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Combined predictive value of early pregnancy fasting plasma glucose and pre-pregnancy body mass index for gestational diabetes mellitus

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Abstract

This single-center retrospective study explored the predictive value of early pregnancy fasting plasma glucose (FPG) combined with pre-pregnancy body mass index (BMI) for gestational diabetes mellitus (GDM). Healthy singleton pregnant women with natural pregnancy who delivered at the Second People's Hospital of Wuhu City between January 2023 and January 2025 were included. Blood glucose indicators were measured at 11–13 weeks of gestation, and a 75 g oral glucose tolerance test was performed at 24–28 weeks. Participants were classified into GDM and non-GDM groups. After Z-score normalization, univariate and multivariate Logistic regression analyses identified pre-pregnancy BMI, gestational weight gain and FPG as independent risk factors for GDM. The established Logistic regression model showed moderate predictive efficiency, with an AUC of 0.75, an accuracy rate of 0.82, a sensitivity of 0.48, a specificity of 0.92, a PPV of 0.63 and a NPV of 0.86. Bootstrap internal validation and Hosmer–Lemeshow test indicated acceptable model calibration, while decision curve analysis showed clinical net benefit within a threshold probability range of 0.10–0.50. We conclude that early pregnancy FPG combined with pre-pregnancy BMI may help identify women at high risk of GDM and support personalized intervention strategies. *(Afr J Reprod Health 2026; 30 [17] 106-116).*

Keywords: Fasting plasma glucose; Body mass index; Gestational diabetes mellitus; Gestational weight gain

Résumé

This single-center retrospective study explored the predictive value of early pregnancy fasting plasma glucose (FPG) combined with pre-pregnancy body mass index (BMI) for gestational diabetes mellitus (GDM). Healthy singleton pregnant women with natural pregnancy who delivered at the Second People's Hospital of Wuhu City between January 2023 and January 2025 were included. Blood glucose indicators were measured at 11–13 weeks of gestation, and a 75 g oral glucose tolerance test was performed at 24–28 weeks. Participants were classified into GDM and non-GDM groups. After Z-score normalization, univariate and multivariate Logistic regression analyses identified pre-pregnancy BMI, gestational weight gain and FPG as independent risk factors for GDM. The established Logistic regression model showed moderate predictive efficiency, with an AUC of 0.75, an accuracy rate of 0.82, a sensitivity of 0.48, a specificity of 0.92, a PPV of 0.63 and a NPV of 0.86. Bootstrap internal validation and Hosmer–Lemeshow test indicated acceptable model calibration, while decision curve analysis showed clinical net benefit within a threshold probability range of 0.10–0.50. We conclude that early pregnancy FPG combined with pre-pregnancy BMI may help identify women at high risk of GDM and support personalized intervention strategies. *(Afr J Reprod Health 2026; 30 [17]:106-116).*

Mots-clés: Glycémie à jeun ; Indice de masse corporelle ; Diabète gestationnel ; Prise de poids gestationnelle

Introduction

Pregnancy outcomes have varying degrees of influence on all aspects of maternal-infant health in the short and long terms. In particular, the adverse effects of adverse pregnancy outcomes such as gestational diabetes mellitus (GDM), hypertensive disorder complicating pregnancy, amniotic fluid abnormality, postpartum hemorrhage, fetal distress, preterm birth, large-for-gestational-age (LGA) infant, low birth weight infant, neonatal hypoglycemia and neonatal pneumonia on maternal-infant health have received increasing attention. According to data from the International Diabetes Federation (IDF)[1], 21.1 million women or 16.7% of mothers of live births worldwide by 2025 have suffered from a certain form of gestational hyperglycemia, with GDM accounting for 80.3% of these cases. In China, the prevalence rate of GDM is currently on the rise, and healthcare coverage ability and difference result in inconsistent prevalence rates of gestational hyperglycemia

across different areas.[2] Based on the diagnostic criteria of the International Association of Diabetes and Pregnancy Study Groups (IADPSG), data from a 2013 survey in China[3] have revealed that the national average prevalence rate of GDM is 17.5%. Data from a 2024 survey in China have indicated that the gap in GDM prevalence rate between urban and rural areas is narrowing, with the incidence rate in rural areas growing faster (0.90% annually in rural areas, 0.60% per year in urban areas).[4] Numerous studies have demonstrated that abnormal blood glucose in middle pregnancy can increase the risks of perinatal complications such as first-time cesarean section, LGA infant and gestational hypertension as well as the mother's own susceptibility to type 2 diabetes mellitus and the increased risk of overweight or obesity in the offspring.[5–6]

In addition to age, family history and past medical history, pre-pregnancy body mass index (BMI), total weight gain during pregnancy, weight increase velocity, body composition status and blood glucose during pregnancy are all correlated with the occurrence of adverse pregnancy outcomes, especially blood glucose during pregnancy is strongly associated with the occurrence of GDM and neonatal birth weight [7–8]. However, there remain inconsistent findings regarding the associations between blood glucose in early pregnancy and occurrence and influence of adverse pregnancy outcomes such as LGA infant and gestational hypertension, so further investigation into these relationships is warranted. There is currently no universally accepted consensus on the diagnostic methods for GDM. In China, the IADPSG diagnostic criteria are currently in use [9]: 75 g oral glucose tolerance test (OGTT) is performed between 24 and 28 weeks of gestation to diagnose or rule out GDM, with threshold values of fasting plasma glucose (FPG) and blood glucose levels at 1 hour and 2 hours after taking glucose of 5.1 mmol/L, 10.0 mmol/L and 8.5 mmol/L, and a diagnosis of GDM is made if any one of these thresholds is met or exceeded. However, conducting OGTT screening at 24–28 weeks of gestation not only misses the optimal time period for preventing and treating hyperglycemia in early pregnancy, but also OGTT procedure is cumbersome and subject to numerous influencing factors, and may be difficult for some pregnant women to accept and may cause poor adherence, thereby resulting in the final missing of the optimal timing for intervention and treatment as well as increasing the risk of adverse maternal-infant outcomes. Therefore, early detection, early prevention and early treatment of GDM are essential [10].

However, due to the particularity of demographic distribution in China where the rural population constitutes the majority, there are significant disparities in infrastructures between rural areas and urban areas as well as differences in the education levels of pregnant women, leading to variations in the timing of the first prenatal examination and adherence to prenatal examination during pregnancy among most pregnant women. If FPG level≥5.10 mmol/L is used as the diagnostic criterion for GDM, some pregnant women may be undiagnosed and fail to receive timely intervention and treatment. Furthermore, studies have found that in the course of normal pregnancy, FPG level decreases progressively with the progress of gestational age, generally beginning at 10 weeks of gestation, decrease rate gradually slowing down at 16 weeks of gestation and tending to be stable at 20 weeks of gestation [11–12]. It is evident that diagnosing GDM based on FPG≥5.10 mmol/L during pregnancy will not only increase the medical burden, but also cause psychological pressure on pregnant women. Against this backdrop, this study selected low-cost and routinely collected biochemical markers and clinical data, including early pregnancy FPG and pre-pregnancy BMI, to investigate whether these indicators are associated with the occurrence of GDM, thereby providing new insights for the clinical prevention of GDM occurrence.

Methods

Study design and patients

The study included singleton pregnant women with natural pregnancy who underwent routine prenatal examination in department of obstetrics of the Second People's Hospital of Wuhu City and had previous good physical health, no history of pregnancy-related anemia and no history of

medication between January 2023 and January 2025. Routine laboratory tests were performed at 11–13 weeks of gestation, and OGTT was performed at 24–28 weeks of gestation. Based on the results, the pregnant women were assigned into either GDM group or N-GDM group.

Inclusion criteria encompassed regular prenatal examination in department of obstetrics of the hospital throughout pregnancy and successful delivery, maternal age≥18 years old, early pregnancy FPG ranging between 4.1 mmol/L and 6.0 mmol/L, no important organ diseases involving heart, liver, lung and kidney prior to pregnancy, no history of diabetes mellitus or relevant family history before pregnancy, singleton pregnancy with natural conception, no history of GDM in previous pregnancy and no acute infectious diseases occurred during study.

Exclusion criteria consisted of multiple pregnancy, pregnancies due to in vitro fertilization-embryo transfer, history of pre-pregnancy hyperglycemia and fetal macrosomia as well as incomplete data.

Oral glucose tolerance test

Three days before OGTT examination at 24–28 weeks of gestation, the pregnant women maintained normal diets. Before blood collection, they strictly fasted for 8 hours. First, venous blood was drawn to detect FPG. Then, the pregnant women were kept quiet, and abstained from drinking water or smoking after taking the liquid containing 75 g of glucose. The timing was started from the beginning of taking the first glass of liquid. Venous blood samples were collected again at 1 hour and 2 hours after taking glucose. The three blood glucose values were expected to lower than 5.1 mmol/L, 10.0 mmol/L and 8.5 mmol/L before taking glucose and at 1 hour and 2 hours after taking glucose. GDM was confirmed when any of the blood glucose values reached or exceeded the above criteria.

Data collection

Basic data of patients were obtained from Maternal and Child Health Information System of Anhui Province and the hospital's electronic medical record system, including age at registration, pre-pregnancy BMI, blood pressure, gravidity, parity, education level, smoking history, alcohol drinking history and gestational weight gain. Key laboratory biochemical indicators contained early pregnancy FPG, total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), alanine aminotransferase (ALT), aspartate aminotransferase (AST), total protein (TP) and albumin (ALB). Fasting venous blood samples were collected at 11–13 weeks of gestation and placed in EP tubes for subsequent laboratory testing. Beckman Coulter AU5800 biochemical analyzer was used for testing, and the testing personnel were qualified professionals. The testing process was carried out in strict accordance with the instrument requirements and the reagent kit instructions.

To ensure the accuracy and fidelity of data in this retrospective study, the following measures were taken: all data were independently extracted by two researchers from the electronic medical records; any discrepancies were resolved by consulting the original records; data were double-entered into a standardized database and cross-checked for consistency; and range checks were performed to identify and correct any out-of-range or missing values.

Statistical analysis

Data processing was conducted by SPSS (version 26.0; IBM, Armonk, New York, United States). Normality was evaluated by Shapiro-Wilk test. Continuous variables conforming to normal distribution were represented as mean±standard deviation by applying t-test, and continuous variables inconsistent with normal distribution were denoted as median and M (P_{25}, P_{75}) by adopting Mann-Whitney U test. Enumeration data were expressed as percentages (%), and chi-square test was utilized for data comparison. Differences between groups were considered statistically significant if $p<0.05$ was found for variables in both groups.

The independent influencing factors were explored by Logistic regression analysis, and nomogram was constructed to visually describe the above factors. The overall effect of the constructed regression model was assessed by receiver

operating characteristic (ROC) curve, calibration curve and decision curve.

Ethical principles

(1) Basic principle: This study was approved by the ethics committee of the Second People's Hospital of Wuhu City (Date: 2026-05-18, No:2026-KY-038). This study was retrospective and patient informed consent was waived.
(2) Principle of confidentiality: All data during the study process were retained by the research team, and were not allowed to be used for any commercial purposes except for article publication and ethical review. The data recorded and used during the study process were encoded to ensure no infringement of personal privacy of patients.
(3) Principle of safety: The study process would not cause any potential harm to the study subjects.

Results

Basic data

A total of 140 patients were included in this study, comprising 31 cases (22.14%) with GDM. Shapiro-Wilk test was applied for normality assessment, with $p>0.05$ considered indicative of normal distribution. In this study, FPG ($p=0.001$), TG ($p=0.002$), HDL-C ($p=0.013$) and ALB ($p<0.001$) did not follow the normal distribution, while age ($p=0.077$), pre-pregnancy BMI ($p=0.801$), systolic blood pressure ($p=0.317$), diastolic blood pressure ($p=0.323$), gestational weight gain ($p=0.311$), TC ($p=0.084$), LDL-C ($p=0.359$), ALT ($p=0.249$), AST ($p=0.462$) and TP ($p=0.139$) conformed to the normal distribution. Statistical descriptions of categorical variables and numerical variables were displayed in Table 1 and Table 2 respectively.

Logistic regression results

This study performed Z-score normalization for the numerical variables, with $Z=(X - \mu)/\sigma$, where X represented the raw data, μ was the mean of the data sample, and σ referred to the standard deviation of the sample. As detailed in Table 3, univariate Logistic regression discovered that pre-pregnancy BMI, gestational weight gain and FPG were linked to GDM. The variance inflation factor (VIF) values of these three indicators were 1.015, 1.002 and 1.014 respectively, and they were close to 1, indicating no severe collinearity.

Table 1: Statistical descriptions of categorical variables

Variables	Variable analysis	n
Education level	Junior high school or below	31
	Senior high school	37
	University and above	72
Gravidity	1	42
	2	69
	≥3	29
Parity	0	63
	1	69
	2	8
Smoking history	No	132
	Yes	8
Alcohol drinking history	No	133
	Yes	7

Variables with $p<0.05$ in the univariate analysis were incorporated into the multivariate Logistic regression model. Variables with $p<0.05$ were selected by stepwise regression, as shown in Table 4. Pre-pregnancy BMI [OR (95%CI): 1.78 (1.14–2.78), $p=0.012$], gestational weight gain [OR (95%CI): 1.68 (1.08–2.62), $p=0.023$] and FPG [OR (95%CI): 1.56 (1.03–2.39), $p=0.038$] were independent influencing factors for GDM.

Establishment of a prediction model for GDM

Based on the results of the multivariate analysis, a prediction model for GDM was constructed with model formula as logit P=ln[P/(1-P)] – 1.51 + 0.58*pre-pregnancy BMI + 0.52*gestational weight gain + 0.45*FPG (Z-score value). The constructed prediction model was presented by the way of nomogram, as indicated in Figure 1.

This nomogram included three variables: (1) Variable names on the left side: For example, "Pre-pregnancy BMI" and "Gestational weight gain" shown in the figure. The line of each variable was labeled with a scale indicating its range of possible values for the variable, while the length of the line segment reflected the magnitude of that factor's contribution to the clinical outcome events.

Table 2: Statistical descriptions of numerical variables

Variables	Mean	SD	Median	P_{25}	P_{75}
Age, years	31.0	3.4	31.0	29.0	33.2
Pre-pregnancy BMI, kg/m^2	22.5	3.0	22.4	20.2	24.8
Systolic blood pressure, mmHg	113.5	4.9	114.0	111.0	117.0
Diastolic blood pressure, mmHg	76.2	3.9	76.0	74.0	79.0
Gestational weight gain, kg	14.1	4.1	14.0	10.9	16.9
FPG, mmol/L	4.6	0.2	4.7	4.5	4.8
TC, mmol/L	3.8	0.6	3.9	3.4	4.3
TG, mmol/L	1.1	0.1	1.1	1.0	1.2
HDL-C, mmol/L	1.6	0.2	1.7	1.5	1.8
LDL-C, mmol/L	2.0	0.3	2.1	1.8	2.4
ALT, U/L	24.5	4.8	25.0	21.0	28.0
AST, U/L	20.6	4.6	20.0	18.0	24.0
TP, g/L	66.0	4.9	65.3	63.1	66.9
ALB, g/L	38.8	2.1	39.0	37.8	40.2

Table 3: Univariate logistic regression results

Variables	β	S.E	Z	*P*	OR (95%CI)
Gravidity					
1					1.00 (Reference)
2	0.41	0.61	0.66	0.507	1.50 (0.45 ~ 4.96)
≥3	0.37	0.57	0.65	0.514	1.45 (0.48 ~ 4.41)
Parity					
0					1.00 (Reference)
1	-0.12	0.42	-0.28	0.777	0.89 (0.39 ~ 2.01)
2	-0.78	1.11	-0.71	0.480	0.46 (0.05 ~ 4.02)
Education level					
Junior high school or below					1.00 (Reference)
Senior high school	-1.11	0.62	-1.81	0.070	0.33 (0.10 ~ 1.10)
University and above	-0.51	0.48	-1.07	0.285	0.60 (0.24 ~ 1.53)
Smoking history					
No					1.00 (Reference)
Yes	0.80	0.76	1.05	0.292	2.23 (0.50 ~ 9.90)
Alcohol drinking history					
No					1.00 (Reference)
Yes	1.03	0.79	1.30	0.192	2.81 (0.59 ~ 13.30)
Age	0.22	0.19	1.12	0.261	1.25 (0.86 ~ 1.81)
Pre-pregnancy BMI	0.64	0.22	2.87	0.004	1.90 (1.23 ~ 2.96)
Systolic blood pressure	0.06	0.19	0.30	0.761	1.06 (0.72 ~ 1.55)
Diastolic blood pressure	-0.21	0.20	-1.02	0.308	0.81 (0.55 ~ 1.21)
Gestational weight gain	0.54	0.22	2.50	0.013	1.72 (1.12 ~ 2.63)
FPG	0.49	0.20	2.42	0.016	1.64 (1.10 ~ 2.44)
TC	-0.24	0.21	-1.17	0.243	0.78 (0.52 ~ 1.18)
TG	-0.06	0.20	-0.29	0.773	0.94 (0.63 ~ 1.41)
TP	-0.02	0.20	-0.01	0.926	0.98 (0.66 ~ 1.45)
HDLC	-0.03	0.20	-0.15	0.884	0.97 (0.65 ~ 1.45)
LDLC	0.23	0.21	1.11	0.267	1.26 (0.84 ~ 1.91)
ALT	-0.26	0.20	-1.30	0.193	0.77 (0.53 ~ 1.14)
AST	-0.36	0.19	-1.87	0.062	0.70 (0.47 ~ 1.02)
ALB	-0.31	0.20	-1.72	0.128	0.73 (0.50~ 1.09)

OR: Odds Ratio, CI: Confidence Interval

Table 4: Multivariate logistic regression results

Variables	β	S.E	Z	*P*	OR (95%CI)
Intercept	-1.51	0.24	-6.17	<0.001	0.22 (0.14 ~ 0.36)
Pre-pregnancy BMI	0.58	0.23	2.52	0.012	1.78 (1.14 ~ 2.78)
Gestational weight gain	0.52	0.23	2.28	0.023	1.68 (1.08 ~ 2.62)
FPG	0.45	0.22	2.08	0.038	1.56 (1.03 ~ 2.39)

OR: Odds Ratio, CI: Confidence Interval

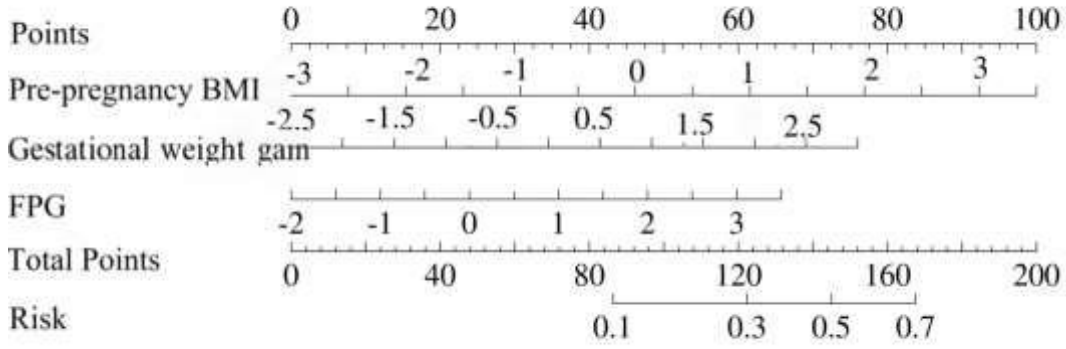

Figure 1: Prediction model for GDM

(2) Scores involving individual score (i.e., "Point" in the figure) which represented the score corresponding to each variable at different values as well as the total score (i.e., "Total Point") which was the sum of the individual scores corresponding to all variables values. 3) "Risk" in the figure referring to the risk of developing a certain disease.

The raw data were normalized by Z-score. For example: The score range of pre-pregnancy BMI after Z-score normalization was from -3 to 3.5 points, with corresponding individual score ranging from 0 to 100 points. The score range of gestational weight gain was between -2.5 and 3 points after Z-score normalization, with corresponding individual score ranging from 0 to 75 points. The range score of FPG after Z-score normalization was between -2 and 3.5 points, and the corresponding individual score ranged from 0 to 65 points. The total score was the sum of the individual scores for the above three indicators, and the total score corresponded to a specific risk level.

Evaluation of the prediction model

ROC curve was drawn for the prediction model, as exhibited in Figure 2. The AUC (95%CI), accuracy (95%CI), sensitivity (95%CI), specificity (95%CI), PPV (95%CI), NPV (95%CI) and cutoff value of the model were 0.75 (0.65–0.85), 0.82 (0.75–0.88), 0.48 (0.31–0.66), 0.92 (0.87–0.97), 0.63 (0.43–0.82), 0.86 (0.80–0.92) and 0.369 respectively, suggesting good discrimination of the model.

Bootstrap method was adopted to sample 1,000 times for internal validation of the model, and Hosmer-Lemeshow goodness-of-fit test was applied for model fitting and found X-squared of 8.683, df of 8 and p value of 0.323, revealing good calibration of the model, as shown in Figure 3. The decision curve was located above the two extreme lines when the decision probability was in the range of 0.10–0.50, indicating good clinical utility of the model, as demonstrated in Figure 4

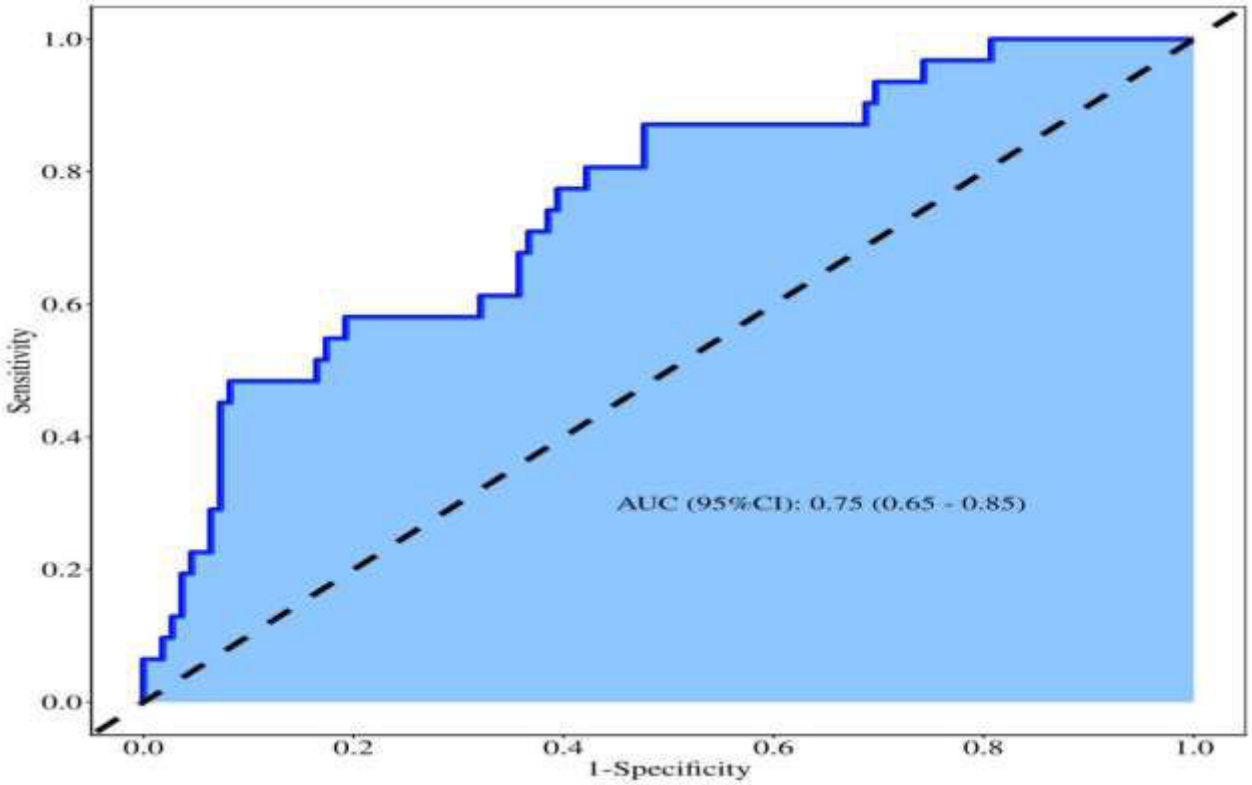

Figure 2: ROC curve of the prediction model for GDM

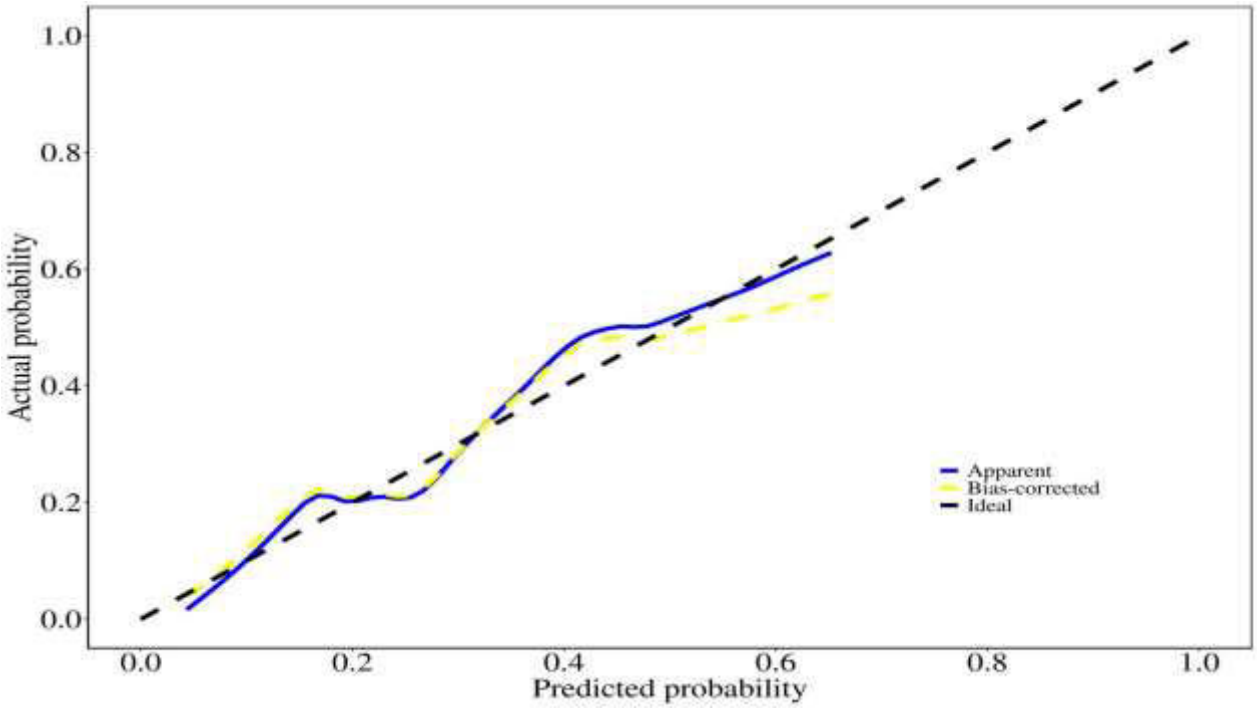

Figure 3: Calibration curve of the prediction model for GDM

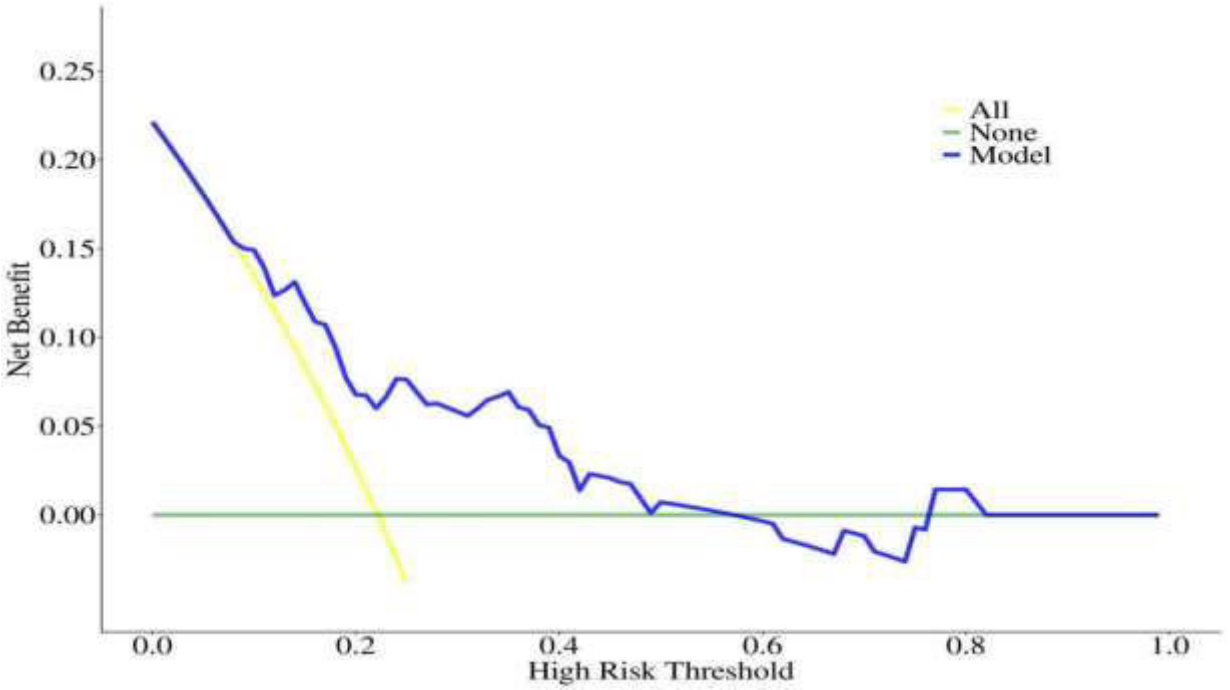

Figure 4. Decision curve of the prediction model for GDM

Discussion

Multiple studies have reported on the correlation between early pregnancy FPG and GDM. For example, a prospective study of Smirnakis KV et al. has found that women diagnosed with GDM at 24–28 weeks have higher FPG in early pregnancy.[13] The study of Riskin-Mashiah S has also indicated that early pregnancy FPG is positively correlated with the risk of GDM occurrence, particularly when FPG level in early pregnancy exceeds 5.0 mmol/L [14]. In another study involving overweight women at extremely high risk of GDM, the prevalence rate of GDM after 24 weeks is 53% among women with FPG>4.9 mmol/L in early pregnancy, and the prevalence rates of GDM are 12%, 15% and 20% respectively when early pregnancy FPG levels are 4.4 mmol/L, 4.41–4.6 mmol/L and 4.61–4.89 mmol/L [15]. Moreover, a study has revealed that among 2,284 women in China, those who with GDM have higher FPG at the first prenatal examination than those without GDM.[16]

Compared to women with N-GDM, women with elevated FPG in early pregnancy demonstrate impaired β-cell function (as indicated by proinsulin index). In addition, it has been proved that elevated FPG in early pregnancy is connected with poor prognosis, and can be immediately improved through dietary intervention if necessary.[17] A previous study has suggested that the optimal cutoff value of FPG in early pregnancy is 5.01 mmol/L, but determining the cutoff value of FPG is actually quite complex.[18] Firstly, FPG decreases as gestational age increases. In the Chinese population, the median FPG level is 4.95 mmol/L at 4–6 weeks, 4.70 mmol/L at 10–12 weeks and 4.53 mmol/L at 14–16 weeks, and it reaches the lowest value of 4.38 mmol/L at 20–24 weeks. Secondly, based on ROC curve and the area under the curve, another study on Chinese population has displayed that the optimal cutoff value of FPG for predicting GDM must be determined according to BMI, with the cutoff value of 4.77 mmol/L for women with pre-pregnancy underweight, 4.92 mmol/L for those with normal pre-pregnancy weight, 5.00 mmol/L for those with pre-pregnancy overweight and 5.05 mmol/L for those with pre-pregnancy obesity [19]. In general, the optimal FPG cutoff value may vary depending on various high-risk factors such as age and BMI. Therefore, more further studies are needed to determine the optimal threshold of early pregnancy FPG.

Pre-pregnancy BMI is an important indicator to describe the physical conditions of pregnant women. In recent years, rapid economic development has led to improved living standards and unhealthy dietary habits, resulting in pre-pregnancy BMI of most pregnant women falling outside the healthy range. GDM is a glucose metabolism disorder caused by insulin resistance in pregnant women, and weight gain is a risk factor for the occurrence of insulin resistance. It has been found that pre-pregnancy BMI and gestational weight gain can serve as risk factors for GDM, though specific values remain undetermined [20]. It has been confirmed in a prospective study that family history of diabetes mellitus in first-degree relatives, pre-pregnancy BMI and weight gain in early pregnancy can be regarded as independent risk factors for GDM.[21] The occurrence of GDM is closely linked to insulin resistance. Under normal circumstances, the sensitivity of pancreatic β-cells in some pregnant women cannot be enhanced due to various reasons. With regard to pregnant women with obesity, enlarged fat cells further attract inflammatory factors, causing additional damage to pancreatic β-cells and accelerating the development of insulin resistance, thereby increasing the likelihood of abnormal glucose metabolism during pregnancy. Therefore, weight adjustment before pregnancy, health education before pregnancy and weight control during pregnancy are crucial for preventing the occurrence of GDM.

Accurate early risk prediction of GDM can provide targeted intervention and prevention for women at highest risk. Risk factors currently identified and listed in clinical guidelines include maternal age, ethnicity, BMI, family history of diabetes mellitus, previous history of GDM, previous history of macrosomia and history of multiple pregnancies.[22–23] The findings of this study also reveal higher pre-pregnancy BMI of pregnant women in GDM group than N-GDM group. Many scholars believe that risk prediction model for GDM based on risk factors can aid in the early identification of pregnant women with high-risk GDM. The clinical GDM risk prediction model based on age, ethnicity, BMI, family history of diabetes mellitus and previous history of GDM can identify high-risk GDM pregnant women early, with an area under the curve (AUC) of 0.88 (95%CI 0.85–0.92).[24] The results of this study find that pre-pregnancy BMI, gestational weight gain and early pregnancy FPG are independent risk factors for GDM. The OR value of pre-pregnancy BMI is 1.78 (95%CI: 1.14–2.78), suggesting that pre-pregnancy obesity or overweight is an important early warning signal for GDM occurrence. The OR value of gestational weight gain is 1.68 (95%CI: 1.08–2.62), indicating that excessive gestational weight gain significantly increases the risk of GDM, which may be associated with the imbalance of energy metabolism and the aggravation of insulin resistance during pregnancy. As an indicator of reflecting baseline glucose metabolism, early pregnancy FPG has an OR value of 1.56 (95%CI: 1.03–2.39), revealing that pregnant women with mildly elevated blood glucose in early pregnancy are more likely to subsequently develop GDM, providing a basis for the early clinical identification of high-risk individuals. The prediction model constructed based on these three independent influencing factors exhibits an AUC of 0.75 (95%CI: 0.65–0.85), manifesting that the model possesses a good discriminatory ability and can accurately predict the risk of GDM.

Implications for policy and practice

Our findings have several implications. Firstly, early pregnancy FPG, pre-pregnancy BMI and gestational weight gain are simple and low-cost measures that can be integrated into routine antenatal nursing to identify women at high GDM risk. Secondly, women identified as high-risk can be targeted for early lifestyle interventions, including dietary modification and physical activity, which have been shown to reduce GDM risk. Thirdly, healthcare systems should consider adopting risk-stratified approaches to GDM screening rather than a one-size-fits-all OGTT at 24–28 weeks. In resource-limited settings, our model can help prioritize women for OGTT or early glucose monitoring. Fourthly, pre-pregnancy counseling emphasizing healthy weight and glucose control potentially reduces the GDM occurrence.

Strengths and limitations

This study has several strengths. Firstly, the three predictors are routinely collected in clinical

practice, requiring no additional cost or specialized equipment. Secondly, the model is internally validated by Bootstrap resampling, and calibration curve and decision curve analyses confirm its clinical utility. Thirdly, the study focuses on a general obstetric population rather than a selected high-risk group, thus enhancing the generalizability.

However, several limitations should be acknowledged. This study includes a limited number of study subjects, all of whom are pregnant women from a single hospital. The sample selection is not representative and unable to reflect regional conditions due to geographical limitations and medical treatment bias. Whether the predictive indicators and model are applicable to large-scale screening remains to be discussed. Furthermore, this study only measures serum FPG in early pregnancy, and fails to monitor the concentration changes throughout the entire pregnancy and does not follow up the pregnancy outcomes. In the future, large-scale and multi-center studies can be carried out to explore the relationship between serum FPG levels in early, middle and late pregnancy and occurrence and prognosis of GDM, which will not only provide reliable clinical data to support the early prediction of GDM, but also offer insights into its possible role mechanism and its relationship with prognosis.

Conclusion

This study achieves its objective of evaluating the predictive value of early pregnancy FPG combined with pre-pregnancy BMI for GDM. The findings of this study demonstrate that pre-pregnancy BMI, gestational weight gain and early pregnancy FPG are independent risk factors for GDM. The prediction model combining these three factors shows moderate discrimination, good calibration and clinical net benefit.

Author contributions

Yanjuan Zhou was responsible for conception, design and manuscript writing. Li Li was responsible for collection and assembly of data. Wei Zhang was responsible for data analysis and interpretation. All authors were responsible for manuscript writing. All authors were responsible for the final approval of the manuscript.

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Conflict of interests

The authors declare no competing interests.

Data availability

The data are publicly available and have been uploaded to the magazine as attachments.

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