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Original Research Article

Screening of gestational diabetes mellitus using fasting plasma glucose before the 24th gestational week in women with different pre-pregnancy body mass index

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ABSTRACT

Background: Gestational Diabetes Mellitus (GDM) is usually diagnosed between 24th and 28th gestational week using the 75-g Oral Glucose Tolerance Test (OGTT). It is controversial that if FPG ≥92 mg/dL before 24th gestational week should be intervened or not. The aim of this study was to evaluate the value of FPG to screen GDM before 24th gestational week in women with different pre-pregnancy Body Mass Index (BMI).
Methods: This was a hospital based retrospective cohort study done at CHC Balipatna, Khurdha, Odisha. Women who had a singleton live birth between June 20, 2016 and June 30, 2019, resided in Balipatna block area and received prenatal care in the Community Health Centre, were included in this study. Pre-pregnancy BMI, FPG before the 24th gestational week, and one-step GDM screening with 75 g-OGTT at the 24th to 28th gestational weeks were extracted from medical records and analyzed. The pregnant women were classified into four groups based on pre-pregnancy BMI: Group A (underweight), Group B (normal), Group C (overweight) and Group D (obesity). Statistical analysis using independent sample t-test, Analysis of Variance (ANOVA) and Pearson Chi-square test was done.
Results: The prevalence of GDM was 20.0% (68/341) in the study population. FPG decreased gradually as the gestational age increased in all pre-pregnancy BMI groups until the 19th gestational week. The incidence of GDM in women with FPG ≥92 mg/dL in the 19th to 24th gestational weeks and pre-pregnancy overweight or obesity was significantly higher than that in women with FPG ≥92 mg/dL and pre-pregnancy BMI <24.0 kg/m^2.
Conclusions: FPG decreased gradually as the gestational age increased in all pre-pregnancy BMI groups until the 19th gestational week. Pre-pregnancy overweight or obesity was associated with an increased FPG value before the 24th gestational week. FPG ≥92 mg/dL between 19 and 24 gestational weeks should be treated as GDM in women with pre-pregnancy overweight and obesity.

Keywords: Body mass index, Diabetes, Fasting plasma glucose, Gestational diabetes mellitus, Odisha, Pregnancy

INTRODUCTION

India is considered as the Diabetes Capital of the World. The burden of disease is projected to increase from 425 million in 2017 to 380 million in 2025 shooting up to 629 million adults by 2045.[1] Developmental Origins of Health and Disease (DOHaD) hypothesis indicated that environmental exposures during pregnancy and postnatal development can affect health years or even decades later.[2] Gestational Diabetes Mellitus (GDM) is one of the

most common pregnancy complications and is associated with a higher risk of maternal morbidity and perinatal/neonatal morbidity.[3] Intrauterine hyperglycemia has long-term consequences for the offspring, including increased risk for obesity and type 2 diabetes in later childhood and adulthood. It has been reported that good blood glucose control in GDM could decrease the risk of maternal/fetal complications, such as macrosomia, cesarean section and the risk of diabetes in adults.

The diagnosis of hyperglycemia in pregnancy (pre-gestational diabetes mellitus and GDM) has been a hot area of research for several years.[4-6] GDM is usually diagnosed between the 24th and 28th gestational weeks using the 75-g Oral Glucose Tolerance Test (OGTT); therefore, women with GDM only have about 14 to 16 weeks to control blood glucose. Earlier diagnosis of GDM may trigger earlier blood glucose management and benefit the patients, but it is difficult to predict GDM before the 24th gestational week because Fasting Plasma Glucose (FPG) decreases as the gestational age increases.[7,8] It is controversial that if FPG ≥5.10 mmol/L before the 24th gestational week should be intervened or not. The aim of this study was to evaluate if FPG before the 24th gestational week could be used to predict GDM, which is often diagnosed at the 24th to 28th gestational weeks, and examine if considering pre-pregnancy Body Mass Index (BMI) in addition to FPG can increase the accuracy of prediction.

METHODS

Study population

This was a hospital based retrospective cohort study done at CHC Balipatna, Khurdha, Odisha. Women who had a singleton live birth between June 20, 2016 and June 30, 2019, resided in Balipatna block area and received prenatal care in the Community Health Centre, were included in this study.

Women with pre-pregnancy diabetes mellitus, without an FPG test before the 24th gestational week or 75-g OGTT during pregnancy, without pre-pregnancy BMI, or with other fetal factors (fetal malformations and fetal death) were excluded.

Data collection

Pre-pregnancy weight and height, the dates and values of FPG test before the 24th gestational week, the results of 75-g OGTT during pregnancy, and the diagnosis of GDM were extracted from medical records by trained residents and nurses at study hospitals.

Definitions

The diagnosis of GDM was made when any one of the following values was met or exceeded in 75-g OGTT at the 24th to 28th gestational week: 0 h (fasting), 5.1 mmol/L; 1 h, 10.0 mmol/L; and 2 h, 8.5 mmol/L. The cutoff points were from the guideline established by the Maternal Health Division, Ministry of Health and Family Welfare, Government of India and International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria.[7] Pre-pregnancy BMI was calculated based on self-reported pre-pregnancy weight and measured height obtained at the first prenatal visit. Then the women were classified into four groups based on World Health Organization (WHO) recommendations for Asian population: Group A (underweight): BMI <18.5 kg/m^2; Group B (normal): 18.5 to 23.9 kg/m^2; Group C (overweight): 24.0 to 27.9 kg/m^2; and Group D (obesity): ≥28.0 kg/m^2.[9]

Statistical analysis

As FPG values decreased with gestational age, this study compared FPG values across pre-pregnancy BMI groups, after controlling for gestational age, using linear regression models with and without pre-pregnancy BMI-gestational age interaction. As the decrease of FPG with gestational age might not be linear, this study tried adding square terms of gestational age in the model to improve fit.

Then the logistic regression was used to build the predictive model, in which GDM was the dependent variable, while FPG and pre-pregnancy BMI were independent variables. This study tested the predictive power of the models with and without pre-pregnancy BMI and checked if adding pre-pregnancy BMI can significantly increase the predictive power of the model by checking the change of C-statistic. This study also tested adding FPG gestational age and interaction terms to test if they could elevate the predictive power.

Lastly, this study tested if the models have better predictive power in patients with 19th to 24th gestational weeks FPG to predict GDM in patients with overweight/obesity.

Data were analyzed using SPSS version 21.0 statistical software (SPSS Inc., Chicago, IL, USA). Continuous variables are presented as the mean±standard deviation, and categorical variables are presented as numbers and percentages. Differences in the means between groups were evaluated using independent sample t-test and Analysis of Variance (ANOVA). Pearson Chi-square test was used for categorical variables. The level of statistical significance was set at 0.05.

RESULTS

The prevalence of GDM was 20.0% (68/341) in the study population. The pregnancy week and value for FPG test before the 24th week of gestation were 12.7±4.0 weeks of gestation and 4.70±0.44 mmol/L, respectively.

FPG decreased with increasing gestational age in different pre-pregnancy BMI groups from 4 to 5+6

gestational weeks. In fact, in study population, FPG declined gradually until the 19th week to reach a steady state. After controlling for pre-pregnancy BMI, compared to FPG of 22 to 23+6 gestational weeks, the FPG of 4 to 22 gestational weeks were 0.59 mmol/L (4-5+6 weeks), 0.43 mmol/L (6-7+6 weeks), 0.30 mmol/L (8-9+6 weeks), 0.22 mmol/L (10-11+6 weeks), 0.19 mmol/L (12-13+6 weeks), 0.13 mmol/L (14-15+6 weeks), 0.06 mmol/L (16-17+6 weeks), 0.02 mmol/L (18-19+6 weeks) and 0.01 mmol/L (20-21+6 weeks) higher (all $p<0.001$), except 18 to 19+6 and 20 to 21+6 weeks ($p=0.217$ and 0.747, respectively).

The proportion of patients were diagnosed with GDM in four groups of FPG and pre-pregnancy BMI combinations. With every 0.50 mmol/L increase in FPG level >4.10 mmol/L at the first prenatal visit, the incidence of GDM diagnosis later in pregnancy increased in pre-pregnancy BMI groups. Logistic regression indicated patients with higher FPG (OR: 3.1, 95% CI: 2.90-3.30) and higher pre-pregnancy BMI (OR: 1.1, 95% CI: 1.06-1.13) were more likely to be diagnosed with GDM.

The prevalence of GDM was associated with FPG in 19 to 24 weeks of gestation and pre-pregnancy BMI. The incidence of GDM in women with FPG ≥5.10 mmol/L and pre-pregnancy overweight or obesity was higher than that in women with FPG ≥5.10 mmol/L and pre-pregnancy BMI <24.0 kg/m^2 (78.5% [62/79] vs. 52.9% [64/121], $x2 = 13.425$, $p<0.001$).

DISCUSSION

The results of the multi-region retrospective cohort study showed the predictive value of FPG before the 24th gestational week for GDM in this study population. As we all know, type 2 diabetes has become a global epidemic. It has been reported that the prevalence of diabetes was 9.7% for the entire population (8.8% for women) and the prevalence of pre-diabetes was 15.5% (14.9% for women) in the study population.[10] Both GDM mothers and babies have the high risk of DM in their further lives, and the risk would decrease significantly after good glycemic control during pregnancy.

It is recommended that all pregnant women should have FPG test to exclude pre-pregnancy diabetes mellitus by the International Association of Diabetes and Pregnancy Study Groups (IADPSG).[11,12] One issue with GDM screening test is that the test is usually performed between the 24th and 28th gestational week using 75-g OGTT, resulting in only about 14 to 16 weeks for GDM management. 13-15 In recent years, studying the predictive value of FPG to GDM has become a hot topic.[16-19]

FPG is a well predictive index for GDM diagnosis, but it has been reported that it is inappropriate to use FPG as the diagnostic basis of GDM at the early stage of pregnancy as FPG decreases with increasing gestational age.[8] Pre-pregnancy obesity or overweight is an independent risk factor for GDM. Therefore, authors evaluated if combining pre-pregnancy BMI and FPG before the 24th gestational week can better predict GDM.

This study showed that the downtrend of FPG level was not significant after the 19th gestational week, suggesting FPG at the 19th to 24th gestational weeks would be a good predictor for GDM. In women pre-pregnancy with overweight and obesity, the predictive power of FPG was even higher. For example, the incidence of GDM was up to 78.5% when FPG ≥5.10 mmol/L in the 19th to 24th gestational week in women with pre-pregnancy overweight or obesity, and the AUC of FPG ≥5.10 mmol/L was as high as 0.803; these women should be treated as GDM earlier. Authors also recommended the screening test of PFG at the 19th to 24th gestational week for GDM in women who were overweight or obese before pregnancy.

However, several limitations existed in this study. First, the study targeted only pregnancy women reporting for ANC to CHC Balipatna at Khurdha District of Odisha. Second, the pre-pregnancy weight was based on self-report of the participants, which was at risk of self-report bias.

CONCLUSION

FPG decreased as gestational age increased in different pre-pregnancy BMI groups, and the downward trend became insignificant after 19 weeks of gestation. Pre-pregnancy overweight or obesity was associated with an increased FPG value before the 24th gestational week. FPG ≥5.10 mmol/L between the 19th and 24th gestational week was a good predictor for GDM in women with pre-pregnancy overweight and obesity.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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