

A study on the correlation between serum levels of IL-33 and its receptor sST2 and GDM in pregnant women

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Abstract: Objective To explore the correlation between serum levels of interleukin-33 (IL-33) and its receptor soluble tumor suppressor 2 (sST2) and gestational diabetes mellitus (GDM) in pregnant women. Methods One hundred and fifteen pregnant women who underwent regular obstetric examination at the Obstetrics Department of Kunming Maternal and Child Health Hospital from September 2022 to September 2022 were retrospectively analyzed as the study subjects and were divided into the GDM group (n=53) and the normal glucose tolerance (NGT) group (n=62) on the basis of the results of the OGTT at 24-28 weeks' gestation. The differences in general information and laboratory indicators between the two groups were compared. The risk of GDM in pregnant women was analyzed by multifactorial logistic regression; the correlation of IL-33 and sST2 levels with fasting glucose (FPG) and insulin resistance index (HOMA-IR) at OGTT time was analyzed by Pearson's linear analysis; and the predictive value of IL-33 and sST2 levels on the risk of GDM in pregnant women was analyzed by using the subject's work characteristics (ROC) curve. The predictive value of IL-33 and sST2 levels on the risk of GDM in pregnant women was also analyzed using the ROC curve. Results The results of univariate analysis showed that fasting insulin (FINS), hemoglobin (Hb), total cholesterol (TC), FBG, eosinophil count (EOS), glutamyltransferase (GGT), HOMA-IR, IL-33, and sST2 were higher than those in the NGT group in the GDM group, and the amount of post-partum hemorrhage and LDL were lower than that in the NGT group ($P<0.05$). $P<0.05$); Pearson linear correlation analysis showed that serum IL-33 level was negatively correlated with maternal FPG and HOMA-IR in the GDM group ($P<0.05$), and sST2 level was positively correlated with maternal FPG and HOMA-IR in the GDM group ($P<0.05$); multifactor logistic regression analysis The results showed that a total of six indicators, FINS, Hb, FBG, HOMA-IR, IL-33 and sST2, were independent risk factors for the occurrence of GDM in pregnant women ($P<0.05$), in which the higher the levels of serum FINS, Hb, FBG, HOMA-IR, IL-33 and sST2, the higher the risk of occurrence of GDM; and the results of ROC curve analysis showed that: The area under the curve (AUC) of the two combined to predict the occurrence of GDM in pregnant women was 0.911, with a sensitivity of 85.06% and a specificity of 83.39%, which had a higher predictive value compared with a single indicator ($P<0.05$). Conclusion Serum IL-33 and its sST2 levels were significantly increased after the occurrence of GDM in pregnant women, and the

levels of serum IL-33 and its receptor sST2 could be used to predict the occurrence of GDM in pregnant women, which has an ideal evaluation value and is worthy of popularization and application.

Keywords: pregnant women; serum IL-33 levels; sST2 levels; GDM; correlation

Gestational diabetes mellitus (GDM) is any degree of glucose tolerance abnormality first detected or produced during pregnancy, which is characterized by insufficient pancreatic β -cell function for insulin resistance, leading to glucose metabolism disorders, and is one of the common comorbidities in pregnancy^[1]. Epidemiological surveys show that the global prevalence of GDM is about 1% to 28%, while the prevalence of GDM in China is as high as 17.5%^[2-3]. GDM not only increases the risk of complications such as eclampsia, hypertension, fetal macrosomia, etc., but also produces a series of adverse effects on newborns such as newborn hypoglycemia, jaundice, respiratory distress syndrome, etc.^[4] Mathew et al.^[5] relevant studies show that GDM is associated with an increased risk of type 2 diabetes in both mother and child. Currently, the Oral glucose tolerance test (OGTT) at 24-28 weeks of pregnancy is the main clinical test to detect GDM in pregnant women, and there is a lack of effective means to assess the occurrence of GDM at an early stage^[6]. Therefore, it is particularly important to explore more efficient diagnostic methods and criteria for disease assessment.^[7] It has been found that serum interleukin-33 (IL-33) and soluble tumor suppressor 2 (sST2) levels are involved in a variety of inflammatory and metabolic diseases, so exploring the correlation between these levels and GDM is of far-reaching clinical significance and research value. However, there are few clinical reports on the correlation between serum IL-33 and sST2 levels and GDM, and even fewer reports on the predictive value of GDM. Therefore, in the present study, we assessed the GDM of women who underwent regular obstetric examination in our hospital by using serum IL-33 and sST2 levels in order to provide theoretical basis for the early prevention of the occurrence of GDM, and the methodology and results are now reported as follows.

1 Information and Methods

1.1 General information

One hundred and fifteen pregnant women who underwent regular obstetric examination in the Department of Obstetrics and Gynaecology of Kunming Maternal and Child Health Hospital from September 2022 to September 2022 were retrospectively analyzed as the study subjects, among whom the age ranged from 21 to 42 years old, with an average of (30.22 ± 8.12) years old, the number of pregnancies ranged from 1 to 8, with an average of (2.39 ± 0.91) , and the number of deliveries ranged from 1 to 4, with an average of (1.61 ± 0.95) . They were divided into GDM group ($n=53$) and NGT group ($n=62$) according to the

results of OGTT at 24-28 weeks of pregnancy. GDM group: age 21-42 years old, mean (30.41±8.51) years old, 1-6 pregnancies, mean (2.38±0.46) times, and 1-3 deliveries, mean (1.73±0.76) times; NGT group: age 22-41 years old, mean (22.39±0.91) years old, mean (1.61±0.95) times. 22-41 years old, mean (30.05±8.07) years old, 1-8 pregnancies, mean (2.39±0.65) times, 1-4 deliveries, mean (1.51±0.76) times. Inclusion criteria: (1) age ≥20 years old pregnant women filed in the obstetrics department of our hospital; (2) singleton pregnancy; (3) regular obstetric examination and completion of glucose tolerance test (OGTT) at 24-28 weeks of gestation; (4) the GDM group complied with the International Association of Diabetes and Pregnancy Study Groups, IADPSG, and the International Association of Diabetes and Pregnancy Study Groups, IADPSG, and IADPSG. Study Groups (IADPSG)^[8] and the diagnosis was confirmed by OGTT. Exclusion criteria: (1) type 1 or type 2 diabetes mellitus diagnosed before or during pregnancy; (2) other serious pregnancy complications; (3) long-term use of corticosteroids, antipsychotics, or other medications that may affect blood glucose generation during pregnancy; (4) participation in other clinical trials during pregnancy. This study was approved by the Ethics Committee of Kunming Maternal and Child Health Hospital, and the mothers agreed and signed an informed consent form.

1.2 Methodology

(1) General information: including age, pre-pregnancy BMI, pregnancy, delivery, week of delivery, comorbidities (hypertension, thyroid disease) and postpartum hemorrhage; (2) Laboratory indicators: ① serum sample collection: early morning collection of pregnant women's peripheral venous blood 2mL, placed in a blood collection tube containing procoagulant, the use of 15,800r/min micro-high-speed centrifuge (Shenzhen Reward Life Science and Technology Co. Ltd.; Model: M1324R), with a centrifugal radius of 8cm for 10min, the serum was extracted and placed in EP tubes for sample distribution, and stored in -40°C laboratory reagents, vaccines and medicines freezer (Shanghai Kolok Bio-medical Instrumentation Co., Ltd.; Model: DW-86L290); ② examination methods: the use of automatic biochemistry combined with the supporting reagents to determine the pregnant women's fasting insulin (FINS), hemoglobin (Hb), total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), fasting blood glucose (FBG), white blood cell count (WBC), the percentage of neutrophils (N%), neutrophils and lymphocytes ratio (NLR), monocyte count (Mon), eosinophil count (EOS), and the number of cells (EOS). granulocyte count (EOS), alkaline phosphatase (ALP), glutamyltransferase (GGT), uric acid (UA), interleukin-33 (IL-33), and soluble tumor suppressor 2 (sST2) levels, and the insulin resistance index (HOMA-IR) was calculated, with $HOMA-IR = FBG (mmol/L) \times FINS (\mu U/mL) / 22.5$.

1.3 Statistical analysis

SPSS 25.0 statistical software was used to implement the statistical assessment of the data obtained in this study. Normal distribution count data were expressed as mean±standard deviation ($\bar{x} \pm s$) by t-test, and count data were expressed as percentage by χ^2 test. IL-33 and sST2 levels were correlated with FPG and HOMA-IR at the time of OGT T by Pearson's straight line, and Spearman's rank was used to analyze the correlation analysis if the levels did not meet the normal distribution. Multifactorial logistic regression was used to analyze IL-33 and sST2 levels as independent risk factors for the development of GDM in pregnant women, and based on the logistic regression model, the receiver operating characteristic (ROC) curve was drawn for IL-33 and sST2 levels, and the area under the curve (AUC) was calculated. The area under the ROC curve (AUC) was calculated to assess the predictive value. $p < 0.05$ indicates statistically significant difference.

2 Results

2.1 Univariate analysis of risk factors associated with the occurrence of GDM in pregnant women

Pregnant women in the GDM group had higher FINS, Hb, TC, FBG, EOS, GGT, HOMA-IR, IL-33, and sST2 than those in the NGT group, and post-partum hemorrhage and HDL were lower than those in the NGT group ($P < 0.05$); the other indicators were compared ($P > 0.05$). See **Table 1**.

Table 1. Univariate analysis of risk factors associated with the occurrence of GDM in pregnant women [$\bar{x} \pm s$, n]

norm	GDM group (n=53)	NGT group (n=62)	χ^2 /t value	P-value
Age (years)	30.41±8.51	30.05±8.07	0.233	0.817
Pre-pregnancy BMI (kg/m) ²	25.99±2.45	26.27±2.68	0.581	0.562
Number of pregnancies (times)	2.38±0.46	2.39±0.65	0.094	0.926
Number of births (times)	1.73±0.76	1.51±0.76	1.547	0.125
Gestational week of delivery (weeks)	38.65±3.84	38.59±3.22	0.091	0.928
high blood pressure Yes/No	2/51	4/58	0.414*	0.520
Thyroid Diseases Yes/No	2/51	5/57	0.920*	0.337
Postpartum hemorrhage (mL)	327.05±20.88	351.25±20.57	6.245	<0.001
FINS (mIU/L)	14.59±8.59	4.54±1.34	9.090	<0.001
Hb(g/L)	126.75±6.47	123.55±9.61	2.058	0.042
TC (mmol/L)	6.02±1.68	5.29±1.56	2.414	0.017
TG (mmol/L)	4.19±1.36	3.91±0.37	1.556	0.122
HDL (mmol/L)	1.65±0.75	1.95±0.27	2.937	0.004
LDL (mmol/L)	2.95±0.52	3.02±0.22	0.964	0.337
FBG (mmol/L)	5.52±2.58	4.12±2.46	2.974	0.004
WBC (×10 ⁹ /L)	8.87±2.77	9.25±2.66	0.749	0.455
N%(%)	72.67±10.92	73.72±10.16	0.534	0.595
NLR	19.77±5.92	18.62±5.83	1.047	0.297
Mon(×10 ⁹ /L)	6.35±1.28	6.44±1.83	0.301	0.764
EOS (×10 ⁹ /L)	0.88±0.09	0.78±0.06	7.098	<0.001
ALP (mIU/L)	172.84±28.15	174.01±19.16	0.264	0.793
GGT (IU/L)	19.12±5.26	17.01±4.23	2.384	0.019
UA (μmol/L)	354.61±71.69	366.33±72.88	0.866	0.388

HOMA-IR	2.64±0.21	1.76±0.74	8.369	<0.001
IL-33 (pg/mL)	35.69±8.04	32.21±9.89	2.047	0.043
sST2 (pg/mL)	146.42±26.09	90.11±13.01	14.964	<0.001

Note: * is the χ^2 value.

2.2 Correlation analysis of serum IL-33 and sST2 levels with maternal FPG and HOMA-IR in GDM group

Using Pearson linear correlation analysis, serum IL-33 level showed negative correlation with maternal FPG and HOMA-IR in GDM group ($P<0.05$); sST2 level showed positive correlation with maternal FPG and HOMA-IR in GDM group ($P<0.05$). See **Table 2**.

Table 2. Correlation analysis of serum IL-33 and sST2 levels with maternal FPG and HOMA-IR in GDM group

norm	FPG		HOMA-IR	
	r	P	r	P
IL-33	-0.733	0.003	-0.689	0.009
sST2	0.672	0.011	0.542	0.027

2.3 Multifactorial regression analysis of risk factors associated with the occurrence of GDM in pregnant women

Logistic regression analysis was performed with the occurrence of GDM in pregnant women as the dependent variable, and 11 statistically significant factors in the univariate analysis as the independent variables (see Table 3 for descriptions of the independent variables), and the results showed that a total of 6 indexes, including FINS, Hb, FBG, HOMA-IR, IL-33, and sST2, were the independent risk factors for the occurrence of GDM in pregnant women ($P<0.05$); among them, the higher the levels of serum FINS, Hb, FBG, HOMA-IR, IL-33 and sST2, the higher the risk of developing GDM. See **Table 4**.

Table 3. Description of independent variables

independent variable	Description of variables	Assignment of values
Postpartum hemorrhage	continuous variable	Substitute the original value
FINS	continuous variable	Substitute the original value
Hb	continuous variable	Substitute the original value
TC	continuous variable	Substitute the original value
HDL	continuous variable	Substitute the original value
FBG	continuous variable	Substitute the original value
EOS	continuous variable	Substitute the original value
GGT	continuous variable	Substitute the original value
HOMA-IR	continuous variable	Substitute the original value
IL-33	continuous variable	Substitute the original value
sST2	continuous variable	Substitute the original value

Table 4. Results of multifactorial logistic regression analysis of risk factors associated with the occurrence of GDM in pregnant women

variant	beta value	SE	Wald χ^2	P-value	OR	95% CI
Postpartum hemorrhage	-0.118	0.453	1.014	0.416	0.282	0.025~1.509
FINS	0.966	0.444	11.279	<0.001	5.325	3.378~22.811
Hb	0.959	0.433	11.377	0.009	3.041	1.069~11.855
TC	0.049	0.379	0.833	0.237	0.825	0.325~1.381
HDL	-0.052	0.266	0.177	0.223	0.591	0.231~1.914
FBG	0.833	0.624	8.633	0.009	2.145	1.044~11.258
EOS	0.256	0.078	0.757	0.175	0.752	0.101~1.316
GGT	0.033	0.391	1.544	0.112	0.323	0.269~1.245
HOMA-IR	0.841	0.382	10.176	0.006	2.556	1.124 to 12.164
IL-33	0.769	0.424	15.614	<0.001	3.743	1.023~26.926
sST2	0.943	0.286	21.834	<0.001	4.842	4.387~28.353

2.5 Comparison of the predictive value of serum IL-33 and sST2 levels alone and in combination for the development of GDM in pregnant women

ROC curve analysis showed that the combination of the two predicted the occurrence of GDM in pregnant women with an AUC of 0.911, a sensitivity of 85.06%, and a specificity of 83.39%, which had a higher predictive value compared to a single indicator ($P<0.05$). See Table 5 with Figure 1.

Table 5. Comparison of the predictive value of serum IL-33 and sST2 levels alone and in combination for the development of GDM in pregnant women

norm	truncation value	Sensitivity (%)	Specificity (%)	AUC	95% CI	
					limit	lower limit
IL-33	>33.08pg/mL	68.55	72.71	0.788	0.722	0.843
sST2	>117.36pg/mL	71.55	68.16	0.751	0.688	0.806
joint test	-	85.06	83.39	0.911#	0.863	0.946

Note: Comparison with other indicators, # $P<0.05$.

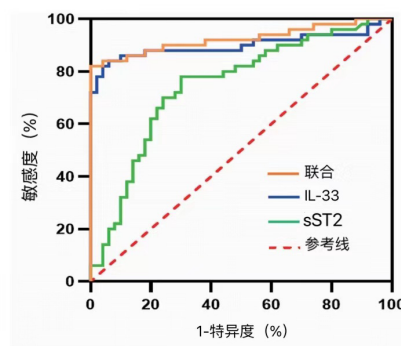


Figure 1. ROC curves of serum IL-33 and sST2 levels alone and in combination to predict the occurrence of GDM in pregnant women

3 Discussion

3.1 Risk factors for maternal GDM

Currently, the mainstream screening methods for GDM include OGTT and glycosylated hemoglobin (HbA1c), but these two methods are cumbersome, affected by diet, hormones and other physiological factors, and do not have a high degree of specificity and sensitivity, so there are some limitations in clinical practice^[9]. Therefore, it is important to explore a more simple and feasible test that is not affected by other factors for the prediction of GDM. The results of this study showed that pregnant women in the GDM group had higher levels of FINS, Hb, TC, FBG, EOS, GGT, HOMA-IR, IL-33, and sST2 than those in the NGT group, and lower levels of postpartum hemorrhage and HDL than those in the NGT group ($P < 0.05$), which was similar to the results of Julia et al.^[10], suggesting that serum IL-33 and sST2 levels can be used to scientifically assess the risk factors of GDM in women. GDM risk factors. The reason for this is that high FINS and HOMA-IR can directly reflect the insulin secretion and use of pregnant women, and pregnancy is a physiological state of insulin resistance, and when insulin secretion is insufficient to cope with insulin resistance, it may lead to the occurrence of GDM; disorders of glucose metabolism, lipid metabolism disorders, and liver dysfunction play a key role in GDM, and high FBG indicates that the metabolism of glucose is impaired in the body. High TC and low HDL indicate that lipid metabolism is impaired in the body, and high GGT indicates that liver dysfunction occurs in the body, which may increase the risk of GDM to a certain extent; elevated Hb level may be related to the oxygen-carrying capacity of the body and the increase of red blood cells in the pregnant women, which may increase the risk of GDM in pregnant women; the increase in the number of EOS reflects the state of inflammation in the body, which has been proved to be related to insulin resistance and GDM; and the increase in EOS has been related to insulin resistance and GDM. It has been shown to be related to insulin resistance and GDM; low postpartum hemorrhage may be due to abnormal metabolism or insufficient function of the placenta, which is an important tissue at the maternal-fetal interface and has the function of nutrient delivery as well as participating in the secretion of a variety of biologically active substances, and when abnormalities occur in the placenta, it may lead to an increase in insulin resistance, which may affect glucose metabolism of the pregnant woman and increase the risk of GDM; serum IL-33 is a cytokine with a variety of biological functions. cytokine with multiple biological functions, which plays a central role in the pathogenesis of inflammation, autoimmunity and a variety of other diseases. sST2 is the main receptor for IL-33, and after binding to IL-33, it can regulate a variety of cellular functions, such as T-cells, macrophages, endothelial cells, etc. The mother's body undergoes a series of physiological changes during pregnancy to adapt to the growth needs of the fetus, but when the serum IL-33, sST2 levels are abnormal, it may lead to enhanced inflammatory response and increased insulin resistance

in pregnant women, thus leading to GDM. In addition, the results of multifactorial regression analysis showed that a total of six indicators, FINS, Hb, FBG, HOMA-IR, IL-33 and sST2, were independent risk factors for the development of GDM in pregnant women ($P < 0.05$), similar to the results of the study by Alwash et al.^[11]

3.2 Correlation of serum IL-33 and sST2 levels with maternal FPG and HOMA-IR in GDM group

The pathogenesis of GDM involves the interaction of many factors, among which insulin resistance, inflammatory response and genetic factors play key roles, and in-depth study of these mechanisms is of great significance for the prevention and treatment of GDM. In the present study, the results of Pearson linear correlation analysis showed that serum IL-33 level was negatively correlated with maternal FPG and HOMA-IR in the GDM group ($P < 0.05$), and sST2 level was positively correlated with maternal FPG and HOMA-IR in the GDM group ($P < 0.05$), which was similar to the results of the study conducted by Kuitunen et al.^[12]. similarly. The reasons were analyzed as (1) serum IL-33 level may reduce the inflammation level in pregnant women by inhibiting the inflammatory pathway, thus positively affecting insulin sensitivity and enabling insulin to exert a better effect in vivo, so serum IL-33 level showed a negative correlation with FPG; (2) IL-33 may affect the function of pancreatic islet cells either directly or indirectly and promote insulin secretion from islet cells, thus improving maternal FPG and HOMA-IR in GDM group ($P < 0.05$). thus improving maternal insulin resistance in GDM, so the serum IL-33 level is negatively correlated with HOMA-IR; (3) when the serum sST2 level is increased, the amount of IL-33 can be reduced, which may attenuate the role of IL-33 in inhibiting inflammation and enhancing islet cell function, leading to the rise of inflammation level in the body, the increase of inflammatory factor release, which in turn leads to the blockage of insulin signaling Therefore, sST2 level showed positive correlation with FPG and HOMA-IR.

3.3 Efficacy of serum IL-33 and sST2 levels alone and in combination to predict the occurrence of GDM in pregnant women

Serum IL-33 and sST2 levels are simple, fast, minimally invasive, highly reproducible and specific, and can provide real-time and accurate data for clinical support. Compared with the traditional glucose metabolism testing methods, there is no need for prolonged water loading or multiple glucose monitoring, which effectively reduces the discomfort and risk of complications during the testing process. The results of the present study showed that the AUC of the two combined tests for predicting the occurrence of GDM was significantly higher than that of a single indicator ($P < 0.05$), suggesting that serum IL-33 and sST2 levels have a desirable effect in predicting the occurrence of GDM in pregnant women. Serum IL-33 and sST2 levels, as novel inflammatory factors, are closely

related to metabolic disorders and insulin resistance. Compared with the OGTT method, checking serum IL-33 and sST2 levels has higher specificity and sensitivity, and it can be used as a biomarker for the early prediction of GDM, which provides a new direction for the early screening, diagnosis, and management of GDM, combining serum IL-33, sST2 levels with traditional methods can help to develop individualized management strategies for high-risk GDM patients in a more accurate and timely manner, thus better protecting the health of mothers and infants.

3.4 Summary

In summary, serum IL-33 and its receptor sST2 levels were significantly elevated after the occurrence of GDM in pregnant women, and serum IL-33 and its receptor sST2 levels can be used to predict the occurrence of GDM in pregnant women, which has a desirable value and is worthwhile to be promoted and applied. However, there are some shortcomings in this study. Firstly, the sample size of this study is relatively limited, representing only the obstetrics group of Kunming Maternal and Child Health Hospital, so the results may be affected by geographic, racial, and genetic factors, and may not be comprehensively representative; secondly, the study only examined the correlation between serum IL-33 and sST2 levels and GDM, and did not cover other cytokines or inflammatory mediators that may affect the development of GDM, which may lead to some bias in the results. which may lead to some bias in the results; again, this study used a cross-sectional study design, which could not accurately assess the causal relationship between changes in serum IL-33 and sST2 levels and the development of GDM, and could only draw correlation conclusions; furthermore, this study did not explore the biological functions of serum IL-33 and sST2 levels in depth, and the specific mechanisms of how they mediate or modulate GDM are still In addition, this study did not explore the biological functions of serum IL-33 and sST2 levels in depth. Therefore, a larger sample size, multicenter, prospective, and more rigorously designed randomized controlled trial is needed for further validation and confirmation.

bibliography

[1]Brittany R. A , Samantha M D , Linda M ,et al. Resistance Training as a Countermeasure in Women with Gestational Diabetes Mellitus: a Review of Current Literature and Future Directions[J].Sports medicine, 2022,52(12):2871-2888.

[2]Loo E X L , Zhang Y , Yap Q V ,et al.Comparative epidemiology of gestational diabetes in ethnic Chinese from Shanghai birth cohort and growing up in Singapore towards healthy outcomes cohort[J].BMC Pregnancy and Childbirth, 2021, 21(1):566.

[3]Stalheim A M , Iversen M , Jenum A K ,et al. Seasonal variation in gestational diabetes mellitus among women in Norway: a national population-based study[J].BMJ Open, 2023, 17(13):1012-1018.

[4]Derya A , Elif C E .Evaluation of the circulating serum endotrophin in women with and without gestational diabetes mellitus during second trimester[J].International journal of diabetes in developing countries. 2022,42(4):614-620.

- [5] Mathew N P , Rao A P , Narayanan P .Barriers to postpartum follow-up of mothers with gestational diabetes mellitus and its implications: a mixed method study[J].International journal of diabetes in developing countries. 2022,42(1):173.
- [6] Grnvall L , Skjeldestad F E .Changed definition of disease and broader screening criteria had little impact on prevalence of gestational diabetes mellitus[J].Acta obstetricia et gynecologica Scandinavica, 2022, 101(6):581-588.
- [7] Hiroki H , Kazumasa T , Sasagu K ,et al. Interleukin-33 and Soluble ST2 Levels in Infants with Hypoxic-Ischemic Encephalopathy[J].Neonatology, 2023 Neonatology, 2023 ,120(3):353-362.
- [8] Metzger B E , Gabbe S G , Persson B ,et al. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy: Response to Weinert[J].Diabetes Care, 2010,33(3):676-682.
- [9] Jamieson E , Spry E , Kirke A ,et al. Real-world screening for diabetes in early pregnancy: improved screening uptake using universal glycated haemoglobin.[J].Primary care diabetes, 2021, 15(6):995-1001.
- [10] Julia Günther, Hoffmann J , Stecher L ,et al. How does antenatal lifestyle affect the risk for gestational diabetes mellitus? A secondary cohort analysis from the GeliS trial.[J].European journal of clinical nutrition, 2022,76(1):150-158.
- [11] Alwash S M , McIntyre H D , Mamun A .The association of general obesity, central obesity and visceral body fat with the risk of gestational diabetes mellitus: Evidence from a systematic review and meta-analysis[J].Obesity Research & Clinical Practice, 2021,15(5):425-430.
- [12] Kuitunen I , Vh-Tuisku S , Huttunen T .Gestational diabetes mellitus and labor analgesia: nationwide register-based analysis in Finland[J].Acta Diabetologica, 2022, 59(11):1515-1517.