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ORIGINAL RESEARCH

Development of a Model to Predict Cesarean Delivery as the Outcome of a Failed Labor Induction in Singleton Obese Pregnant Women at Term

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Background: Maternal obesity is a major global public health issue. Induction of labor (IoL) is common in obstetrics. Both the rate of IoL and induction failure rate are higher in obese women than in those with normal body mass index (BMI). This study aimed to construct a model to predict the failed IoL with a caesarean section (CS) as the outcome among term singleton obese pregnant women.

Methods: Electric health records of term singleton obese pregnant women were retrieved from Beijing Obstetrics and Gynecology Hospital from February 2018 to December 2022 (discovery cohort), and January to December 2024 (validation cohort). CS was defined as the outcome of failed IoL. Univariate logistic regression analysis was used to identify the risk factors, and multivariate logistic regression (stepwise and backward) was used to construct the prediction model. Performance was assessed using the area under the receiver operating characteristic curve (AUC) and internally validated with the validation cohort.

Results: Pre-pregnant BMI (OR 1.074, 95% CI 1.016–1.135, p=0.011), gestational weight gain (OR 1.033, 95% CI 1.006–1.062) and neonatal weight (OR 1.673, 95% CI 1.175–2.380, p=0.004) were identified as the risk factors of a failed IoL, whereas gravidity (OR 0.706, 95% CI 0.592–0.844, p<0.001), parity (OR 0.105, 95% CI 0.055–0.198, p<0.001), height (OR 0.935, 95% CI 0.907–0.963, p<0.001) and Bishop score (OR 0.892, 95% CI 0.799–0.996, p=0.042) as the protective factors. The final model included parity, height, pre-pregnant BMI, gestational weight gain, Bishop score, and neonatal weight, achieving an AUC of 0.752 (95% CI, 0.717–0.788) in the discovery cohort and 0.826 (95% CI 0.757–894) in the validation cohort.

Conclusion: This practical model predicts the failed IoL among term singleton obese women using routinely available variables. It may support obstetric decision-making, enhance counseling, and improve resource planning for women at increased risk of intra- and postpartum complications.

Keywords: induction of labor, cesarean section, obesity, prediction model

Introduction

Obesity in pregnancy women is a growing public health problem worldwide. According to the China Chronic Disease and Risk Factor Surveillance, the prevalence of obesity among women increased from 8.1% in 2004 to 14.1% in 2013–14.[1] It was estimated that more than 4.28 million pregnant women in China were overweight or obese in 2014, which increased by 33.9% from 2005.[2] The World Health Organization defines Body Mass Index (BMI) over 30 kg/m^2 as obesity,[3] whereas in China, it is defined as BMI over 28 kg/m^2,[4] reflecting ethnic social-economic differences. Obesity significantly increases the risks of pregnancy complications, such as gestational diabetes, pre-eclampsia, gestational hypertension and depression,[5–7] and is also associated with adverse maternal and fetal outcomes. For example, Gonzalez-Plaza et al reported higher odds of caesarean section (CS) in obese women compared with women of normal weight (OR 2.68 95% CI 2.18–3.29), and their offsprings were at higher risk to be macrosomia (OR 2.03 95% CI 1.40–2.93).[8] A population-based cohort study in Sweden further showed that maternal obesity accounted for a substantial proportion of infant mortality (12.7% 95% CI 9.8–15.7) and maternal morbidity (8.5% 95% CI 6.0–11.0).[9] Meanwhile, the rate of induction of labor (IoL)

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increased with BMI from 28% in normal weight women to 34% in those with class III obesity,[10] and the induction failure rate was significantly higher in obese women than in women of normal group (47.8% vs 26.7%, p=0.01).[11]

IoL is a common obstetric practice. In the United States, the overall rate of IoL increased from 9.6% in 1990 to 27.1% in 2018, then 31.4% in 2020.[12] In China, the overall weighted rate of IoL was 14.2% in 2015–2016, with 18.4% in nulliparas and 10.2% in multiparas.[13] IoL aims to reduce adverse maternal and fetal outcomes, such as CS and traumatic birth. The ARRIVE trial showed that IoL at 39 weeks in low-risk nulliparous women significantly reduced the frequency of CS, compared with expectant management.[14] A comprehensive meta-analysis of 34 randomized trials including more than 21,000 women at or beyond 37 gestational weeks and infants also demonstrated that IoL not only lowered CS rate, but also reduced the risk of perinatal deaths and neonatal intensive care unit admission.[15]

The definitions of failed IoL remain inconsistent. Grobman et al proposed that 15 hours of oxytocin after rupture of membrane (ROM) without progression to the active phase of labor (≥5 cm dilated regardless of effacement) constitutes failed IoL,[16] whereas another study defined the active labor as ≥6 cm dilation regardless of effacement and considered a latent phase after oxytocin initiation of at least 12 hours for nulliparous women and 15 hours for multiparous women following ROM as a failed induction.[17] The 2024 Guideline of cervical ripening and labor induction during the third trimester pregnancy, endorsed by the Obstetrics subgroup of Chinese Society of Obstetrics and Gynecology, Chinese Medical Association, defines a failed IoL as 18 hours of intravenous oxytocin infusion to induce effective uterine contractions after ROM without progression to labor.[18] However, to instruct the clinical practice more directly, many obstetricians prefer applying the outcome, instead of the progress to define a failed IoL. In this case, the vaginal delivery is usually considered as the main outcome of IoL, whereas CS is recognized as the outcome of a failed IoL.

The Bishop score, a cervical assessment system, is traditionally used to predict the success of IoL. However, because it is subjective, its predictive performance and reproducibility are uncertain in the real-world settings. A systematic review of 40 primary studies identified the Bishop score as a poor predictor for the CS outcome of IoL at term, reporting sensitivity-specificity pairs of 47%–75%, 61%–53% and 78%–44% for the Bishop scores of 4, 5 and 6.[19] Beyond the Bishop score, several studies applied other clinical and/or ultrasonographic factors to predict IoL outcomes. Tolcher et al developed a nomogram incorporating maternal age, height, BMI, weight change, gestational age, hypertension, diabetes and initial cervical dilation to predict CS among term nulliparous women achieving a bias-corrected c-index of 0.709.[20] Another model integrating nulliparity, gestation age ≥40 weeks, BMI at delivery, modified Bishop score and height predicted CS in term singleton pregnancies with intact membranes and an unfavorable cervix, with a calculated areas under the curve (AUC) of 0.73.[21] Although these models provided reasonable predictive ability, they were generally derived from broader obstetric populations with relatively few obese women. Therefore, their performances in the obese pregnant women specifically are still unknown. Rossi et al developed a model in a US population-based cohort of obese women with singleton term births that achieved an AUC of 0.79.[22] However, inclusion of context-specific variables (eg, Medicaid type) may limit its generalization in other countries.

This study aimed to develop a predictive model for failed IoL with CS as the outcome among term singleton obese pregnant women, as defined by the Chinese criteria.

Methods

This retrospective study was approved by the Ethical Committee of Beijing Obstetrics and Gynecology Hospital, Capital Medical University (2018-KY-003-02). The study complies with the Declaration of Helsinki. The patient data were extracted from the hospital's electric health records for two periods: February 2018 to December 2022 (discovery cohort), and January to December 2024 (validation cohort). All the participants provided informed consents, and data were anonymized for analysis. CS was defined as the outcome of failed IoL in this study.

Participants

Inclusion Criteria

(1) Pre-pregnant BMI ≥ 28 kg/m^2; (2) singleton pregnancy; (3) term pregnancy (37^{+0} to 41^{+6} gestational weeks); (4) IoL for any indication.

Exclusion Criteria

(1) Multiple pregnancy; (2) miscarriage or preterm delivery (<37 gestational weeks); (3) elective CS; (4) CS indications due to fetal factors, such as fetal distress or placental abruption.

The general indications for CS among included participants were: (1) failure to progress to labor after 12–18 hours of intravenous oxytocin infusion following ROM; (2) no onset of labor after three consecutive days of IoL; (3) intrapartum arrest of cervical dilation or failure of fetal head descent.

Definition of the Complications and Bioshop Score

Hypertensive disorders in pregnancy: it includes chronic hypertension, gestational hypertension and pre-eclampsia. Chronic hypertension is defined as blood pressure ≥140/90 mmHg that develops either before pregnancy or within the first 20 weeks of gestation. Gestational hypertension presents after 20 weeks of gestation, resolves within 12 weeks postpartum, and is not accompanied by proteinuria. Preeclampsia is gestational hypertension associated with significant proteinuria.

Hyperglycemia in pregnancy: it includes preexisting diabetes (type 1 or type 2) and gestational diabetes mellitus (GDM). GDM develops during pregnancy and is diagnosed using a 75 g oral glucose tolerance test (OGTT). Diagnostic thresholds are fasting glucose >5.1 mmol/L, or 1-hour glucose >10.0 mmol/L or 2-hour glucose >8.5 mmol/L.

Bishop Score

Cervical assessment includes dilation, effacement, position, consistency, and fetal station. Each parameter is scored, with most ranging from 0 to 3; position and consistency are scored 0 to 2. The Bishop score is the sum of all parameter scores.

Statistical Analysis

Continuous variables were analyzed using the *t*-test when normally distributed and with the Mann–Whitney *U*-test when skewed. Categorical variables were compared using $\chi 2$ test. Normally distributed continuous variables were presented as means ±SD and non-normally distributed variables were presented as median and interquartile range (IQR). Univariate logistic regression analyses was used to identify the risk factors for a failed IoL. Multivariate logistic regression (stepwise and backward) was used to build the prediction model. Model discrimination was evaluated using the area under the receiver operating characteristic (ROC) curve (AUC). Calibration was assessed with the Hosmer-Lemeshow test and calibration plots. DeLong's test was used to compare the AUCs for the prediction model and the Bishop score. Analyses were performed using SPSS statistics V.29.0.

Results

From March 2018 to August 2022, 1,924 singleton obese pregnant women delivered at our hospital. After excluding women who had abortion, preterm deliveries, or elective CS, 1,234 remain eligible. Among these, 724 (37.1%) women underwent IoL. Of the 724 inductions, 379 (53.1%) resulted in vaginally delivery, and 345 (46.9%) in CS. An additional 36 CS cases were excluded because the indications were fetal factors, such as non-reassuring fetal heart rate status and placental abruption. Ultimately, 379 vaginally deliveries and 309 CS cases were included in the analysis (Figure 1).

The maternal antepartum and intrapartum characteristics, as well as neonatal weight and sex, are compared in Table 1. Compared with the CS group, the vaginal delivery group had more times in gravidity and parity (both p<0.001), and lower pre-pregnant BMI (p=0.002) and was taller (p<0.001). They also tended to have less gestational weight gain (p=0.053) and higher Bishop scores (p=0.052). Neonatal birthweight was significantly lower in the vaginal delivery group (p=0.039). In univariate logistic regression, all seven variables remained associated with failed IoL: gravidity (OR 0.706, 95% CI 0.592–0.844, p<0.001), parity (OR 0.105, 95% CI 0.055–0.198, p<0.001), height (OR 0.935, 95% CI 0.907–0.963, p<0.001) and bishop score (OR 0.892, 95% CI 0.799–0.996, p=0.042) were protective, whereas pre-pregnant BMI (OR 1.074, 95% CI 1.016–1.135, p=0.011), gestational weight gain (OR 1.033, 95% CI 1.006–1.062) and neonatal weight (OR 1.673, 95% CI 1.175–2.380, p=0.004) were risk factors (Table 2).

All seven variables were entered into a multivariate logistic regression to develop the prediction model for failed IoL. Six factors remained in the final model, including parity, height, pre-pregnant BMI, gestational weight gain, Bishop score and neonatal weight (Table 3). The final model was:

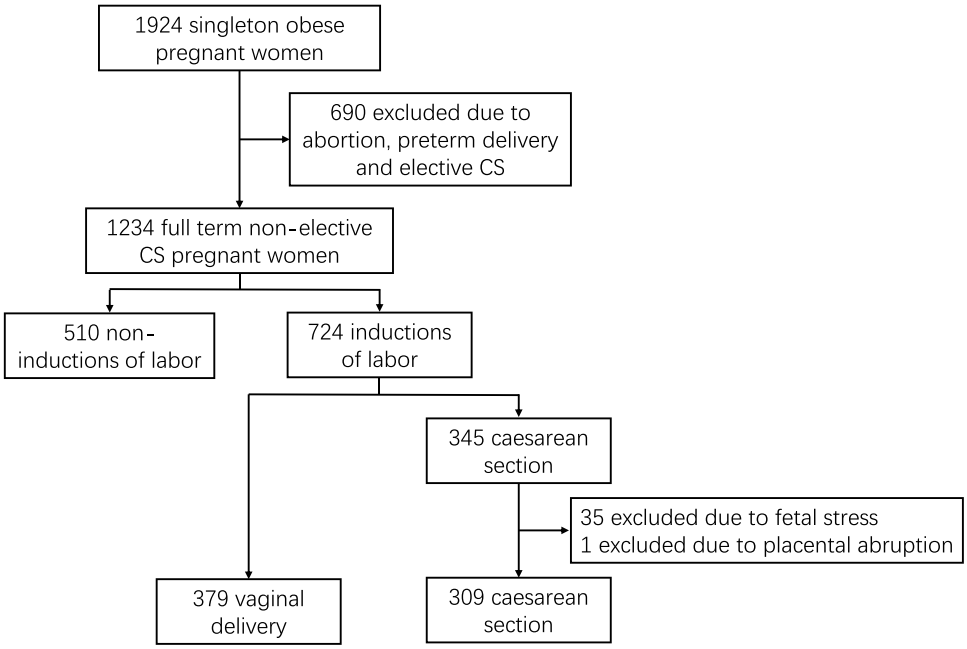

Figure 1 Flow chart to identify the discovery cohort.

LogitP=10.494–2.456*parity-0.092*height+0.127*pre-pregnant BMI+0.052*gestational weight gain-0.122*Bishop score+0.879*neonatal weight

The model achieved an AUC of 0.752 (95% CI, 0.717–0.788), with sensitivity of 0.689 and specificity of 0.694, significantly outperforming the Bishop score alone (AUC_{Bishop} 0.542, 95% CI 0.500–0.584; p<0.001, Figure 2A). The model passes the Hosmer-Lemeshow test with a significancy of 0.214, and the calibration plot showed good agreement between predicted and observed risks (Figure 2B).

Table 1 Baseline Characteristics of the Discovery Cohort

	Vaginal Delivery (n=379)	Caesarean Section (n=309)	p value
Age (year)	32 (30, 34)	32 (29, 35)	0.924
Gravidity	2 (1, 2)	1 (1, 2)	<0.001
Parity	1 (1, 2)	1 (1, 1)	<0.001
Height (cm)	165 (160, 168)	162 (160, 166)	<0.001
Pre-pregnant weight (kg)	83.0 (77.0, 88.0)	82.0 (75.0, 88.0)	0.319
Pre-pregnant BMI (kg/m2)	30.11 (28.90, 31.93)	30.44 (29.24, 32.72)	0.022
Gestational weight gain (kg)	9.0 (6.0, 12.1)	10.0 (6.5, 13.0)	0.053
Gestational age (week)	39 (39, 40)	39 (39, 40)	0.120
Gestational hypertensive disorder			
Yes	152	143	0.104
No	227	166	
Gestational diabetes mellitus			
Yes	164	135	0.912
No	215	174	
Bishop	4 (3, 5)	4 (3, 5)	0.052
Fundal height (cm)	35 (33, 36)	35 (33, 36)	0.284
Maternal abdominal circumference (cm)	115 (110, 119)	115 (111, 120)	0.282

(*Continued*)

Table 1 (Continued).

	Vaginal Delivery (n=379)	Caesarean Section (n=309)	p value
First medicine for labor induction			
Prostaglandins	206	173	0.899
Oxytocin	140	109	
Mechanical methods	33	27	
Neonatal weight (g)	3462 (411)	3558 (458)	0.004
Neonatal sex			
Male	184	164	0.238
Female	195	145	

Table 2 Univariate Logistic Analysis Showing Independent Variables Associated with Failed IoL

	OR	95% CI	p value
Gravidity	0.706	0.592–0.844	<0.001
Parity	0.105	0.055–0.198	<0.001
Height (cm)	0.935	0.907–0.963	<0.001
Pre-pregnant BMI (kg/m2)	1.074	1.016–1.135	0.011
Gestational weight gain (kg)	1.033	1.006–1.062	0.018
Bishop	0.892	0.799–0.996	0.042
Neonatal weight (kg)	1.673	1.175–2.380	0.004

Table 3 Multivariate Regression Logistic to Identify the Factors in the Model to Predict Failed IoL

	OR	95% CI	p value
Parity	0.086	0.044–0.166	<0.001
Height (cm)	0.912	0.882–0.944	<0.001
Pre-pregnant BMI (kg/m2)	1.136	1.063–1.214	<0.001
Gestational weight gain (kg)	1.053	1.019–1.088	0.002
Bishop	0.885	0.783–1.000	0.051
Neonatal weight (kg)	2.408	1.606–3.610	<0.001

Ultrasound plays an important role in assessing maternal and fetal welling-being. We next examined whether basic fetal ultrasound parameters could improve the prediction model. Because the ultrasound examination is not routinely performed before or during IoL at our hospital, and given the typical frequency of antenatal ultrasound examinations, we restricted this analysis to women with ultrasound data obtained within 7 days prior to IoL. This yielded 224 cases left in the vaginal delivery group and 187 cases in the CS group. The demographic characteristics of this sub-cohort (Table S1) were similar to those of the overall cohort, except that the gestational age was significantly lower in the vaginal delivery group and fundal height trended higher in the CS group. Among fetal ultrasound measures, head circumference, biparietal diameter and abdominal circumference are significantly smaller in the vaginal delivery group than in the CS group, whereas femur length did not differ (Table S1). In the univariate logistic regression analysis (Table 4), only head circumference remained significantly associated with failed IoL (OR 1.023, 95% CI 1.003–1.043, p=0.022) and biparietal diameter showed a nonsignificant trend (OR 1.053, 95% CI 0.991–1.119, p=0.097). Adding all four ultrasound parameters did not significantly improve the discrimination beyond the model with six clinical variables alone ($AUC_{ultrasound\ parameters+clinical\ factors}$ 0.767 vs $AUC_{clinical\ factors}$ 0.766, p=0.851, Figure S1). Cross-validation using sub-cohorts with and without ultrasound parameters showed that the model performance remained good (Figure S2 and Table S2).

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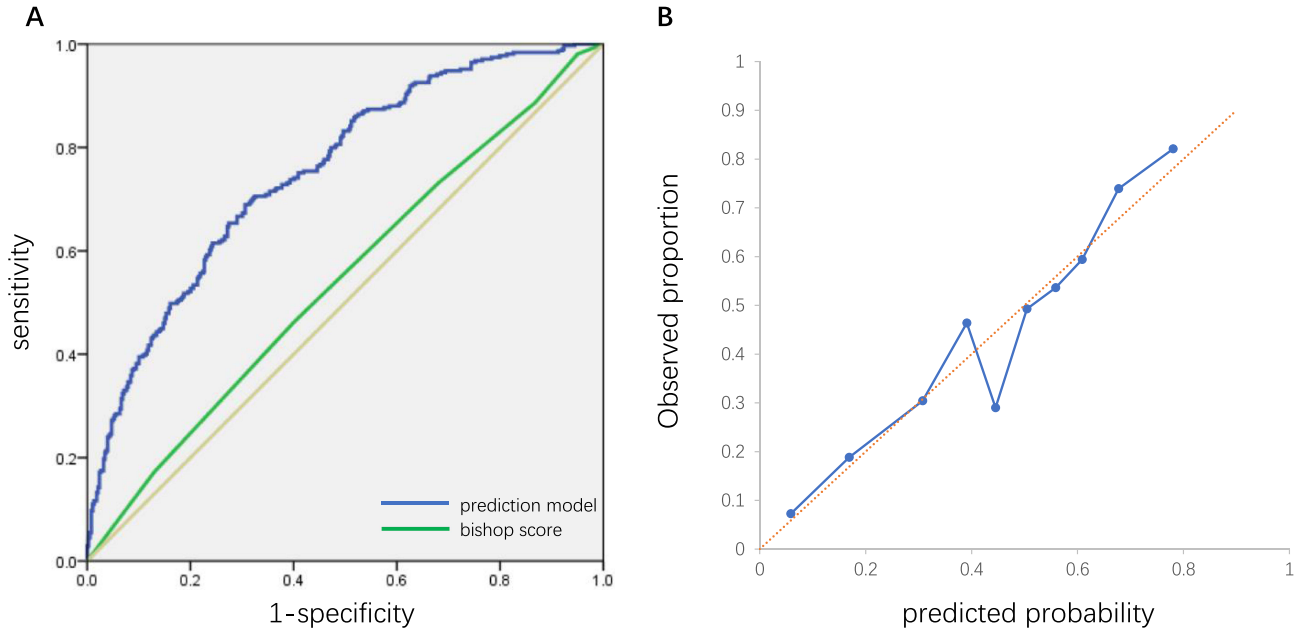

Figure 2 The predictive capability of the model in the discovery cohort. (**A**). AUC for the ability of the model to predict cesarean delivery. (**B**). Calibration plot generated by Hosmer-Lemeshow test for the predictive model.

To further validate the prediction model, another cohort of 134 obese women who underwent IoL at our hospital in 2024 was collected with the same criteria (71 cases in the vaginal delivery group and 63 cases in the CS group). The demographic characteristics of this validation cohort (Table 5) were similar to those of the discovery cohort, except that women in the vaginal delivery group were significantly older than those in the CS group (p=0.031), and the gestational weight gain did not differ between the groups (p=0.189). As shown in Figure 3, the AUC of the model in the validation cohort was 0.826 (95% CI 0.757–894) with sensitivity of 0.810 and specificity of 0.718, significantly outperforming the Bishop score alone (AUC_{Bishop} 0.610, 95% CI 0.513–0.707, p<0.001).

Discussion

In this study, we identified gravidity, parity, height and bishop score as the protective factors and pre-pregnant BMI, gestational weight gain and neonatal weight as the risk factors for failed IoL, with CS as the outcome, among term singleton obese pregnant women. Using these variables, excluding gravidity, we developed a prediction model that demonstrates good performance in both in the discovery and internal validation cohorts, and outperformed the Bishop score alone.

The rising prevalence of obesity in pregnancy places substantial pressure on the public health services worldwide. Obese pregnant women face increased intrapartum risks, and excess adiposity can make vaginal examination and abdominal palpation more challenging; consequently, they may require additional resources to ensure a safe delivery.[23] The model proposed in this study may support obstetricians in delivery planning and facilitate informed antenatal counseling with patients and their families. We do not advocate offering elective CS solely to "high risk" obese women

Table 4 Univariate Logistic Analysis Showing the Association of Fetal Ultrasound Biometry with Failed IoL

	OR	95% CI	p value
Head circumference	1.023	1.003–1.043	0.022
Biparietal diameter	1.053	0.991–1.119	0.097
Abdominal circumference - fetal	1.007	0.997–1.018	0.170

Table 5 Baseline Characteristics of the Validation Cohort

	Vaginal Delivery (n=71)	Caesarean Section (n=63)	p value
Age (year)	33 (30, 35)	31 (28, 34)	0.031
Gravidity	2 (1, 2)	1 (1, 2)	0.005
parity	1 (1, 2)	1 (1, 1)	<0.001
Height (cm)	165 (6)	162 (5)	0.004
Pre-pregnant weight (kg)	84.0 (77.5, 90.0)	82 (78.0, 88.7)	0.565
Pre-pregnant BMI (kg/m2)	30.11 (28.95, 32.65)	31.61 (29.29, 34.29)	0.021
Gestational weight gain (kg)	9.0 (6.5, 11.5)	10.0 (7.3, 13.0)	0.189
Gestational age (week)	39 (39, 40)	39 (38, 40)	0.680
Gestational hypertensive disorder			
Yes	34	37	0.209
No	37	26	
Gestational diabetes mellitus			
Yes	35	35	0.469
No	36	28	
Bishop	3 (3, 4)	3 (2, 4)	0.022
Fundal height (cm)	35 (33, 37)	35 (34, 37)	0.136
Maternal abdominal circumference (cm)	113 (8)	115 (9)	0.215
First medicine for labor induction			
Prostaglandins	52	46	0.780
Oxytocin	18	15	
Mechanical methods	1	2	
Neonatal weight (g)	3407 (430)	3553 (375)	0.039
Neonatal sex			
Male	31	33	0.313
Female	40	30	

identified by this model rather, the prediction could heightened preparedness for potential emergencies in this population. When IoL does not progress smoothly, a CS could be scheduled more promptly and in an orderly manner, thereby reducing the maternal and neonatal risks associated with emergency CS, such as infection, wound dehiscence and infant mortality.[24]

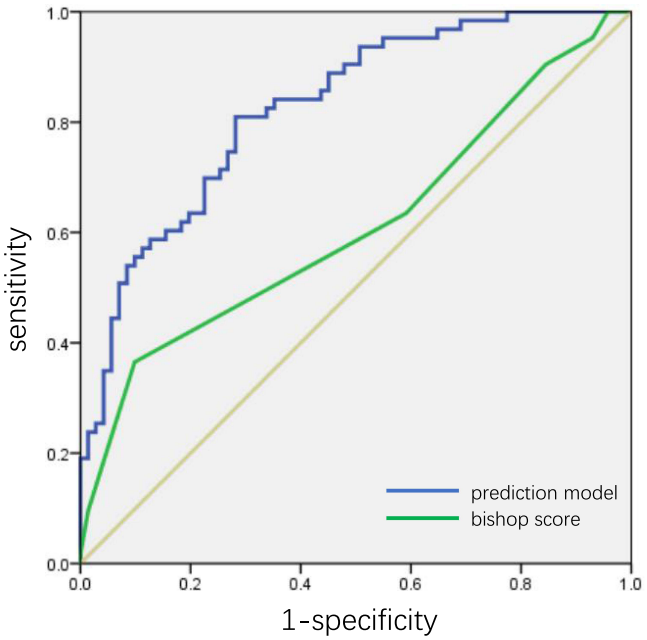

Figure 3 AUC for the ability of the model to predict failed IoL in the validation cohort.

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Previous studies have sought to identify risk factors for failed IoL in obese pregnant women. In a retrospective multicenter study from France, the investigators found that nulliparity ratio (OR 2.81), low Bishop score (OR 0.794) and weight gain (OR 1.04) were independent risk factors for failed IoL among women with class III obesity (BMI≥40kg/m^2).[25] Rossi et al reported that prior vaginal birth (OR 0.13), prior cesarean birth (OR 10.8), maternal height (OR 0.88), maternal age (OR 1.057), maternal weight at delivery (OR 1.008), parity (OR 0.90), gestational weight gain (OR 1.004), Medicaid (OR 1.17), pregestational diabetes (OR 1.64) and chronic hypertension (OR 1.15) were significantly associated with failed IoL.[22] The findings of this study are broadly consistent with these results. We did not observe significant associations between hypertensive disorders or hyperglycemia in pregnancy and failed IoL, likely due to their high prevalence in our cohorts. Maternal age also did not differ significantly between the vaginal delivery group and the CS group, possibly reflecting the tendency toward delayed childbearing in large cities in China. Women with a history of CS often underwent elective CS and were therefore not included in this study. From a preventive standpoint, limiting gestational weight gain has been shown to reduce CS rates among overweight and obese women.[26] The results here further support controlling gestational weight gain to improve the likelihood of successful IoL among obese women. Numerous trials have shown that lifestyle interventions, including diet modifications and physical activities, are associated reduced gestational weight gain and improved outcomes.[27] Obstetricians and nutritionists should closely monitor gestational weight gain in obese pregnant women and provide personalized and specific guidance. Because the risk of failed IoL increases with rising BMI among obese women,[28] weight control before pregnancy may also help reduce the likelihood of CS rate during IoL.

In addition to maternal factors, fetal factors also influence the success of IoL. We used neonatal birthweight as a proxy for estimated fetal weight because it more accurately reflects the effect of fetal size on IoL outcomes. To minimize scaling effects, the neonatal weight was entered in kilograms. Neonatal birthweight was clearly associated with failed IoL in obese women, consistent with prior findings in general obstetric populations.[29,30] Three fetal ultrasound parameters – head circumference, biparietal diameter and abdominal circumference – were significantly larger in the CS group than in the vaginal delivery group, but in univariate logistic regression only head circumference remained a risk factor for failed IoL. Adding these ultrasound parameters did not meaningfully improve the model's predictive performance. Although fetal ultrasound biometry in the third trimester has been associated with intrapartum CS,[31,32] its predictive value remains uncertain. Karaaslan et al reported that admission fetal ultrasound had poor discriminatory ability for emergency CS and did not improve the performance of the Bioshop score.[33] Similarly, Tan et al were unable to predict CS using ultrasound-estimated fetal weight in a cohort of 152 women undergoing IoL at term.[34] Beyond basic biometry, newer sonographic measures have been proposed to predict CS after IoL. Transvaginal sonographic assessment of cervical length is among the most studied. A meta-analysis of 31 studies reported sensitivities ranging from 0.14 to 0.92 and specificities from 0.35 to 1.00, indicating limited standalone predictive capacity.[35] The pre-induction fetal head-perineum distance before measured transperineally showed modest discrimination (AUC=0.62) and contributed, along with parity, cervical length and cervical angle to a Cox regression model predicting vaginal delivery within 24 hours.[36] A model combining angle of progression at rest and occiput posterior position together with maternal age and cervical length achieved an AUC of 0.7969.[37] Despite being more objective than the Bishop score, these ultrasound-based approaches have typically been developed and tested in small cohorts. Larger, prospective multicenter studies are needed to validate these models. Moreover, integrating ultrasound measurements with clinical variables will likely yield better predictive performance than sonographic assessment alone, and should be a focus of future research.

The current study has several limitations. First, the model was derived from retrospective cohorts at a single tertiary hospital in a highly developed city in China; therefore, its generalizability should be evaluated in other settings, ideally through prospective studies. Second, the discovery and validation cohorts did not include maternal ultrasound measurements, which may limit its predictive performance. Third, given rapid advances in machine learning and artificial intelligence, more contemporary methods could further enhance the model's accuracy.

In conclusion, we developed a model to predict failed IoL among term singleton obese women. This tool may help obstetricians manage a population at increased risk of intra- and postpartum complications and reduce the burden on the public health system.

Data Sharing Statement

Data can be obtained from the corresponding author (Chenghong Yin) upon reasonable request.

Ethics Approval and Consent to Participate

The study is approved by the ethical committee of Beijing Obstetrics and Gynecology Hospital, Capital Medical University (2018-KY-003-02). All the participants provided informed consents.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no competing interests.

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