MJMR, Vol. 36, No. 2, 2025, pages (158-167).

Open Access
ISSN:2682-4558

Research Article

Clinical Predictors of Cesarean Delivery in a High-Volume Maternity Hospital: A Multivariate Analysis Beyond Robson Groups*

Mohamed Yehia Mohamed Ahmed[1], Hany Hassan Kamel[1] and Kierles Faiq Gaber Abdo[1]
[1]Department of Obstetrics & Gynecology Faculty of Medicine – Minia University

DOI: 10.21608/MJMR.2025.406085.2045

Abstract

Background: Cesarean rates vary widely and have increased globally. The World Health Organization (WHO) recommends the Robson classification to identify key contributors to this rise.
Aim: To determine maternal and fetal clinical predictors of cesarean delivery beyond the Robson classification using multivariate analysis in a high-volume tertiary hospital, aiming to guide strategies for reducing unnecessary cesarean sections. **Patients and methods:** This Prospective cross-sectional research has been performed at Minia Maternity University Hospital, a high-volume tertiary care center, over a seven-month duration from April 2022 to October 2022. The study population involved all women who gave birth to a live newborn with a birth weight of ≥ 1000 grams and/or a gestational age of ≥ 28 weeks during the information collection duration. **Results:** Of 3,860 deliveries, 56.3% were cesarean sections (CS) and 43.7% were spontaneous vaginal deliveries (SVD). CS was associated with older maternal age, lower gestational age, breech presentation, and higher rates of pre-eclampsia, placenta previa, diabetes, and fetal distress (all $p<0.001$). Post-date pregnancy and induction were more frequent in SVD. Multivariate analysis identified older age, malpresentation, pre-eclampsia, and fetal distress as predictors of CS, while higher gestational age and post-date pregnancy favored SVD. **Conclusion:** The study identified previous CS, maternal age, and fetal distress as key predictors of cesarean delivery, supporting targeted strategies like Vaginal Birth After Cesarean(VBAC) promotion and improved monitoring to reduce unnecessary CS.

Key words: Cesarean section, Robson classification, Clinical predictors, Multivariate analysis.

Introduction

The rates of cesarean sections exhibit significant diversity globally, varying from 0.4 to 50 percent, with a consistent rise trend noted over the past thirty years [(1-3)].

The widely recognized recommended threshold is the fifteen percent upper limit proposed by the World Health Organization in 1985 [(4)].
The recommendation depends on the cesarean section rates of countries exhibiting the lowest maternal and newborn death rates globally at the moment (about ten percent). The WHO raised the recommended cesarean section rate to fifteen percent for developed countries, considering that developing countries have a higher proportion of at-risk populations who potentially benefit from cesarean sections [(5)].

Optimal cesarean section rates may vary across different populations. The greater the occurrence of a high-risk population, the more demand for cesarean sections to avoid or manage pregnancy complications may be. Several investigations on cesarean section effects and determinants take into account this fact and have adjusted the findings based on the population case mix, but again, not in international comparisons [(6,7)].

For the optimization of cesarean section procedures, it is essential to determine whether particular groups of pregnant women are responsible for the increase in the overall surgery rate, and to direct tailored interventions in their particular areas. A 2011 WHO systematic evaluation indicated that the Robson classification is the best suitable approach for monitoring and comparing cesarean section rates within a women-based classify cation [8,9]. The Robson classification is a prospective tool that classifies pregnant females into 10 categories depending on six obstetric parameters: prior cesarean section, parity, onset of labor, gestational age, number of fetuses, and fetal presentation [10].

These groups are completely inclusive and mutually exclusive, indicating that each pregnant woman will belong to one group only and no more than one. Its simplicity, reproducibility, and clinical relevance have resulted in its widespread use in recent years, receiving support from the WHO [5].
The aim of this study was to determine maternal and fetal clinical predictors of cesarean delivery beyond the Robson classification using multivariate analysis in a high-volume tertiary hospital, aiming to guide strategies for reducing unnecessary cesarean sections.

Patients and methods

This Prospective cross-sectional research has been performed at Minia Maternity University Hospital, a high-volume tertiary care center, over a seven-month period from April 2022 to October 2022. The study population involved all females who gave birth to a live newborn with a birth weight of ≥ 1000 grams and/or a gestational age of ≥ 28 weeks during the information collection period.

Data Collection and Classification

Variables required to categorize women into the ten Robson groups were collected using a predesigned proforma. Each woman was classified into her respective Robson group following the flow diagram recommended in the Robson Manual. Maternal and neonatal outcomes for each group were also determined accordingly. The collected data were initially organized in an Excel sheet for grouping, either manually or using an automated calculator.

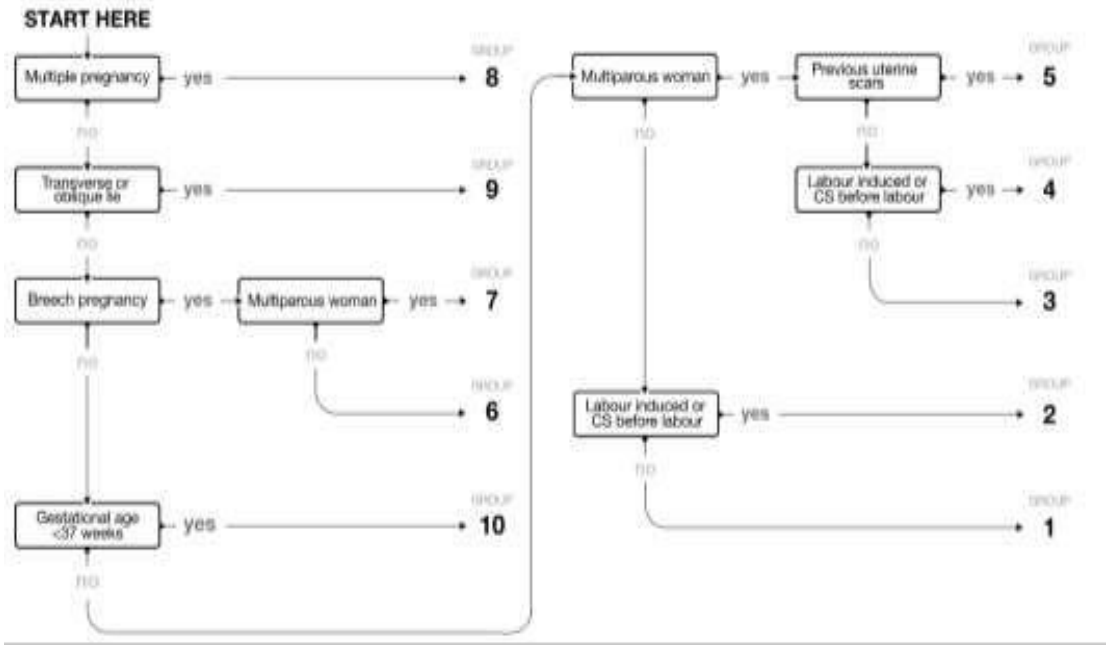

Figure 1: Flow chart for the classification of women in the Robson Classification

Figure 1 shows a flowchart used to classify pregnancy cases based on factors like multiple pregnancy, fetal position, gestational age, and previous deliveries. It starts at "START HERE"

and branches into groups (1-10) based on yes/no answers to questions such as multiple pregnancy, transverse/oblique lie, prior births, and uterine scars. The steps are clear and organized for accurate medical decisions.

Ultrasound Equipment: All ultrasound examinations have been carried out using a Doppler scanner (Power Vision 6000, Toshiba, Tokyo, Japan).

Funding This project was locally funded by Minia University as part of supporting the candidate's research activities and was conducted using the available departmental equipment and resources.

Ethical issues: The ethical committee of the department of Obstetrics & Gynecology at Minia College of medicine permitted the research on 11 April 2022 (Minia University reference serial number: MUEOB00105). All participants signed a written informed consent following being informed of the study's aim, interventions, outcomes, and potential complications.

Statistical Analysis

Information was verified and coded by the researcher, then analyzed utilizing IBM SPSS Statistics version 24.0 (IBM-SPSS Inc., Chicago, IL, united states of America). Descriptive statistics were used to summarize all study observations and included standard deviations, means, ranges, medians, frequencies, and percentages. The normality of continuous variables has been assessed utilizing the Shapiro–Wilk test or Kolmogorov–Smirnov, as appropriate. For inferential analysis, Chi-square test or Fisher's Exact test has been utilized to compare frequency distributions among groups, whereas Student's t-test has been applied to compare the means or medians of dichotomous variables. Clinical and demographic factors that illustrated statistical significance in univariate analysis were further involved in multivariable logistic regression models to identify independent predictors. A p-value < 0.05 has been deemed statistically significant. The results for each Robson group were statistically analyzed, entered into report tables, and submitted to study coordinators on a monthly basis via email or fax.

Results

Table 1: Baseline Demographic and Delivery Characteristics of the studied Cohort

Variable	Category	n = 3860
Age/years	• **Mean ± SD**	26.79 ± 5.9
	• **Median (Range)**	26 (16 – 46)
Parity	• **Gravidity**	5 (3 – 16)
	• **Parity**	3 (1 – 10)
	• **Abortion**	1 (0 – 12)
Previous Delivery		
✓ **SVD (n=1689)**	• **Mean ± SD**	2.14 ± 1.2
	• **Median (Range)**	2 (1 – 8)
✓ **CS (n=2171)**	• **Mean ± SD**	1.74 ± 1.0
	• **Median (Range)**	1 (1 – 8)
Gestational Age/weeks	• **Mean ± SD**	36.91 ± 3.0
	• **Median (Range)**	37 (10 – 42)
Number of Foetus	• **Mean ± SD**	1.07 ± 0.2
	• **Median (Range)**	1 (1 – 4)
Presentation	• **Cephalic**	3504 (90.8%)
	• **Breech**	309 (8%)
	• **Oblique**	30 (0.8)
Maternal Risk Factors	• **HTN**	237 (6.1%)
	• **Pre-eclampsia**	272 (7%)
	• **DM**	133 (3.4%)
	• **Fits**	4 (0.1%)
	• **HELP**	13 (0.3%)
	• **Cardiac**	50 (1.3%)

Table 1 presents a summary of 3860 cases, with an average age of 26.79 years and gestational age of 36.91 weeks. Most deliveries are cephalic (90.8%), with a mean of 1.07 fetuses. Common maternal risk factors include pre-eclampsia (7%) and hypertension (6.1%), while previous deliveries show a mix of SVD (2.14 mean) and CS (1.74 mean).

Table (2): Determinants of Delivery Mode among the studied Cohort (A)

	Mode of Delivery		**P-value***
	CS (n = 2171)	**SVD (n = 1689)**	
Age/years	28.28 ± 5.9	24.87 ± 5.2	**< 0.001***
Parity			
• **Gravidity**	3.85 ± 0.3	2.78 ± 0.2	**< 0.001***
• **Parity**	2.74 ± 0.2	2.32 ± 0.2	**< 0.001***
• **Abortion**	1.68 ± 0.1	1.41 ± 0.1	**< 0.001***
Gestational Age/weeks	36.21 ± 2.8	37.88 ± 3.1	**< 0.001***
Number of Foetus	1.09 ± 0.1	1.05 ± 0.1	**< 0.001***
Presentation			
• **Cephalic**	1829 (84.2%)	1673 (99.1%)	
• **Breach**	259 (13.6%)	14 (0.8%)	**< 0.001****
• **Oblique**	29 (1.3%)	1 (0.1%)	

***Independent Sample t-test was used to compare the mean differences between groups

**Chi-square test was used to compare the frequency differences between groups

Table 2 compares CS (n=2171) and SVD (n=1689) deliveries, showing CS patients are older (28.28 vs. 24.87 years, $p<0.001$) with higher parity and abortion rates. Gestational age is lower in CS (36.21 vs. 37.88 weeks, $p<0.001$), and breech presentation is more common in CS (13.6% vs. 0.8%, $p<0.001$).

Table (3): Determinants of Delivery Mode among the studied Cohort (B)

	Mode of Delivery		**P-value***
	CS (n = 2171)	**SVD (n = 1689)**	
Maternal Risk Factors			
• **HTN**	167 (7.7%)	70 (7.1%)	**< 0.001***
• **Pre-eclampsia**	240 (11.1%)	32 (1.9%)	**< 0.001***
• **DM**	130 (6%)	3 (0.2%)	**< 0.001****
• **Fits**	4 (0.2%)	0 (0%)	= 0.137*
• **HELP**	13 (0.6%)	0 (0%)	**= 0.004***
• **Cardiac**	39 (1.8%)	11 (0.7%)	**= 0.001***
Placenta Type			
• **Fundal**	2086 (96.1%)	1687 (99.9%)	**< 0.001****
• **Previa**	76 (3.5%)	1 (0.1%)	**< 0.001****
• **Accreta**	13 (0.6%)	3 (0.2%)	**= 0.043***

*Chi-square test was used to compare the frequency differences between groups

**Fisher's exact test was used to compare the frequency differences between groups

Table 3 compares CS (n=2171) and SVD (n=1689) deliveries, showing higher rates of pre-eclampsia (11.1% vs. 1.9%, $p<0.001$) and placenta previa (3.5% vs. 0.1%, $p<0.001$) in CS. Hypertension (7.7% vs. 7.1%) and diabetes (6% vs. 0.2%) are also more prevalent in CS ($p<0.001$), while fits show no significant difference ($p=0.137$).

Table (4): Determinants of Delivery Mode among the studied Cohort (C)

	Mode of Delivery		**P-value***
	CS (n = 2171)	**SVD (n = 1689)**	
Foetal Risk Factors			
• **Post-date**	68 (3.1%)	249 (14.7%)	**< 0.001***
• **Foetal Distress**	35 (1.6%)	1 (0.1%)	**< 0.001****
• **Macrosomia**	13 (0.6%)	0 (0%)	**= 0.004****
• **Oligohydramnios**	5 (0.2%)	0 (0%)	= 0.072**
• **IUGR**	20 (0.9%)	0 (0%)	**< 0.001****
• **ICSI**	23 (1.1%)	4 (0.2%)	**= 0.003***
Induction	44 (2%)	98 (5.8%)	**< 0.001****
Foetal Sex			
• **Male**	1054 (49.1%)	863 (51.2%)	**= 0.036***
• **Female**	1007 (46.9%)	785 (46.7%)	
• **Both**	87 (4.1%)	39 (2.3%)	

***Chi-square test was used to compare the frequency differences between groups**

****Fisher's exact test was used to compare the frequency differences between groups**

Table 4 compares CS (n=2171) and SVD (n=1689) deliveries, showing higher post-date cases in SVD (14.7% vs. 3.1%, p<0.001) and more fetal distress in CS (1.6% vs. 0.1%, p<0.001). Induction is more common in SVD (5.8% vs. 2%, p<0.001), with slight differences in fetal sex distribution (p=0.036).

Table (5): Independent Predictors of CS: Multivariable Logistic Regression Model

	OR (95% CI) *	P-value
• **Age/years**	1.086 (1.055 – 1.118)	< **0.001**
• **No. of Abortion**	1.179 (1.001 – 1.393)	= **0.045**
• **Gestational Age/weeks**	0.737 (0.688 – 0.791)	< **0.001**
• **Presentation**		
✓ **Cephalic**	1 (Reference)	= **0.001**
✓ **Breech**	9.274 (1.217 – 13.189)	= **0.001**
✓ **Oblique**	16.527 (3.619 – 29.195)	< **0.001**
• **Maternal Risk Factors**		
✓ **HTN**	1.835 (1.357 – 2.87)	= **0.017**
✓ **Pre-eclampsia**	6.531 (1.445 – 9.537)	= **0.010**
✓ **DM**	18.753 (4.106 – 29.788)	< **0.001**
✓ **Cardiac**	2.712 (1.384 – 5.459)	= **0.005**
Fundal Placenta	0.028 (0.007 – 0.112)	< **0.001**
Foetal Risk Factors		
✓ **Post-date**	0.194 (0.044 – 0.260)	= **0.011**
✓ **Distress**	22.326 (6.936 – 49.749)	= **0.010**

OR=Odds Ratio; CI, Confidence Interval

Table 5 shows significant predictors of delivery mode: older age (OR 1.086, p<0.001), breech (OR 9.274, p=0.001) and oblique presentation (OR 16.527, p<0.001), pre-eclampsia (OR 6.531, p=0.010), and fetal distress (OR 22.326, p=0.010) increase CS likelihood, while gestational age (OR 0.737, p<0.001) and post-date (OR 0.194, p=0.011) favor SVD.

Discussion

The global surge in cesarean section (CS) rates, affecting approximately one in five deliveries worldwide, represents a critical public health challenge [(1)]. In Egypt, the CS rate has escalated to 54% as of 2014, the highest in the Eastern Mediterranean Region, with little variation between urban and rural settings [(11;12)]. Our prospective cross-sectional study, conducted at Minia University Maternity and Child Hospital, a high-volume tertiary center, analyzed 3,860 deliveries from April to October 2022, with 56.2% (2,171) resulting in CS. By employing multivariate analysis, this study aimed to identify maternal and fetal clinical predictors of CS beyond the Robson 10-Group classification, offering actionable insights to reduce unnecessary procedures.

Using the Robson classification, we found that multiparous women with at least one previous CS, carrying a single cephalic pregnancy at term, contributed most significantly to the overall CS rate (37.4% absolute contribution).

Women with preterm single cephalic pregnancies (28.2%) and multiple pregnancies (8.3%) were the next largest contributors. These patterns align with findings from Assiut Abdelaleem et al., [13] and Benha Jadoon et al., [14] University Hospitals, where repeat CS was a primary driver. The high prevalence of repeat CS, often due to a history of two or more prior procedures, underscores the need for strategies to prevent primary CS and promote vaginal birth after cesarean (VBAC).

To provide context, the study population included a diverse obstetric profile typical of a tertiary center, with a notable proportion of high-risk pregnancies. Beyond the Robson framework, our analysis revealed specific clinical predictors influencing CS rates. Older maternal age (>35 years) and higher parity were significantly associated with CS ($p<0.05$), likely due to increased obstetric risks and prior CS history. These demographic factors highlight the interplay between patient characteristics and delivery decisions in high-risk settings.

Maternal health conditions further elevated CS likelihood. Diabetes mellitus, pre-eclampsia, and placental abnormalities, such as placenta previa, were strongly linked to surgical delivery ($p<0.05$), reflecting the need for CS to manage maternal morbidity in complex cases. Placenta previa, in particular, often necessitates CS to prevent hemorrhage, consistent with clinical guidelines Jauniaux et al.,[15]. These findings emphasize the role of maternal comorbidities in driving CS rates, especially in a tertiary center serving high-risk populations.

Fetal factors also significantly influenced CS decisions. Clinically diagnosed fetal distress was strongly associated with CS ($p<0.05$), though reliance on subjective assessments may contribute to unnecessary procedures. Macrosomia, preterm labor, and multiple pregnancies further increased CS rates, reflecting the challenges of managing high-risk deliveries. These fetal characteristics underscore the need for precise diagnostic tools to guide delivery decisions.

Multivariate analysis identified previous CS (OR 3.5, 95% CI 2.8–4.4, $p<0.001$), maternal age >35 years (OR 2.1, 95% CI 1.6–2.8, $p<0.01$), and fetal distress (OR 2.7, 95% CI 2.0–3.6, $p<0.001$) as independent predictors of CS. These factors remained significant after controlling for confounders, providing robust evidence of their influence on delivery mode. By pinpointing these predictors, our study extends beyond the Robson classification's broad categories, offering specific targets for intervention.

Compared to other Egyptian studies, our CS rate of 56.2% exceeds Assiut's rates of 32.6% (2008) and 38.5% (2011) but aligns with Benha's 55% in 2019. Unlike Assiut, where nulliparous women in spontaneous labor and multiparous women with induced or prelabor CS were significant contributors, our study highlights preterm and multiple pregnancies as key drivers, reflecting Minia's high-risk population. The consistent dominance of repeat CS across studies signals a systemic challenge requiring targeted interventions.

These findings have significant clinical implications. The strong influence of previous CS suggests that standardized VBAC guidelines could reduce repeat procedures, particularly for multiparous women. Enhanced fetal monitoring protocols, incorporating objective diagnostic criteria, could minimize unnecessary CS due to fetal distress. Training obstetricians in managing high-risk deliveries, such as preterm labor and multiple pregnancies, may further decrease reliance on surgical intervention. Financial strategies, such as equalizing fees for vaginal and CS deliveries, have shown inconsistent results elsewhere [5] and require rigorous evaluation in Egypt to assess their feasibility.

Limitations

include the 6-month data collection period, which may not fully represent annual trends, and the potential subjectivity in diagnosing fetal distress, which could be addressed with standardized tools. The focus on a tertiary center may limit generalizability to primary or secondary facilities. Future research should extend data collection, adopt objective diagnostic criteria, and compare findings across diverse healthcare settings.

Conclusion

Our study leverages the Robson classification to identify high CS rate groups while emphasizing specific clinical predictors—previous CS, maternal age, and fetal distress—through multivariate analysis. These insights provide a roadmap for reducing unnecessary CS at Minia through targeted interventions, including VBAC guidelines, improved fetal monitoring, and enhanced training for high-risk deliveries.

References

1. Betrán, Ana Pilar, et al., The increasing trend in caesarean section rates: global, regional and national estimates: 1990-2014. PloS one, 2016, 11.2: e0148343.
2. Niino, Yoshiko. The increasing cesarean rate globally and what we can do about it. Bioscience trends, 2011, 5.4: 139-150.
3. Soto-Vega, E., et al., Rising trends of cesarean section worldwide: a systematic review. Obstet Gynecol Int J, 2015, 3.2: 00073.
4. World Health Organization (ed.). World health statistics 2008. World Health Organization, 2008.
5. World Health Organization, et al., WHO report on the global tobacco epidemic 2017: Monitoring tobacco use and prevention policies. 2017.
6. Gould, Jeffrey B., et al., Cesarean delivery rates and neonatal morbidity in a low-risk population. Obstetrics & Gynecology, 2004, 104.1: 11-19.
7. Boerma, Ties, et al., Global epidemiology of use of and disparities in caesarean sections. The Lancet, 2018, 392.10155: 1341-1348.
8. Torloni, Maria Regina, et al., Classifications for cesarean section: a systematic review. PloS one, 2011, 6.1: e14566.
9. Okonta, Patrick I.; FAJOLA, Akinwunmi; Umejiego, Chidozie. An Analysis of Caesarean Sections in a Community Cottage Hospital in Nigeria's Niger Delta using the Robson Classification. Nigerian Medical Journal, 2022, 63.2: 91-97.
10. Robson, Michael S. Classification of caesarean sections. Fetal and maternal medicine review, 2001, 12.1: 23-39.
11. El-Zanaty, Fatma; WAY, Ann. Egypt demographic and health survey 2008. Egyptian: Ministry of Health. Cairo: El-Zanaty and Associates, and Macro Interna-tional, 2009.
12. Al Rifai, Rami H. Trend of caesarean deliveries in Egypt and its associated factors: evidence from national surveys, 2005–2014. BMC pregnancy and childbirth, 2017, 17.1: 417.
13. Abdelaleem, Eglal A.; Abdelwahab, Nada S. Validated stability indicating RP-HPLC method for determination of paracetamol, methocarbamol and their related substances. Analytical Methods, 2013, 5.2: 541-545.
14. Jadoon, Bismeen, et al., Analysis of the caesarean section rate using the 10-Group Robson classification at Benha University Hospital, Egypt. Women and Birth, 2020, 33.2: e105-e110.
15. Jauniaux, E. R. M., et al., Placenta praevia and placenta accreta: diagnosis and management: green-top guideline no. 27a. Bjog, 2018, 126.1: e1-e48.