and 95% CIs were calculated. The area under the ROC curve (AUC) was used to evaluated discrimination of the predictive model of gestational TG level on postpartum hypertriglyceridemia. The Hosmer-Lemeshow goodness-of-fit test [14] was carried out for assessment of calibration. Hierarchical logistic regression model was used for subgroup analysis among different pre-BMI subgroups and between GDM subgroups.P value of < 0.05 was considered statistically significant.

Results

Characteristics of study population

The characteristics of study participants are shown in **Table 1** . The mean age of 908 pregnant women was 31.8 ± 3.9 years. The mean height was 162.94 ± 4.98 cm. The mean pre-pregnancy weight was 59.18 ± 10.01 kg. The mean final weight was 71.43 ± 10.17 kg. The mean GWG between the first visit and the fourth visit was 12.57 ± 4.92 kg. The mean pre-BMI was 22.37 ± 3.37 kg/m^2, among which about 8.3% of the participants were stratified as low weight for pre-BMI $<$ 18.5kg/m^2, 64.0% had normal pre-BMI, and 27.7% were stratified as overweight and obese for pre-BMI [?] 24.0kg/m^2. 233 pregnant women suffered from GDM as the incidence was 25.7%, which can be ascribed to the relatively higher mean age. 45.0% of the participants were pregnant for the first time. 66.4% of the participants were primiparas and 33.6% were multiparas. The mean gestational age was 39.3 +- 1.4 weeks.

Longitudinal change of serum TG level of pregnant women from gestation to 42 days postpartum

There was a tendency that serum TG level increased with gestational weeks. Particularly, TG level rise by 3-fold from the first to third trimester, and decreased until 42 days postpartum (**Fig. 1 A**). The cutoff point of postpartum hypertriglyceridemia defined by the P_{75} of non-fasting TG level at 42 days postpartum was 2.66 mmol/L.

Compared with low weight and normal weight group, TG levels of overweight and obese group were consistently higher throughout gestation and postpartum (**Fig. 1 B**). Besides, at the 24th gestational week and 42 days postpartum, mean TG levels of pregnant women with normal pre-BMI were higher than those of low weight. TG levels of pregnant women with GDM were significantly higher than normal pregnant women at each gestational week and 42 days postpartum (**Fig. 1 C**).

Associations between serum TG level during pregnancy and at 42 days postpartum

TG level at 42 days postpartum was significantly positive correlated with TG levels at each gestational week according to Bivariate correlation analysis (Table S1 in the Supplementary Appendix). After adjustment of age, GWG, pre-BMI, GDM and gestational age, a positive association between TG levels at 6-8th, 16th, 24th, 36thgestational week and at 42 days postpartum was found by stepwise multiple linear regression (B = 0.789, $P < 0.001$; B = 0.634, $P < 0.001$; B = 0.572, $P < 0.001$; B = 0.366, $P < 0.001$). Besides, pre-BMI and GDM were the positive associated factors of TG level at 42 days postpartum throughout gestation **(Table 2)** .

The TG trend of change across pregnancy was positively associated with TG level at 42 days postpartum [B 1.425, 95% CI (1.162-1.688)], according to LME and liner regression model **(Table 3)** .

Associations between serum TG level during pregnancy and risk of postpartum hypertriglyceridemia

Binary logistic regression analysis showed that higher TG levels at 6-8th, 16th, 24thand 36th gestational weeks were positively associated with the higher risk of hypertriglyceridemia at 42 days postpartum, respectively [OR 4.962, 95% CI (3.007-8.189); OR 3.201, 95% CI (2.222-4.612); OR 2.484, 95% CI (1.853-3.329); OR 1.979, 95% CI (1.597-2.452)]. It is worth noting that the OR value in early pregnancy was the highest and decreased with gestational weeks. The age, GWG, pre-BMI of pregnancy women and suffering from GDM, were also positively associated with the incidence of postpartum hypertriglyceridemia during pregnancy **(Table 4)** .

LME and logistic regression model showed that the TG trend of change was positively associated with the incidence of hypertriglyceridemia at 42 days postpartum [OR 11.660, 95% CI (6.018-22.591)] **(Table 5)** .

Cutoff points of TG at each gestational week

ROC curves for the prediction of gestational TG level on hypertriglyceridemia at 42 days postpartum reached an AUC of 0.759, 0.750, 0.738 and 0.708 at 6-8th,16th, 24thand 36th gestational week, respectively (**Fig. 2**). TG cutoff point was 1.12 mmol/L at 6-8thgestational week (sensitivity = 67.7%, specificity = 70.7%), 1.93 mmol/L at 16th gestational week (sensitivity = 61.7%, specificity = 75.9%), 2.35 mmol/L at 24th gestational week (sensitivity = 66.2%, specificity = 73.4%), and 3.08 mmol/L at 36th gestational week (sensitivity = 70.1%, specificity = 63.8%) **(Table 6)** . According to AUC and the Hosmer-Lemeshow goodness-of-fit test, the prediction model had favorable discrimination and calibration ($\chi^2 = 6.156$, $P = 0.630$; $\chi^2 = 10.382$, $P = 0.239$; $\chi^2 = 9.786$, $P = 0.280$; $\chi^2 = 21.917$, $P = 0.050$) **(Table 6)** .

Effects of pre-BMI and GDM on the risk ofpostpartum hypertriglyceridemia

According to the hierarchical logistic regression analysis for different pre-BMI subgroup, the positive association between gestational TG levels and risk of postpartum hypertriglyceridemia remained in normal weight and overweight & obese group. At 16th, 24th and 36th gestational week, the risk of postpartum hypertriglyceridemia for women with normal pre-BMI [OR 3.756, 95% CI (2.337-6.035); OR 2.603, 95% CI (1.760-3.850); OR 2.174, 95% CI (1.630-2.901)] was higher than overweight & obese group [OR 2.748, 95% CI (1.457-5.181); OR 2.451, 95% CI (1.505-3.991); OR 1.862, 95% CI (1.295-2.677)], respectively**(Table 7)** .

As for the subgroup divided by GDM, the risk of postpartum hypertriglyceridemia for non-GDM women at 6-8th, 16th, 24th and 36th gestational week [OR 5.710, 95% CI (2.975-10.956); OR 3.421, 95% CI (2.208-5.302); OR 2.580, 95% CI (1.833-3.632); OR 2.161, 95% CI (1.646-2.836)] was higher than GDM group [OR 3.702, 95% CI (1.673-8.193); OR 2.890, 95% CI (1.465-5.701); OR 2.125, 95% CI (1.216-3.714); OR 1.821, 95% CI (1.253-2.646)], respectively **(Table 7)** .

Discussion

Main findings

In this prospective study of pregnant women, we specified the increasing trend of gestational TG and its decline after delivery. There was a tendency that overweight and obese women and women with GDM had higher serum TG throughout gestation and postpartum than normal women. Serum TG during pregnancy were positively associated with TG at 42 days postpartum. High gestational TG level increased the risk of postpartum hypertriglyceridemia, especially in early pregnancy. TG trend of change during pregnancy was positively associated with postpartum TG and risk of postpartum hypertriglyceridemia. TG level should be controlled under a threshold as 1.12, 1.93, 2.35 and 3.08 mmol/L at 6-8th, 16th, 24thand 36th gestational week, respectively. The association between gestational TG and increased risk of postpartum hypertriglyceridemia was more significant among pregnant women with normal pre-BMI and without GDM.

Strengths and Limitations

Our study described the longitudinal change in serum TG from pregnancy to 42 days postpartum, and particularly focused on the postpartum outcome of TG elevation in gestation, making up for the missing part of existing studies that only studied during pregnancy. Our study was the first to find that TG level at 42 days postpartum was positively associated with gestational TG, and presented that gestational TG can be a predictor of postpartum hypertriglyceridemia. Considering that TG changes continuously from pregnancy to postpartum, we also got down to the positive associations between TG time trend of change throughout gestation and postpartum TG level and hypertriglyceridemia, which took into account the time variation and scientifically reflected the association.

At present, there is no consensual recommended reference values of maternal serum lipids during pregnancy. We innovatively found four TG cutoff points at four gestational week that involved all three trimesters, which gave clinical significance to epidemiological analytic study, and provided a referable guidance on blood lipid control for pregnant women.

Another light spot of the study was that we compared the postpartum TG outcomes in pregnant women with different pre-BMI and between women with and without GDM. We were amazed to find that the risk of gestational TG to postpartum health is even greater for normal women. The results were supposed to aware pregnant women of pre-BMI, blood glucose and lipid control, for the sake of their postpartum lipid health.

There were still some limitations in the present study. For instance, the follow-up visit was up to 42 days postpartum, for lack of subsequent trace. Lifestyles of pregnant women including dietary structure and physical activity that could be important factors for serum TG level is needed to be considered during pregnancy and postpartum.

Interpretation

During pregnancy, the increased secretion of hormones such as estrogen, progesterone, insulin and human placental lactogen in maternal blood promotes the absorption of lipids in intestine.[1] Other maternal factors such as BMI, GWG, maternal nutrition, pre-pregnancy lipid levels and various pregnancy complications may also have significant effects on lipid metabolism and serum lipid levels.[15] It follows that there was a significant elevation of all maternal blood lipids during pregnancy, including TG, which helps fetus to obtain maternal lipid nutrients through placenta for the sake of fetal development. Several population-based studies have found that serum levels of lipids, including TG, TC, LDL-C, HDL-C and phospholipids, increase gradually starting at gestational week 12, and show more prominent increases during the second and third trimesters.[1, 16] The present study demonstrates that maternal TG increase with gestational weeks throughout pregnancy, especially rise by 3-fold from the first to third trimester, which is consistent with previous findings.[1, 17] Many factors can affect serum lipids. Farias et al.[11] found that pre-BMI was the main factor associated gestational TG level, on account of overweight and obese women showed higher mean TG compared with their normal weight counterparts during pregnancy. Our results made this conclusion even more favorable. Additionally, we found women with GDM had higher TG level throughout pregnancy, which reached the coincident conclusion as the study of Herrera et al..[18]

However, postpartum TG outcomes remain controversial. Hansen et al.[19] reported that maternal serum total lipids at 3 days postpartum was higher than the second trimester, while was declined at 6 weeks postpartum. Mbadugha et al.[20] found maternal serum lipids dropped significantly within a week after delivery, but returns to normal levels after about a year. Our study indicated that maternal TG level decreased at 42 days postpartum, but is still relatively high, which suggested that although most maternal organs and systems can return to a normal state of non-pregnancy at 42 days postpartum, it seems that blood lipids cannot back to normal that easily. It should be noted that non-fasting blood samples were tested at 42 days postpartum. Although fasting blood lipid test was deeply rooted, the clinical value of non-fasting blood lipid detection has been paid more and more attention due to support of several large population studies.[21-24] Bansal et al.[23] found that non-fasting TG levels were associated with cardiovascular events, independent of traditional cardiac risk factors, levels of other lipids, and markers of insulin resistance; by contrast, fasting triglyceride levels showed little independent relationship. The European Atherosclerosis Society (EAS) and European Federation of Clinical Chemistry and Laboratory Medicine (EFCC) reached a joint consensus statement to recommended that non-fasting blood samples be used as a routine method for detecting blood lipids in April, 2016.[25] The effects of pre-BMI and GDM on serum TG continued to postpartum. We found overweight or obese and suffering from GDM can resulted in higher TG level at 42 days postpartum, compared to normal women, which backed up previous studies.[10, 18]

According to existing studies, association between postpartum TG and gestational TG is not clear. We firstly find that TG level at 42 days postpartum was positively associated with gestational TG. It was reported that plasma TG metabolism is altered by age in humans.[26] Previous study found a positive relationship between maternal GWG and several pregnancy complications, most of which were accompanied by TG disorder.[27] Considering these factors, including maternal age, pre-BMI, GWG, GDM and gestational age might have effects on postpartum TG level, the models of linear regression and logistic regression analysis were adjusted for them. Pre-BMI and GDM showed positive effects for postpartum TG in relation to TG level at each studied gestational week in the present study.

There is no consistent clinical diagnosis for non-fasting TG level, we defined postpartum hypertriglyceridemia as serum TG level [?] P_{75} of all participants at 42 days postpartum. Hypertriglyceridemia has been regarded as an independent risk factor for cardiovascular disease and lipid metabolic disorders,[28] which threatens the long-term health of women. In the present study, we proved that gestational TG levels were positively associated with higher risk of postpartum hypertriglyceridemia, especially in early pregnancy. The result suggested that elevated gestational TG can be a biomarker for postpartum hypertriglyceridemia for pregnant women. Enough attention should be paid to the supervision and control of blood lipid level early in the first trimester.

Considering the longitudinal design of the study, the positive associations between gestational TG trend of change and postpartum TG level and risk of hypertriglyceridemia were found overall. The LME model was used instead of the difference value between TG level in the third and first trimester, for the reason that TG level during pregnancy is a continuous process of change. The results indicated pregnant women whose gestational TG level elevated more significant and faster have a greater risk of postpartum hypertriglyceridemia. It suggests that it is necessary for pregnant women to pay attention to the elevation of lipid level and managing through diet and exercise during pregnancy, so as to make for postpartum health.

As a biomarker of postpartum hypertriglyceridemia for pregnant women, gestational TG level should be concreted as a threshold or a cutoff point to meet clinical significance. As for there is no consensual recommended reference values of gestational serum lipids, it is always doubtful for obstetricians to determine the status of blood lipids of pregnant women. Wang et al.[29] took adverse pregnancy outcomes as the main outcome and presented the lipid reference range and abnormal lipid values in early and middle pregnancy, using the cut-off of the 95^{th} percentiles. Our study newly set up a prediction model of gestational TG level on postpartum hypertriglyceridemia by using ROC curves and the Hosmer-Lemeshow goodness-of-fit test, and found four TG cutoff points of each studied gestational week. To find the best gestational predictive value for postpartum hypertriglyceridemia, we selected TG cut-off by the point nearest to the top-left most corner

of the ROC curve instead of the 95th percentiles as diagnostic value, so as to ensure optimum sensitivity and specificity. Our results provide a reference standard for pregnant women in different trimester to pay attention to postpartum and lifelong lipid health.

For the first time, we compared the postpartum TG outcomes in pregnant women with different pre-BMI and between GDM and normal women. Interestingly, the positive association between gestational TG levels and risk of postpartum hypertriglyceridemia remained in normal weight and overweight & obese group, but not in low weight women. Furthermore, the risk of postpartum hypertriglyceridemia for women of normal weight was higher than overweight & obese group in the second and third trimester. Over the years we have been talking about the hazard of overweight and obesity,[11] but the newfangled results suggested that the risk of gestational TG to postpartum health is even greater for normal women. A similar case was found in the comparison between women with and without GDM. Previous study found that high TG levels during gestation were independently associated with an increased risk of GDM.[30] Free fatty acids (FFAs) potentially derived from elevated TGs might decrease insulin sensitivity, creating a vicious cycle between TG levels and insulin resistance.[31, 32] Overweight or obese pregnant women and women with GDM themselves have lipid metabolism disorders, which weakened some risks of adverse outcomes of elevated gestational TG. Besides, treatments and nutrition interventions taken by pregnant women after diagnosis of GDM may be responsible for the reduced risk of postpartum hypertriglyceridemia. The study suggested that pregnant women with normal pre-BMI and normal pregnancies should pay more attention to monitoring and control of serum TG level throughout gestation, by means of diet control, nutrition guidance and fitting exercises.

Conclusions

In conclusion, maternal TG increased with gestational weeks, and decreased until 42 days postpartum. Gestational TG was an important risk factor of postpartum hypertriglyceridemia in pregnant women while the risk decreased with gestational weeks. Serum TG level should be controlled below 1.12, 1.93, 2.35 and 3.08 mmol/L at 6-8th, 16th, 24thand 36th gestational week to reduce the risk of postpartum hypertriglyceridemia. Moreover, association between gestational TG and increased risk of postpartum hypertriglyceridemia was more significant among pregnant women with normal weight and without GDM. Our study highlights the importance of measurements and control of TG especially in early pregnancy, and management of pre-BMI and complications of pregnancy.

Data availability

The raw/processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study. If you are interested, please contact the author.

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Disclaimer statement

Contributions

Yandi Zhu: Conceptualization, Methodology, Software, Investigation, Data Curation, Data analysis, Writing - Original Draft, Visualization

Huanling Yu: Conceptualization, Methodology, Writing - Review & Editing, Supervision

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Declarations of Interest None

Ethics approval

This study was approved by the Ethics Committee of Capital Medical University (2012SY29), and abide by the Declaration of Helsinki principles.

Abbreviations

TG, triglyceride

BMI, body mass index

pre-BMI, pre-pregnancy body mass index

GDM, gestational diabetes mellitus

HDP, hypertensive disorders of pregnancy

ICP, intrahepatic cholestasis of pregnancy

GWG, gestational weight gain

IADPSG, the International Association of the Diabetes and Pregnancy Study Groups

OGTT, Oral glucose tolerance test

TC, total cholesterol

LDL-C, low density lipoprotein cholesterol

HDL-C, high density lipoprotein cholesterol

LME, linear mixed-effect model

BLUP, best linear unbiased predictor

OR, odds ratio

CI, confidence interval

ROC curve, receiver operating characteristic curve

AUC, area under the ROC curve

ASCVD, atherosclerotic cardiovascular disease

EAS, European Atherosclerosis Society

EFCC, European Federation of Clinical Chemistry and Laboratory Medicine

FFA, Free fatty acid

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TABLE 1. Characteristics of pregnant women

Characteristics
Age, years
Height, cm
Weight, kg
Pre-pregnancy weight, kg
Final weight, kg
Gestational weight gain, kg
Pre-pregnancy BMI, kg/m^2
$<$ 18.5
18.5-23.9
24.0
GDM
Gravidity, time
1
$>$ 1
Parity, time
1
$>$ 1
Gestational age, week

Data are presented as mean ± SD for normal distributed continuous variables, and numbers (proportion) for categorical var

TABLE 2. Stepwise multiple linear regression for gestational TG level and 42 days postpartum

Time

6-8th week

16th week

24th week

36th week

The B value, SE, 95% CI, β value and P value was calculated by using stepwise multiple linear regression analysis. Serum T

TABLE 3. The association between gestational TG trend of change and serum TG level at 42 days postpar

TG

Slope

Intercept

Age

GWG

Pre-BMI

GDM

Gestational Age

The B value, SE, 95% CI and P value was calculated by linear mixed-effect model (LME) and linear regression model. The

TABLE 4. Binary logistic regression for the risk of hypertriglyceridemia at 42 days postpartum

TG

Age

GWG

pre-BMI

GDM

The Odds Ratios, 95% CI and P value was calculated by using binary logistic regression analysis. The model was adjusted

TABLE 5. The association between gestational TG trend of change and risk of hypertriglyceridemia at 42 d

TG
Slope
Intercept
Age
GWG
Pre-BMI
GDM
Gestational Age
The Odds Ratios, 95% CI and P value was calculated by linear mixed-effect model (LME) and logistic regression model. Th

TABLE 6. Prediction model of gestational TG level on postpartum hypertriglyceridemia

6-8th week
16th week
24th week
36th week
AUC and its 95% CIs were based on ROC curves of the predictive model of gestational TG level on postpartum hypertrigly

TABLE 7. Hierarchical logistic regression analysis for the risk of hypertriglyceridemia at 42 days postpartu

6-8th week
16th week
24th week
36th week
The Odds Ratios, 95% CI and P value was calculated by using binary logistic regression analysis. The model of stratificatio

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