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Impact of body mass index and gestational weight gain on cesarean delivery rates: a comparative study of dinoprostone-induced vs spontaneous labor

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ABSTRACT

Objectives: This study investigates the relationship between pre-pregnancy body mass index (BMI), BMI before labor, and weight gain during pregnancy with the incidence of cesarean delivery (CD) in dinoprostone-induced labor versus spontaneous labor.

Material and methods: This retrospective analysis was carried out at the Jagiellonian University Hospital's Obstetrics and Perinatology Department, encompassing term singleton pregnancies from May 2019 to February 2021. BMI was categorized following WHO guidelines. Gestational weight gain was assessed against the Institute of Medicine's 2009 recommendations.

Results: Of the 366 cases reviewed, 183 were in the dinoprostone-induced labor group, and 183 were in the spontaneous labor group. The study identified a significant association between higher pre-pregnancy BMI and increased weight gain during pregnancy with elevated CD rates, especially in dinoprostone-induced labor compared to spontaneous labor. Specifically, the dinoprostone-induced labor group showed a 33.9% CD rate compared to 16.9% in the spontaneous labor group. Logistic regression analysis further established that for each 1 kg/m^2 increase in pre-pregnancy BMI, the odds of undergoing a CD increased by 10%.

Conclusions: Elevated pre-pregnancy BMI and excessive gestational weight gain significantly heighten the risk of cesarean delivery, particularly in induced labor. The findings underline the need for individualized labor management strategies for women with higher BMI to optimize maternal and neonatal outcomes.

Keywords: body mass index; pregnancy weight gain; induction of labor; dinoprostone; cesarean section

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INTRODUCTION

Recent evidence indicates that maternal obesity significantly impacts the process and outcomes of labour induction (IOL). Women with obesity are more likely than those with normal weight to require cesarean delivery (CD) following labour induction [1]. This group also tends to need more prolonged labour inductions with larger and more frequent applications of both cervical ripening methods and oxytocin [2].

In the context of labour induction, particularly with the use of dinoprostone, the role of maternal body mass index (BMI) and weight gain needs to be clarified. Dinoprostone, a synthetic prostaglandin E2, is widely used for cervical ripening and labour induction in cases of prolonged pregnancy or when labour induction is medically indicated [3]. Its efficacy and safety profile make it a preferred choice in many clinical settings [4]. However, the variability in response to dinoprostone among different BMI categories and gestational weight gain profiles still needs to be studied. Some studies suggest obesity is associated with a lower sensitivity to prostaglandin E2, as evidenced by a higher failure rate of cervical ripening with dinoprostone in obese patients compared to those with normal BMI [5]. This gap highlights the need for focused research to understand how maternal BMI and weight gain might influence the effectiveness of dinoprostone in inducing labour, which is crucial for optimizing labour management strategies and improving maternal and neonatal outcomes.

Objectives

The study aims to explore the effects of pre-pregnancy BMI, BMI before labour, and weight gain during pregnancy on the incidence of CD compared with patients undergoing spontaneous labour.

MATERIAL AND METHODS

Data collection and study sample

This retrospective study was carried out at the tertiary reference center of the Obstetrics and Perinatology Department at Jagiellonian University Hospital in Krakow between May 2019 and February 2021. The study included patients in singleton pregnancy at term, all of whom were candidates for cervical ripening procedures based on the indications established by the Polish Gynecological Society [6]. These indications encompassed hypertension, gestational or pregestational diabetes mellitus, cholestasis, fetal growth restriction, and a gestational age of 41+0 weeks. The minimum gestational age for these procedures was 37 + 0 weeks, subject to specific indications.

Induction protocol

For IOL, our institution follows a protocol that involves the use of a dinoprostone vaginal insert (Cervidil®) for an unprepared cervix (Bishop score < 6 points). Should the first stage of labor not commence within 24 hours and cervical dilation remains less than 3 cm, mechanical methods are then utilized. This includes the application of a Foley catheter, inflated with 60–120 mL, for 24 hours. The administration of intravenous oxytocin infusion is initiated either upon natural expulsion of the balloon without contractile function or its removal after 24 hours.

Control group

The control group consisted of patients who underwent spontaneous labor (SL) and were admitted to the delivery ward during the first stage of labor. The onset of labor was characterized by regular uterine contractions, occurring at least once every 10 minutes, leading to progressive dilation and effacement of the cervix.

BMI

Following the World Health Organization (WHO) guidelines, BMI was divided into four categories: underweight < 18.5 kg/m^2, normal weight 18.5–25 kg/m^2, overweight 25–30 kg/m^2, and obesity > 30 kg/m^2 [7] — the relationship between BMI before pregnancy and BMI before labor was analyzed separately. However, due to the relatively scarce occurrences of the underweight category (3,8%) within our dataset, we decided to amalgamate this group with the normal weight category for our calculations.

Gestational weight gain

Gestational weight gain (GWG) in the normal BMI group was analyzed into three categories according to the Institute of Medicine 2009 weight gain recommendations: adequate (12–20 kg), inadequate (< 12 kg), and excessive (> 20 kg) [8]. Other BMI groups were too small to analyze GWG subgroups. It was believed that analyzing the entire cohort in GWG would be confusing, as inadequate GWG for underweight patients is markedly different than for obese patients.

Data collection

Medical data for this study were extracted from electronic medical records, which included variables such as maternal baseline characteristics (parity, age), gestational age, neonatal birth weight, pre-pregnancy BMI, BMI before labor, weight gain during pregnancy, the incidence of CD. The birthweight was analyzed in three categories: below 2500 g, between 2500–4000 g, and more than 4000 g [9].

The study was conducted with the approval of the Ethics Committee (No. 1072.6120.291.2021).

Statistical analysis

The statistical analysis was conducted using R, a language and environment for statistical computing, version 4.0.4 (R Core Team, 2022). A two-tailed p-value of 0.05 was established as the threshold for significance in all comparisons. Descriptive statistics were presented separately for the IOL and SL groups and the combined dataset. The Chi-square test of independence or Fisher's exact test was employed to assess differences in the frequency of qualitative features across predefined groups. Continuous variables were described using means and standard deviations and compared using the student’s t-test for data with normal distributions; alternatively, medians and quartiles were presented alongside the Mann-Whitney U test for non-normally distributed data.

The relationships between exposures, such as pre-pregnancy and pre-labor BMI, weight gain during pregnancy, and outcomes, including CD rates, were analyzed separately for the IOL and SL groups. Additionally, the frequency of CD was presented for both multiparous and primiparous women, and a logistic regression model adjusted for parity was fitted. The interaction between IOL/SL group and parity was found to be insignificant and was therefore not included in the final analysis.

Due to relatively small cell counts in the contingency tables that depicted the joint distribution of exposures and CD rates (considering separate analyses for the IOL and SL groups), a penalized likelihood procedure proposed by Firth was utilized to calculate odds ratios [ORs] with 95% confidence intervals [CIs] and p-values based on the Wald test. Further adjustment for other variables did not alter the main findings but reduced the precision of the estimates (results not shown).

RESULTS

According to the inclusion criteria, 183 cases were included in the IOL group, while the SL group contained 183 cases. No significant differences were observed between the two groups in most baseline characteristics, such as birth weight, age, and gestational weight gain (Table 1). However, notable differences were found in the rates of CD, parity, and the prevalence of obesity just before pregnancy between the groups. Compared with women undergoing spontaneous delivery, those pre-induced with dinoprostone were more likely to have a CD (33.9% vs 16.9%), were more often in labor for the first time (68.9% vs 55.2%) and were more likely to have been overweight (27.3% vs 10.9%) or obese (7.7% vs 4.9%) before pregnancy. Statistically significant differences regarding BMI before pregnancy and gestational age were also detected, with higher parameters for both variables in the IOL group.

Association between BMI and GWG and CD rates. Comparison between SL and IOL group regarding parity

The frequency of CD was influenced by pre-pregnancy and pre-labor BMI. Generally, higher BMI values were associated with higher CD rates across all groups except multiparous women with labor induction (Table 2). The trend was notably pronounced among multiparous women in the control group. Women categorized as overweight or obese before pregnancy were significantly more likely to undergo CD compared to their normal-weight counterparts (18.2% and 20.0% vs 1.5%, respectively). The absence of a significant interaction between BMI and parity suggests that the relationship between BMI and CD rates is consistent across primiparous and multiparous women. Consequently, logistic regression analysis was performed for the combined cohort of multiparous and primiparous women, incorporating parity as a covariate. In the control group, pre-pregnancy overweight was associated with a significantly increased likelihood of CD (OR = 3.54, 95% CI: 1.14; 10.97), as was obesity before labor (OR = 3.64, 95% CI: 1.03; 12.83). These findings indicate a general trend where overweight and obesity elevate the risk of CD, although not always reaching statistical significance. No significant associations were found between GWG and CD rates. Primiparous women consistently showed a higher risk of CD compared to multiparous women, with the risk ranging from six to eleven times higher across different models (data not shown).

Finally, after confirming the insignificance of the interaction between groups (SL vs IOL) and the main explanatory variables (Chisq = 0.62, df = 2, p = 0.733 for pre-pregnancy BMI, Chisq =1.96, df = 2, p = 0.376 for pre-labor BMI, Chisq = 0.93, df = 2, p = 0.627 for gestational weight gain), we built the final models with the group as an additional covariate for the combined cohort of all examined women. The results are presented in Table 3.

In the pooled model, independently of studied groups (SL/IOL) and primiparity, pre-labor obesity was associated with almost threefold higher odds of CD (OR = 2.71, 95% CI: 1.21; 6.07), while the results for pre-pregnancy BMI, although showing similar trends, lost significance.

The joint impact of pre-pregnancy BMI and gestational weight gain as continuous variables on cesarean delivery risk

A detailed multivariable logistic regression analysis was conducted to elucidate the factors influencing the rate of CD, focusing on the roles of pre-pregnancy BMI and gestational weight gain (Table 4). This analysis incorporated variables such as labor type (IOL vs SL), pre-pregnancy BMI (analyzed as a continuous variable), primiparity status, newborn weight categories (< 2500g, 2500–4000g, > 4000g, maternal age [as a continuous variable], gestational weight gain [as a continuous variable], and gestational age [as a continuous variable]).

The analysis disclosed a significant association between the type of labor, pre-pregnancy BMI, and GWG with the odds of CD. The comprehensively adjusted model illustrated an increase in the odds of undergoing a CD by 12% for each unit increment in pre-pregnancy BMI and 5% for each unit increment in GWG. Furthermore, the odds of CD were nearly doubled in the IOL group compared to the SL group and were approximately tenfold higher in primiparous women than in multiparous women. The interaction between the type of labor (IOL/SL) and pre-pregnancy BMI, along with newborn weight and parity, was investigated. Nonetheless, including interaction terms did not significantly enhance the model's fit. The outcomes of the refined Model 2 corroborated the initial findings, highlighting a marked risk of CD associated with first-time pregnancies, the induction of labor, elevated pre-pregnancy BMI, and increased GWG.

Despite the lack of statistically significant interactions, we observed the value of $p < 0.1$ in the interaction between parity and BMI. Therefore, we additionally performed analyses separately for multiparous and primiparous women. This distinction is particularly relevant when considering the increased likelihood of CD in the IOL group and among mothers with higher pre-pregnancy BMI. This trend was notably significant among primiparous women (Table 5).

DISCUSSION

The interplay between maternal body mass index (BMI) and weight gain during pregnancy is a critical determinant of labor. Elevated pre-pregnancy BMI is associated with an increased risk of CD, prolonged labor, and complications such as gestational diabetes and hypertension, which can further complicate labor management [10, 11]. The statistical analysis revealed that for each 1 kg/m² increase in pre-pregnancy BMI, there is a 10% increase in the odds of undergoing a CD (OR = 1.10, 95% CI: 1.03; 1.18). This association underscores a gradient of CD risk that intensifies with higher BMI levels. Specifically, multiparous women categorized as overweight and obese before pregnancy were found to have a significantly higher likelihood of CD compared to their normal-weight counterparts, with the risk escalating in a dose-response manner as BMI increases (18.2% and 20.0% vs 1.5%, respectively). Poobalan et al. study revealed that cesarean delivery risk is increased by 50% in overweight women and is more than double for obese women compared with women with normal BMI [12]. Also, Denison et al. observed that higher BMI during the first trimester (BMI of ≥ 35 kg/m^2 compared with BMI of 20 to < 25 kg/m^2) was also associated with an increased risk of CD (OR 2.39; 95% CI 2.20-2.59) [13]. In our study, among primiparous women, this relationship was particularly pronounced, indicating a statistically significant heightened risk of CD with increasing pre-pregnancy BMI (OR = 1.08, 95% CI: 1.00; 1.17 for primiparous women). Primiparity is one of the most critical factors that significantly increase CD risk in obese patients, also according to other studies [14,15]. In Wolfe et al. study, women with class III obesity without a previous vaginal delivery and a macrosomic fetus had the highest rate of failed induction at even 80% [15]. Similarly, excessive weight gain during pregnancy, particularly beyond the recommendations of the Institute of Medicine (IOM) and the Polish Society of Gynecologists and Obstetricians, correlates with an increased likelihood of CD, macrosomia, and large for gestational age infants [16–18]. The IOM provides specific guidelines for weight gain during pregnancy, tailored based on the mother's pre-pregnancy BMI. These guidelines recommend a weight gain of approximately 12.5–18 kilograms for underweight women, 11.5–16 kilograms for women of normal weight, 7–11.5 kilograms for overweight women, and 5–9 kilograms for obese women [8]. Adherence to these guidelines is crucial as deviations, either above or below, are associated with adverse maternal and infant outcomes, including altered labor dynamics and neonatal health concerns [19]. The analysis in our study delineates the complex interaction between GWG and pre-pregnancy BMI. Exceeding the recommended GWG guidelines was associated with an increased risk of CD. For instance, excessive GWG was linked to a 5% increase in the odds of CD for every additional kilogram gained (OR = 1.05, 95% CI: 1.00; 1.10), highlighting the critical role of managing weight gain during pregnancy. In the metanalysis of Goldstein et al., similar results were confirmed (OR, 1.30 [1.25–1.35]; ARD, 4% [3–6%])[10].

The study found significant differences between induced and spontaneous labor concerning CD rates. Induced labor was associated with a higher likelihood of CD than spontaneous labor (dinoprostone-induced labor group — 33.9%, spontaneous labor group — 16.9%). This relationship was observed across all BMI categories. In spontaneous labor, both BMI and GWG as continuous variables showed a linear relationship with the risk of CD, where higher values increased the risk significantly. In induced labor, this relationship was also observed but was more pronounced. Specifically, for each unit increase in pre-pregnancy BMI, the odds of CD increased by 8% in spontaneous labor and 10% in induced labor. The study highlights that BMI and GWG are essential factors influencing CD risk, with their impact being more substantial in induced labor. These findings are consistent with Wolfe et al. study in which induction failure rates are also associated with increasing obesity class from 13% in normal-weight women to 29% in class III obese women (BMI ≥ 40 kg/m^2). The findings emphasize the need for careful consideration when deciding on labor induction, especially in women with higher BMI, to manage the increased risk of cesarean delivery.

The most effective method for inducing labor in obese patients — whether using a Foley catheter or administering vaginal prostaglandins remains a subject of debate. A randomized study highlighted the Foley catheter's ability to reduce labor duration, though it did not decrease CD rates [20]. Conversely, Beckwith et al. found no significant difference in the efficacy of labor induction between obese and normal-weight women using the Foley catheter. However, prostaglandins proved significantly less effective in obese patients [21]. Despite these findings, insufficient evidence exists to definitively conclude which labor induction method is preferable for obese women [22]. Our study brings one more insight into this debate. The most extensive retrospective cohort study to date, published in 2021, focused on labor induction in obese patients at 39 weeks of gestation. It included 1.184.058 pregnant patients with a BMI ≥ 30 kg/m^2 and found that inducing labor at this time significantly decreased the likelihood of cesarean delivery without increasing perinatal complications risk (OR: 95% CI 0.58–0.60), especially in women with previous births [23]. Given these outcomes, inducing labor at 39 weeks of gestation could be advisable for pregnant women with obesity [19].

Notably, the cesarean delivery rate was significantly higher in the dinoprostone-induced labor group (33.9%) than in the spontaneous labor group (16.9%), emphasizing the challenge of managing labor induction in women with elevated BMI. This is particularly relevant for primiparous women, among whom the risk of cesarean delivery escalates with increasing BMI, aligning with the observed trend of increased cesarean delivery risk (OR = 1.08, 95% CI: 1.00; 1.17) for every unit increase in pre-pregnancy BMI. Another study revealed that indication didn't impact CD rate or time of labor [24, 25]. The significant differences in labor outcomes between the dinoprostone-induced labor and spontaneous labor groups underscore the need for continued research to identify the most influential labor induction strategies for obese women.

Considering the study's findings, inducing labor at 39 weeks in obese patients could potentially reduce the likelihood of cesarean delivery without increasing perinatal complications, offering a promising direction for future clinical practices. Future research should aim to delineate optimal labor induction methods for obese patients, considering the nuanced interplay between maternal weight factors and labor induction outcomes.

Strengths and limitations

This study's strengths include its focused analysis on the impacts of BMI and gestational weight gain on labor induction with dinoprostone, contributing valuable insights into an underexplored area. The comparative approach between induced and spontaneous labor groups provides a comprehensive perspective on labor outcomes influenced by maternal weight factors.

Limitations stem from the study's retrospective design and the inherent challenges of generalizing findings across diverse populations. The amalgamation of underweight and normal weight categories may obscure specific outcomes pertinent to these distinct groups. Furthermore, the small sample size in extreme BMI categories limited the analysis of gestational weight gain.

CONCLUSIONS

Maternal BMI and gestational weight gain play significant roles in determining labor outcomes, particularly in dinoprostone-induced labor. Elevated pre-pregnancy BMI and excessive weight gain during pregnancy increases the risk of cesarean delivery, and induced labor presents additional challenges in managing labor outcomes. These findings underscore the necessity of personalized labor management strategies, especially for women with higher BMI.

Article information and declarations

Data availability statement

Original contributions presented in the study are included in the article. Any further inquiries can be directed to the corresponding author Agnieszka Micek (agnieszka.micek@uj.edu.pl).

Ethics statement

The study was reviewed and approved by the Bioethics Committee of the Jagiellonian University Medical College (opinion no. 1072.6120.291.2021). Due to the study's retrospective and anonymous design, the patient written inform consent was not required.

Author contributions

As per contribution statement.

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Conflict of interests

None.

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Table 1. Comparison of basic characteristics of studied patients between IOL group and SL (control) group

Variable	**SL (control) (n = 183)**	**IOL (dinoprostone) (n = 183)**	**Total (n = 366)**	**P[&]**
Delivery				
vaginal	152 (83.1%)	121 (66.1%)	273 (74.6%)	<
cesarean	31 (16.9%)	62 (33.9%)	93 (25.4%)	
Pre-pregnancy BMI [kg/m^2]				
< 25.0	154 (84.1%)	119 (65.0%)	259 (74.6%)	<
[25.0–30.0)	20 (10.9%)	50 (27.3%)	70 (19.1%)	

Variable	SL (control) (n = 183)	IOL (dinoprostone) (n = 183)	Total (n = 366)	P[&]
≥ 30	9 (4.9%)	14 (7.7%)	23 (6.3%)	
Primiparity				
no	82 (44.8%)	57 (31.1%)	139 (38.0%)	0.010
yes	101 (55.2%)	126 (68.9%)	227 (62.0%)	
Birth weight [kg]				
Q2 [Q1–Q3]	3.51 [3.09–3.74]	3.43 [3.16–3.70]	3.46 [3.15–3.72]	0.432
Age				
mean (SD)	31.16 (4.43)	30.65 (4.83)	30.91 (4.63)	0.289[#]
Gestational weight gain [kg]				
Q2 [Q1–Q3]	14.0 [10.5–17.0]	14.0 [10.0–18.0]	14.0 [10.0–17.0]	0.499
Gestational age [days]				
Q2 [Q1–Q3]	276 [270–281]	277 [273–286]	277 [272–283]	0.014

Abbreviations: SL — spontaneous labor, IOL — induction of labor, BMI — body mass index

[&]p-values based on Chi-squared test or Mann-Whitney U test for all variables except age

[#]comparison of age between groups was performed with Student t test, Q2 — median, Q1, Q3 — lower and upper quartile

Table 2. Comparison of CD rates between SL and IOL groups regarding parity

Variable	SL (control)		IOL (dinoprostone)		SL (control)	IOL (dinoprostone)
	Primipara, n [%] CD	Multipara, n [%] CD	Primipara, n [%] CD	Multipara, n [%] CD	OR (95% CI)[#]	OR (95% CI)[#]
Pre-labor BMI [kg/m^2]						
< 25	4 (17.4)	2 (4.1)	6 (35.3)	4 (16.0)	1 (ref)	1 (ref)
25–30	15 (25.9)	0 (0.0)	21 (39.6)	0 (0.0)	1.71 (0.55; 5.30)	1.60 (0.57; 4.51)
30+	8 (40.0)	2 (11.8)	30 (53.6)	1 (5.3)	3.64 (1.03; 12.83)*	2.22 (0.79; 6.21)
p	0.252	0.348	0.255	0.281		
Pre-pregnancy BMI [kg/m^2]						
< 25	22 (25.0)	1 (1.5)	33 (40.7)	4 (10.5)	1 (ref)	1 (ref)
25–30	4 (44.4)	2 (18.2)	18 (51.4)	1 (6.7)	3.54 (1.14; 10.97)*	1.37 (0.66; 2.84)
30+	1 (25.0)	1 (20.0)	6 (60.0)	0 (0.0)	2.44 (0.49;	1.68 (0.52;

					12.22)	5.43)
p	0.445	0.022*	0.362	1.000		
Gestational weight gain [kg]##						
< 12	1 (6.3)	1 (5.3)	7 (31.8)	0 (0.0)	0.47 (0.11; 1.94)	0.39 (0.14; 1.05)
12–20	16 (26.2)	0 (0.0)	22 (51.2)	4 (17.4)	1 (ref)	1 (ref)
20+	1 (25.0)	0 (0.0)	4 (30.8)	0 (0.0)	1.23 (0.18; 8.69)	0.40 (0.12; 1.37)
p	0.167	0.328	0.229	0.506		

Abbreviations: BMI — body mass index, CD — cesarean delivery, CI — confidence interval, IOL — induction of labor, OR — odds ratio, SL — spontaneous labor

#Models adjusted to parity; ##Only among women with pre-pregnancy BMI in norm; *Indicates statistical significance

Table 3. Determinants of cesarean delivery rate: multivariable logistic regression analysis — separate models for each main explanatory variable (pre-pregnancy BMI, pre-labor BMI and gestational weight gain)

Model 1		**Model 2**		**Model 3**	
Exposure/Cat.	**OR (95%**	**Exposure/Cat.**	**OR (95%**	**Exposure/Ca**	**OR (95% CI)**
Pre-labor BMI [kg/m^2]		**Pre-pregnancy BMI**		**Gestational weight gain [kg]**	
< 25	1 (ref)	**< 25**	1 (ref)	**< 12**	0.39 (0.17;
25–30	1.69 (0.78;	**25–30**	1.78 (0.95;	**12–20**	1 (ref)
30+	2.71 (1.21;	**30+**	1.90 (0.72;	**20+**	0.47 (0.15;
Group		**Group**		**Group**	
SL (Control)	1 (ref)	**SL (Control)**	1 (ref)	**SL (Control)**	1 (ref)

IOL (Dinoprostone)	1.90 (1.12; 3.23)	**IOL (Dinoprostone)**	1.93 (1.13; 3.27)	**IOL (Dinoproston e)**	3.40 (1.74; 6.65)
Primiparity		**Primiparity**		**Primiparity**	
No	1 (ref)	**No**	1 (ref)	**No**	1 (ref)
Yes	7.35 (3.60;	**Yes**	7.66 (3.76;	**Yes**	8.08 (3.18;

Abbreviations: BMI — body mass index, CI — confidence interval, IOL — induction of labor, OR — odds ratio, SL — spontaneous labor

Table 4. Determinants of cesarean delivery rate: multivariable logistic regression analysis

Variable	Category	OR (95% CI)[#]	OR (95% CI)[##]
Group	SL (control)	1 (ref)	1 (ref)
	IOL (dinoprostone)	1.76 (1.02; 3.08)*	1.88 (1.10; 3.24)*
Pre-pregnancy BMI	Per 1 kg/m2	1.12 (1.04; 1.20)**	1.10 (1.03; 1.18)**
Primiparity	No	1 (ref)	1 (ref)
	Yes	9.70 (4.58; 22.89)***	7.83 (3.91; 17.57)***
Gestational weight gain	Per 1 kg	1.05 (1.00; 1.11)*	1.05 (1.00; 1.10)*
Gestational age	Per 1 day	1.03 (1.00; 1.06)	-
Newborn weight	2500–4000 g	1 (ref)	-
	< 2500 g	2.24 (0.41; 10.44)	-
	> 4000 g	1.42 (0.53; 3.56)	-
Age	Per 1 year	1.04 (0.98; 1.11)	-

Abbreviations: BMI — body mass index, CI — confidence interval, IOL — induction of labor, OR — odds ratio, SL — spontaneous labor

*P < 0.05; **P < 0.01; ***P < 0.001; #Model 1 includes all variables; ##Model 2 focuses on statistically significant factors

Table 5. Cesarean delivery risk by parity subgroups: multivariable logistic regression analysis

Variable	Category	Primipara OR (95% CI)[###]	Multipara OR (95% CI)[###]

Group	**SL (control)**	1 (ref)	1 (ref)
	IOL (dinoprostone)	1.97 (1.10; 3.58)*	2.27 (0.54; 10.76)
Pre-pregnancy BMI	**Per 1 kg/m^2**	1.08 (1.00; 1.17)*	1.14 (0.98; 1.32)
Gestational weight gain	**Per 1 kg**	1.06 (1.01; 1.12)*	0.96 (0.83; 1.10)

Abbreviations: BMI — body mass index, CI — confidence interval, IOL — induction of labor, OR — odds ratio, SL — spontaneous labor

*$P < 0.05$; ###Model 3 with IOL/SL group, pre-pregnancy BMI and GWG included