INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

FREQUENCY OF CESAREAN SECTION IN PREGNANT WOMEN PRESENTING WITH GESTATIONAL DIABETES MELLITUS USING RISK SCORE AT TERTIARY CARE HOSPITAL, KARACHI

Original Research

Hira Gul[1], Haleema Yasmin[2], Shighraf Iftikhar[3], Shumaila Khalil[4], Iqra Jam[5], Barkha Kumari[6]
[1]Postgraduate Trainee, Obstetrics & Gynaecology Department, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan.
[2]Head of Department, Obstetrics & Gynaecology Department, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan.
[3]Senior Registrar Ward 8, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan.
[4]Post Fellow, Ward 8, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan.
[5]Resident, Obstetrics & Gynaecology Department, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan.
[6]Jinnah Postgraduate Medical Centre (JPMC), Ward 8, Karachi, Pakistan, Pakistan.
Corresponding Author: Hira Gul, Postgraduate Trainee, Obstetrics & Gynaecology Department, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan, Dr.hira.gul12@gmail.com
Acknowledgement: The authors express gratitude to the Department of Gynaecology and Obstetrics, JPMC, Karachi, for their support in conducting this study.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a prevalent pregnancy complication associated with adverse maternal and neonatal outcomes, including an increased likelihood of cesarean section. Identifying predictive factors for surgical delivery is essential for optimizing obstetric care. Risk stratification models incorporating maternal characteristics such as nulliparity, excessive gestational weight gain, and insulin use may enhance clinical decision-making. However, limited data exist on the predictive accuracy of such models in the local population, necessitating further investigation.

Objective: To determine the frequency of cesarean section among pregnant women with GDM using a risk score and evaluate its predictive value.

Methods: A cross-sectional study was conducted at the Department of Gynaecology and Obstetrics, JPMC, Karachi, over six months. A total of 134 pregnant women diagnosed with GDM were enrolled using non-probability consecutive sampling. Patients were categorized into low, intermediate, and high-risk groups based on nulliparity, excessive gestational weight gain, and insulin use. Additional variables, including estimated fetal weight and gestational age, were also analyzed. Data were analyzed using SPSS version 20. Chi-square test assessed associations, and binary logistic regression determined predictors of cesarean section. One-way ANOVA compared continuous variables across risk categories, with statistical significance set at $p \leq 0.05$.

Results: Cesarean section was performed in 64.9% of cases, with significantly higher rates in high-risk (89.3%), intermediate-risk (71.2%), and low-risk (46.3%) groups ($\chi^2 = 22.557$, $p < 0.001$). Logistic regression confirmed the risk score as a strong predictor (OR = 4.135, 95% CI: 2.183 – 7.833, $p < 0.001$). Insulin use, gestational weight gain, nulliparity (OR = 0.962, $p = 0.928$), estimated fetal weight (OR = 1.324, $p = 0.482$), and gestational age (OR = 0.959, $p = 0.780$) were not significant predictors. One-way ANOVA showed no significant differences in gestational weight gain ($p = 0.682$), estimated fetal weight ($p = 0.276$), or gestational age ($p = 0.386$) across risk categories.

Conclusion: Risk stratification effectively predicts cesarean delivery in GDM pregnancies, emphasizing its clinical utility. Refining predictive models with additional obstetric variables may further enhance decision-making and optimize maternal outcomes.

Keywords: Cesarean section, gestational diabetes mellitus, logistic regression, maternal outcomes, obstetric risk, pregnancy complications, risk assessment.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most common medical disorders complicating pregnancy, with a reported prevalence ranging from 1.8% to 25.1%, and its incidence is rising globally in parallel with the increasing burden of type 2 diabetes (1). GDM is associated with multiple adverse maternal and neonatal outcomes, including preeclampsia, fetal macrosomia, and a subsequent rise in obstetric interventions, particularly cesarean delivery (CD) (2,3). Women diagnosed with GDM have been found to have a higher likelihood of undergoing CD, particularly primary cesarean sections, compared to their glucose-tolerant counterparts (4–7). The elevated risk is often attributed to concerns over complications related to fetal macrosomia, such as shoulder dystocia and birth trauma, prompting clinicians to consider CD as a preventive measure. While there are no absolute guidelines mandating elective CD in GDM pregnancies, standard clinical protocols recommend scheduled CD when the estimated fetal weight (EFW) reaches or exceeds 4500 g (8,9). The global rise in cesarean delivery rates has been substantial, with recent reports indicating an increase to 32%, marking a more than 50% rise over the last decade (10). Similarly, the rate of labor induction has also increased, now affecting approximately 23% of all births, with observational studies suggesting a potential association between labor induction and a higher likelihood of CD (11). Various maternal characteristics have been identified as significant risk factors for CD in women with GDM, including nulliparity, obesity, excessive gestational weight gain (GWG) beyond the Institute of Medicine (IOM) recommendations, and the necessity for insulin therapy (12). A study by Phaloprakarn et al. categorized women with GDM into three risk groups, reporting primary CD rates of 14.7% in the low-risk category, 38.2% in the intermediate-risk category, and 62.3% in the high-risk category (13). This highlights the predictive value of certain maternal characteristics in assessing the likelihood of CD in GDM pregnancies. In addition to these, emerging evidence also suggests that other obstetric factors such as estimated fetal weight and gestational age at delivery may influence the decision-making process regarding the mode of delivery, although their independent predictive value remains uncertain.

Despite these observations, clinical decision-making regarding CD in women with GDM often remains individualized, with obstetricians exercising caution before recommending surgical intervention. A standardized risk assessment tool that integrates multiple predictive factors could enhance decision-making, ensuring that CD is performed based on evidence rather than clinical discretion alone. There remains a paucity of both local and international data on the risk stratification of CD in GDM pregnancies, particularly within institutional settings, where establishing a robust database could contribute to the improvement of maternal care practices. Understanding the frequency of CD in GDM pregnancies through an objective risk score can provide valuable insights for optimizing obstetric management and developing evidence-based guidelines. Therefore, this study aims to determine the frequency of cesarean section in pregnant women presenting with GDM using a risk score at a tertiary care hospital in Karachi, while also evaluating the predictive value of additional maternal and obstetric variables including estimated fetal weight and gestational age.

METHODS

This cross-sectional study was conducted at the Department of Gynaecology and Obstetrics, Jinnah Postgraduate Medical Centre (JPMC), Karachi, over a duration of six months following the approval of the research synopsis. Ethical approval was obtained from the institutional review board prior to the initiation of the study, ensuring compliance with ethical guidelines. Written informed consent was obtained from all participants before enrolment (14). The study population comprised pregnant women diagnosed with gestational diabetes mellitus (GDM), meeting the inclusion criteria. Participants were aged between 20 and 45 years and were recruited through non-probability consecutive sampling. Patients with pre-existing medical conditions such as diabetes mellitus, cardiac disease, respiratory disease, epilepsy, or renal disease were excluded. Additionally, those with obstetric complications, including a history of recurrent pregnancy loss, multiple gestations, preterm premature rupture of membranes, or placenta previa, were not included. Non-consenting individuals were also excluded from participation. The required sample size was calculated using WHO software, based on a cesarean section frequency of 14.7% in the low-risk category, with a margin of error of 6% and a confidence level of 95%, yielding a total of 134 participants (15).

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Data collection was conducted systematically after obtaining permission from the institutional ethical review committee. Eligible participants were enrolled upon presentation to the obstetrics department, and demographic details, including maternal age, residence, socioeconomic status, and obstetric history, were recorded. Risk categorization was performed based on predefined criteria, incorporating Gestational Weight Gain, Insulin Use, Nulliparity, Estimated Fetal Weight and Gestational Age. Gestational diabetes mellitus patients were categorized into risk groups: low risk (0 points), intermediate risk (1–3 points), and high risk (≥4 points). Participants were followed prospectively until delivery, and the mode of delivery, particularly the incidence of cesarean section, was documented. Data were recorded in a structured proforma designed for the study (16). Data analysis was performed using SPSS version 20. Descriptive statistics were applied to summarize quantitative and qualitative variables. Mean and standard deviation were reported for normally distributed continuous variables, such as maternal age, gestational weight gain, estimated fetal weight, and gestational age, whereas median and interquartile range were presented for non-normally distributed variables. Categorical variables, including educational status, occupational status, nulliparity, insulin use, and risk category classification, were summarized as frequencies and percentages. The Kolmogorov–Smirnov test was used to assess the normality of continuous data. Effect modifiers such as maternal age, socioeconomic factors, and gestational age were controlled through stratification to assess their influence on the primary outcome. Post-stratification analysis was conducted using the chi-square test or Fisher's exact test, as appropriate, with a p-value of ≤0.05 considered statistically significant.

RESULTS

A total of 134 pregnant women with gestational diabetes mellitus were included in the study. The mean maternal age was 32.2 ± 3.9 years, while the mean gestational age at delivery was 38.2 ± 1.5 weeks. The mean gestational weight gain was 11.1 ± 2.5 kg, and the mean estimated fetal weight was 3.97 ± 0.49 kg. Among the study participants, 40.3% were categorized as low risk, 38.8% as intermediate risk, and 20.9% as high risk. The overall cesarean section rate was 64.9%, with a significantly higher proportion observed among those with an increased risk score. Cesarean section was performed in 46.3% of low-risk patients, 71.2% of intermediate-risk patients, and 89.3% of high-risk patients. The association between risk score and cesarean delivery was statistically significant (χ^2 = 22.557, $p < 0.001$), with high-risk patients requiring more cesarean sections.

Binary logistic regression analysis identified the risk score as a strong predictor of cesarean section, with an odds ratio of 4.135 (95% CI: 2.183 – 7.833, $p < 0.001$). Insulin use (OR: 1.028, $p = 0.947$), and gestational weight gain (OR: 0.927, $p = 0.389$) were not significant predictors of cesarean section. The three newly analyzed variables—nulliparity, estimated fetal weight, and gestational age—also did not show statistically significant associations with cesarean delivery. Nulliparity had an odds ratio of 0.962 (95% CI: 0.416 – 2.225, $p = 0.928$), estimated fetal weight had an odds ratio of 1.324 (95% CI: 0.606 – 2.893, $p = 0.482$), and gestational age had an odds ratio of 0.959 (95% CI: 0.718 – 1.283, $p = 0.780$).

One-way ANOVA analysis revealed a statistically significant difference in maternal age across the three risk categories ($F = 6.114$, $p = 0.003$). However, no significant differences were observed in gestational weight gain ($F = 0.383$, $p = 0.682$), estimated fetal weight ($F = 1.301$, $p = 0.276$), or gestational age ($F = 0.959$, $p = 0.386$) across risk groups. These findings reinforce the strong correlation between the risk score and the likelihood of cesarean section, underscoring its clinical utility. At the same time, the non-significant associations of most individual predictors with both cesarean delivery and risk group categories suggest the importance of multi-factorial assessment over isolated variables in guiding obstetric decision-making.

Table 1: Mean and Standard Deviation of Study Variables

	Mean	Standard Deviation
Maternal Age (Years)	32.215	3.852
Gestational Age (Weeks)	38.179	1.498
Gestational Weight Gain (Kgs)	11.069	2.471
Estimated Fetal Weight (Kgs)	3.969	0.493

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Table 2: Frequency and Percentage of Categorical Variables

Category	Option	Frequency (%)
Parity	Nulliparous	57 (42.5%)
	Multiparous	77 (57.5%)
Use of Insulin	Yes	52 (38.8%)
	No	82 (61.2%)
Residence Status	Urban	104 (77.6%)
	Rural	30 (22.4%)
Occupational Status	Employed	30 (22.4%)
	Unemployed	104 (77.6%)
Family Monthly Income	≤50000	93 (69.4%)
	>50000	41 (30.6%)
Education Level	Illiterate	26 (19.4%)
	Primary	33 (24.6%)
	Secondary	51 (38.1%)
	Higher	24 (17.9%)

Table 3: Frequency and Percentage of Risk Score Categories

	Risk Score	Percentage
Low Risk	54	40.3
Intermediate Risk	52	38.8
High Risk	28	20.9

Table 4: Frequency and Percentage of Cesarean Section

	Cesarean Section	Percentage
Yes	87	64.9
No	47	35.1

Table 5: Crosstable of Cesarean Section and Risk Score Categories

	Low Risk	Intermediate Risk	High Risk
Cesarean Section			
Yes	25	37	25
No	29	15	3

Table 6: Chi-Square Test Results:

Chi-Square Value	Degrees of Freedom	P-Value
22.557	2	<0.000

Table 7: Binary Logistic Regression Results

	Odds Ratio	95% CI Lower	95% CI Upper	P-Value
Const.	7.844	0	1325619	0.737
Gestational Weight Gain	0.927	0.779	1.102	0.389
Insulin Use	1.028	0.457	2.31	0.947

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

	Odds Ratio	95% CI Lower	95% CI Upper	P-Value
Risk Score	4.135	2.183	7.833	0
Nulliparity	0.962	0.416	2.225	0.928
Estimated Fetal Weight	1.324	0.606	2.893	0.482
Gestational Age	0.959	0.718	1.283	0.78

Table 8: One-Way ANOVA Results for Continuous Variables

Variable	F-Statistic	P-Value
Maternal Age	6.114	0.003
Gestational Weight Gain	0.383	0.682
Estimated Fetal Weight	1.301	0.276
Gestational Age	0.959	0.386

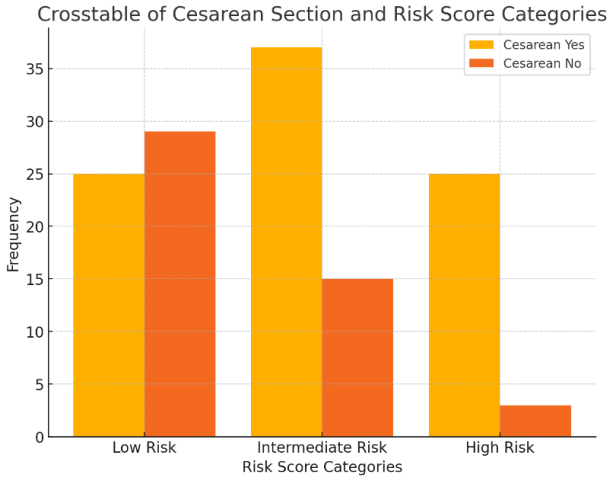

Figure 1 Cross table of Cesarean Section and Risk Score Categories

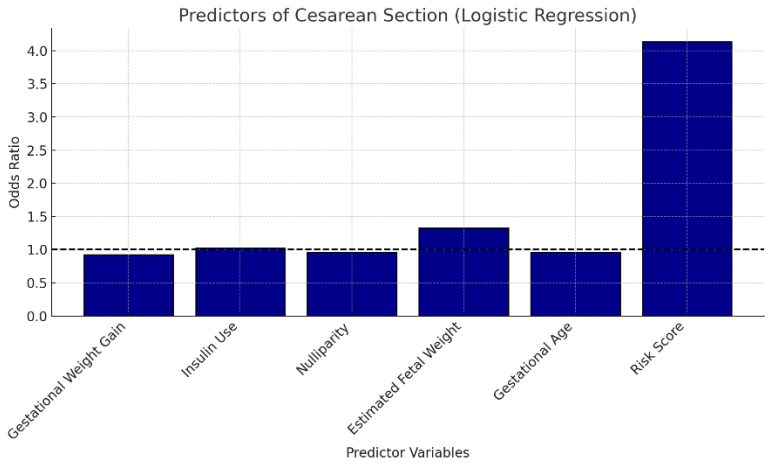

Figure 2 Predictors of Cesarean Section (Logistic Regression)

DISCUSSION

The findings of this study highlight the significant association between the risk score and the likelihood of undergoing a cesarean section in pregnant women with gestational diabetes mellitus. The observed cesarean section rate of 64.9% is consistent with previous studies, which have reported increased surgical deliveries among women with gestational diabetes, largely due to concerns regarding fetal macrosomia, shoulder dystocia, and birth trauma. The strong predictive value of the risk score, as indicated by the logistic regression analysis (OR: 4.135; 95% CI: 2.183–7.833; $p < 0.001$), reinforces the role of clinical risk stratification in guiding obstetric decision-making. Higher risk scores were associated with markedly increased odds of cesarean delivery, suggesting that nulliparity, excessive gestational weight gain, and insulin use contribute substantially to surgical delivery rates (17).

Despite the well-documented correlation between these risk factors and cesarean section, the lack of significant differences in gestational weight gain ($F = 0.383$, $p = 0.682$), estimated fetal weight ($F = 1.301$, $p = 0.276$), and gestational age ($F = 0.959$, $p = 0.386$) across the risk categories raises concerns regarding the effectiveness of current risk stratification models. Although maternal age showed a

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

statistically significant difference across risk categories (F = 6.114, p = 0.003), it was not a significant predictor of cesarean section in regression analysis (OR: 0.966, p = 0.497). Furthermore, the newly added variables—nulliparity (OR: 0.962, p = 0.928), estimated fetal weight (OR: 1.324, p = 0.482), and gestational age (OR: 0.959, p = 0.780)—did not demonstrate significant predictive value for cesarean delivery. This highlights potential limitations in the individual predictive capacity of these variables and emphasizes the need for refining risk assessment models by incorporating additional maternal and fetal parameters such as cervical status at admission, fetal presentation, and labor progression patterns (18,19).

A notable strength of this study is its focus on a well-defined cohort, enabling precise evaluation of cesarean delivery trends in a tertiary care setting. The prospective nature of data collection minimized recall bias, and the inclusion of a risk score provided an objective basis for stratification. However, certain limitations must be acknowledged. The relatively small sample size may have limited the statistical power to detect significant differences in continuous variables across risk categories. Additionally, the lack of longitudinal follow-up data on neonatal outcomes restricts the ability to assess whether cesarean section actually resulted in improved perinatal outcomes in high-risk pregnancies (12,20). The reliance on hospital-based data introduces potential selection bias, as women delivering at tertiary care centers may represent a higher-risk population compared to those managed in primary or secondary healthcare settings. Furthermore, the absence of labor management details, including the indications for induction and the mode of labor onset, limits the ability to determine whether cesarean deliveries were performed electively or as an emergency intervention. Future research should focus on integrating a more comprehensive range of obstetric variables into risk assessment models and validating their predictive accuracy in larger, multicentric cohorts (8,17).

While the findings confirm the strong association between the risk score and cesarean section, they also raise critical questions regarding the adequacy of existing risk classification systems in predicting obstetric outcomes. The refinement of predictive models through the incorporation of additional maternal, fetal, and intrapartum factors could enhance risk stratification and enable more individualized clinical decision-making. The potential for reducing unnecessary surgical interventions while ensuring maternal and neonatal safety remains an essential consideration in optimizing obstetric care for women with gestational diabetes (2,13).

CONCLUSION

This study underscores the critical importance of clinical risk stratification in predicting cesarean section among pregnant women with gestational diabetes mellitus. The strong and statistically significant association between the risk score and the likelihood of surgical delivery affirms its utility in guiding obstetric decision-making. However, the absence of significant associations for individual variables such as gestational weight gain, estimated fetal weight, nulliparity, and gestational age suggests that current models may have limitations when used in isolation. These findings highlight the need to refine existing risk assessment tools by integrating a broader range of maternal, fetal, and intrapartum variables. A more comprehensive and individualized approach to labor management could

AUTHOR CONTRIBUTION

Author	Contribution
Hira Gul*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Haleema Yasmin	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Shighraf Iftikhar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Shumaila Khalil	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Iqra Jam	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Barkha Kumari	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

REFERENCES

1. Sparić R, Stojković M, Plešinac J, Pecorella G, Malvasi A, Tinelli A. Advanced maternal age (AMA) and pregnancy: a feasible but problematic event. Arch Gynecol Obstet. 2024;310(3):1365-76.
2. Maher GM, Ward LJ, Hernandez L, Kublickas M, Duvekot JJ, McCarthy FP, et al. Association between socioeconomic status with pregnancy and neonatal outcomes: An international multicenter cohort. Acta Obstet Gynecol Scand. 2023;102(11):1459-68.
3. Chen YT, Zhang T, Chen C, Xia YY, Han TL, Chen XY, et al. Associations of early pregnancy BMI with adverse pregnancy outcomes and infant neurocognitive development. Sci Rep. 2021;11(1):3793.
4. Akinyemi OA, Fasokun ME, Weldeslase TA, Makanjuola D, Makanjuola OE, Omokhodion OV. Determinants of Neonatal Mortality in the United States. Cureus. 2023;15(8):e43019.
5. Kusinski LC, Murphy HR, De Lucia Rolfe E, Rennie KL, Oude Griep LM, Hughes D, et al. Dietary Intervention in Pregnant Women with Gestational Diabetes; Protocol for the DiGest Randomised Controlled Trial. Nutrients. 2020;12(4).
6. Hou W, Shi G, Ma Y, Liu Y, Lu M, Fan X, et al. Impact of preimplantation genetic testing on obstetric and neonatal outcomes: a systematic review and meta-analysis. Fertil Steril. 2021;116(4):990-1000.
7. Wedlund F, von Wowern E, Hlebowicz J. Increased cesarean section rate and premature birth according to modified WHO maternal cardiovascular risk in pregnant women with congenital heart disease. PLoS One. 2023;18(11):e0294323.
8. Otero-Naveiro A, Gómez-Fernández C, Álvarez-Fernández R, Pérez-López M, Paz-Fernández E. Maternal and fetal outcomes during pregnancy and puerperium in obese and overweight pregnant women. A cohort study. Arch Gynecol Obstet. 2021;304(5):1205-12.
9. Kragelund Nielsen K, Andersen GS, Damm P, Nybo Andersen AM. Migration, Gestational Diabetes, and Adverse Pregnancy Outcomes: A Nationwide Study of Singleton Deliveries in Denmark. J Clin Endocrinol Metab. 2021;106(12):e5075-e87.
10. Kang-Auger G, Chassé M, Quach C, Ayoub A, Auger N. Necrotizing Fasciitis: Association with Pregnancy-related Risk Factors Early in Life. Yale J Biol Med. 2021;94(4):573-84.
11. Lao TT, Annie Hui SY. The obstetric aspects of maternal asthma. Best Pract Res Clin Obstet Gynaecol. 2022;85(Pt A):57-69.
12. Tiwari E, Parveen S, Noor N. Obstetric cholestasis and its impact on the maternal outcome. Arch Gynecol Obstet. 2024;310(3):1587-92.
13. Bean EMR, Knez J, Thanatsis N, De Braud L, Taki F, Hirsch M, et al. Obstetric outcomes in women with pelvic endometriosis: a prospective cohort study. Fertil Steril. 2024;122(4):696-705.
14. Reitzle L, Heidemann C, Baumert J, Kaltheuner M, Adamczewski H, Icks A, et al. Pregnancy Complications in Women With Pregestational and Gestational Diabetes Mellitus. Dtsch Arztebl Int. 2023;120(6):81-6.
15. D'Alterio MN, Sigilli M, Succu AG, Ghisu V, Laganà AS, Sorrentino F, et al. Pregnancy outcomes in women with polycystic ovarian syndrome. Minerva Obstet Gynecol. 2022;74(1):45-59.
16. Sousa KS, Leite HV, Corrêa MD, Sousa MS, Queiroz ALR. Prevalence of macrosomic newborn and maternal and neonatal complications in a high-risk maternity. Rev Bras Ginecol Obstet. 2024;46.
17. Payne JL. Psychiatric Medication Use in Pregnancy and Breastfeeding. Obstet Gynecol Clin North Am. 2021;48(1):131-49.
18. Zahid S, Mohamed MS, Rajendran A, Minhas AS, Khan MZ, Nazir NT, et al. Rheumatoid arthritis and cardiovascular complications during delivery: a United States inpatient analysis. Eur Heart J. 2024;45(17):1524-36.
19. Bahri Khomami M, Shorakae S, Hashemi S, Harrison CL, Piltonen TT, Romualdi D, et al. Systematic review and meta-analysis of pregnancy outcomes in women with polycystic ovary syndrome. Nat Commun. 2024;15(1):5591.
20. Zhu H, Cai J, Liu H, Zhao Z, Chen Y, Wang P, et al. Trajectories tracking of maternal and neonatal health in eastern China from 2010 to 2021: A multicentre cross-sectional study. J Glob Health. 2024;14:04069.

