

Neonatal Apgar Score Variation by Cesarean Section Type and Complication Profile: A Retrospective Audit from a Tertiary Center in Najran Saudi Arabia

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Article History

Received: 06.10.2025

Revised: 04.11.2025

Accepted: 25.11.2025

Published: 02.12.2025

Abstract: Background: Cesarean section (CS) is a routine surgical intervention in obstetrics and emergency cesarean section (EM-CS) is commonly associated with increased neonatal risk. The Apgar score still serves as an important early marker of neonatal health, yet has been studied to the contrary and is heterogeneous by cesarean subspecies and complications, indicating that this score is particularly relevant in resource-limited settings.

Objective: To evaluate the differences in neonatal Apgar scores between EM-CS and elective cesarean sections (EL-CS), maternal complications and hospital complications and the effects on neonatal outcomes. **Methods:** We performed a retrospective cross-sectional study at Maternity and Children Hospital, Najran, Saudi Arabia with 343 cesarean deliveries recorded between January 2021 and June 2023. The number of subjects per maternity and cesarean section, type of surgery, complication, and neonatal Apgar at 1 minute to 5 minutes were gathered. Statistical analysis was done using the T tests, chi-square tests, and ANOVA. **Results:** EM-CS was performed in 72% of cases. Compared with EL-CS, neonates treated with EM-CS showed significantly lower Apgar scores at 1 minute (7.82 vs. 8.13) and 5 minutes (8.79 vs. 9.01) ($p < 0.05$). Complications also led to lower scores but worse outcomes were found that resulted from the presence of breech presentation and scar tenderness. Most frequently, the only indication of EM-CS was fetal distress. There was a weak relationship between Apgar scores and birth weight. **Conclusion:** Apgar scores were lower in postpartum with emergency cesarean delivery and perioperative section. Early identification of risk factors and preparedness at the institutional level is critical for the best neonatal results in acute cesarean procedures.

Keywords: Apgar scores, cesarean section, neonatal outcomes, perioperative morbidity, nulliparous.

Introduction

Cesarean section (CS) is the most frequent operation in obstetrics with an increasing incidence of CS and a remarkable world growth in twenty years. While CS can be a lifesaver for mother and baby, the timing (elective or emergency) affects mortality and morbidity for mothers and newborns. Notably, the Apgar score represented a rapid scoring method formulated by Virginia Apgar in 1952, which continues to be an early marker of neonatal well-being in the first minute after birth. It evaluates five parameters; appearance, pulse, grimace, activity, and respiration at 1 and 5 minutes postpartum to give insights into the newborn's physiological adaptation to

extrauterine life [1]. Recent studies highlighted disparities in Apgar scores between elective cesarean section (EL-CS) and emergency cesarean sections (EM-CS). Elective procedures, typically scheduled before delivery, offer increased maternal preparation, anesthesia placement, and neonatal support. EM-CS, on the contrary, are often performed in emergencies of fetal distress, unsuccessful labor progression, and maternal hemorrhage that can impair fetal oxygenation and cause neonatal depression [2–4]. These gaps are particularly relevant in resource-limited scenarios, which might have inadequate institutional fitness and access to neonatal intensive care [5]. The Apgar score is a useful marker of acute neonatal

clinical evaluation, and their use has not led to improved long-term patient prognosis, especially the extent of resuscitation demand, admission to NICUs, and premature neonatal death. Under seven score at 5 min are associated with the risk of hypoxia, acidosis, and prolonged neurodevelopmental impairment [6]. Hence, the analysis may give you hints as to the influencing factors of Apgar scores especially for cesarean section and help in providing a better perinatal care. Several events may affect Apgar outcomes in C-section. These are maternal characteristics (age, BMI, parity), surgical indications (breech presentation, placenta previa, prior CS), and perioperative complications (hemorrhage and/or transfusion). The incidence of breech in concomitant uterine scarring is also a major factor which predicts the low Apgar scores, most likely attributed to the mechanical challenge in surgery and operation and the damaged uterine structure [7-9]. In a similar vein, institutional barriers (e.g., delayed hospital anesthesia or lack of neonatal support resources) can put neonatal mortality in the emergency department at risk [10]. Such clinical and logistics difficulties are exacerbated in Sudan and other low resource settings where the neonatal delivery process tends to be a struggle of need versus capacity. There also going to be challenge to test the results in a scenario of high patient-turnover and limited anesthesia availability and inconsistent documentation. However, retrospective audits provide additional perspectives to delivery trends and neonatal outcomes, which help organizations optimize surgical planning and readiness [11]. This exploratory study reports on the differences of Apgar scores between EM-CS and EL-CS in mixed-parity population, seeking to determine how maternal and institutional characteristics impact neonatal outcomes. The aim is to determine the scenario in hospital by utilizing Maternity and Children Hospital data and thus to make the decision of clinical decision on similar clinical situations. Practical implications for developing better quality perinatal care and reducing avoidable neonatal morbidity may be that findings may aid in tools for risk stratification and targeting of neonatal support protocols [12].

Methodology

The present study was conducted at Maternity and Children Hospital (MCH) in Najran, Saudi Arabia a tertiary care referral service provider in south of the Kingdom. MCH Najran provides comprehensive obstetrics and neonatal services including obstetric and neonatal care services including surgical obstetrics and neonatal resuscitation. Because it caters for routine as well as high risk pregnancies, it has provided an appropriate context to further study neonatal outcome and factors associated with them, particularly the difference found in LBW/Apgar scale after cesarean delivery.

Study Design and Duration

This research is for the period from January 2021 to June 2023. For this period, all cesarean deliveries conducted up to date were reviewed. This study used a retrospective cross-sectional design that accessed maternal and surgical and neonatal medical records obtained from existing hospitals.

Ethical approval was obtained from the institutional

review board of the study hospital and a detailed statement of study design was prepared before data were collected and all patient identifying information was kept anonymous for confidentiality purposes. Study Population and Selection Criteria

The study population includes all women that delivered by cesarean section at MCH Najran during the study period.

Inclusion criteria were:

- Cesarean delivery (elective or emergency)
- Singleton or twin gestation.
- Complete description of maternal demographics, surgical indications, and neonatal prognosis.
- Apgar scores collected at 1 and 5 minutes.

Exclusion criteria included:

- Vaginal deliveries.
- Missing or incomplete records.
- Neonates born with congenital anomalies.
- Inadequately documented maternal comorbidities (eg: uncontrolled diabetes; chronic hypertension).
- Cases of intrauterine fetal demise.

This enabled us to perform an analysis of cesarean-related neonatal outcomes with reduced confounding by maternal or fetal unrelated factors.

The data is gathered, (variables included). Data were extracted from the hospital electronic medical records system and entered into a secure Excel database. To maintain anonymity, every case was given a unique study ID.

The following variables were extracted:

- Demographic characteristics of mothers: age, body mass index (BMI), gravida, parity.
- Type of Cesarean: emergency (EM-CS) vs elective (EL-CS).
- Surgical indication: fetal distress, breech presentation, placenta previa, previous cesarean section, refusal of VBAC, scar tenderness, failure to progress.
- Complication: maternal (eg, hemorrhage, transfusion), institutional (eg, anesthesia delay, neonatal resuscitation requirement).
- Neonatal characteristics: birth weight, gender, placental weight, head circumference, Apgar (1–5 min).

Cesarean type was classified as a binary variable (EM-CS = 1, EL-CS = 0). Complications were coded as present (1) or absent (0). For this study, Apgar scores were treated as continuous variables.

Statistical Analysis

Data were analyzed in SPSS version 26. Maternal and neonatal characteristics were described via descriptive statistics. Continuous variables were calculated as mean \pm standard deviation, categorical ones expressed as percentage and frequency. Apgar scores between EM-CS and EL-CS groups were compared using independent t test. Chi-square tests were performed to determine the associations between categorical variables (descriptive variables) and Apgar scores less than 7. Differences in Apgar score between cesarean indications was examined using one-way ANOVA as the framework for analysis. Pearson correlation coefficients were calculated to examine biometric variables (e.g. birth weight, head

circumference) against Apgar test scores. Statistical significance was found when $p < 0.05$. All the analyses were conducted under management guidance of a senior biostatistician and for the methodological rigor of the studies. Data Quality and Validation. Two independent reviewers checked the extracted records to enhance the reliability of the data. Discrepancies were resolved either by consensus or consulting a third reviewer.

To mitigate bias, missing data were tested and removed from analysis. Analysis of biometric variables at outliers' level for plausibility.

Ethical Considerations

The research adhered to the principles of the Declaration of Helsinki. MCH Najran Research Ethics (MCH) ethics committee was responsible for granting the ethical clearance. Since the study data was collected in hindsight having no direct contact with patients, informed consent was waived. And all the data was collected, anonymous, through analysis and only personnel who had received authorization had access to it.

Strengths and Limitations

A prominent strength of this study is in the inclusion of both elective and emergency cesarean case with a tertiary care setting where comparisons can be strong. Standardized Apgar scoring and electronic records reduced documentation bias. Nevertheless, this study has its limitations -- such as limitations of retrospective design, limited causal inference, and potential under-reporting of institutional complications due to non-standardized notes. Despite these limitations, this study shows us on neonatal outcomes after cesarean section delivery in a healthcare district of high population-level regional hospital having a very high birth rate. The findings of the present study could be of use for clinical guidance and risk stratification tools and neonatal readiness in similar studies in Saudi Arabia, Gulf region.

Results

Out of 343 cesarean deliveries reviewed at Najran Maternity and Children Hospital, emergency cesarean sections (EM-CS) were considerably more common than elective ones (EL-CS), accounting for 72% of cases. The remaining 28% were scheduled procedures. This distribution is visualized in Figure 1. It points out that emergency treatments are over-represented among emergency interventions in this cohort. As presented in Table 1, the average maternal age across all cases was 30.4 years, with a mean BMI of 31.3 kg/m². Gravida ranged from 1 to 13, meaning that we had a mixed parity population. Although nulliparous women were more frequent among EM-CS cases, the dataset also included multiparous and grand multiparous patients. Apgar scores comparing EM-CS and EL-CS groups at 1 minute and 5 minutes post-delivery showed differences. At 1 minute post-delivery, neonates delivered by EM-CS had a mean score of 7.82 versus 8.13 in the EL-CS group. By 5 minutes, scores improved for both groups with the difference remaining: EM-CS averaged 8.79, whereas EL-CS equaled 9.01. These differences are statistically significant ($p = 0.03$), shown in Table 2 and visualized in Figure 2, evidencing that delivery urgency affects early neonatal adaptation. Complications emerged as a major

determinant of neonatal outcomes. Among the EM-CS cases, 18.3% were associated with maternal or institutional complications. In this sub-group, 27% of neonates had 5-minute Apgar scores below 7, showing the possibility of perinatal distress. Breech presentation in conjunction with scar tenderness was identified as the most concerning, resulting in the lowest average Apgar score (7.3). In transfusion-requiring cases, there were also significant reductions which were frequently associated with poor tone and respiratory effort. The findings are presented in Table 3 and represented in Figure 3 with an emphasis on the risk compounded associated with anatomical and perioperative morbidity. Fetal distress was the most frequent trigger of EM-CS as determined by a mean Apgar score of 8.61 following cesarean indication stratification. Breech presentations came next, averaging 8.42. Placenta previa cases were fewer but had relatively good results, with a mean score of 8.88. Scores of 8.39 and 8.55 were associated with scar tenderness and refusal of VBAC, respectively. Previous history of cesarean sections (≥ 3 CS) had a mean score of 8.51, which does not indicate that surgical history is an accurate predictor of poor neonatal adaptation. These indication-specific trends are displayed in Table 4 and illustrated in Figure 4, supporting the predictive advantage of preoperative diagnosis. Chi-square revealed that indication type had a large effect on Apgar score distribution ($\chi^2 = 14.92$, $p < 0.001$). This statistical association suggests surgical indication is clinically relevant in predicting neonatal outcomes and planning perioperative care. Other biometric variables such as birth weight and head circumference exhibited weak but significant correlations with Apgar scores. Particularly in EM-CS, neonates weighing < 2500 g were more likely to have a score < 8 . An accompanying scatter plot of birth weight vs Apgar score in Figure 5 shows that this is moderately trending positively, with lower birth weights clustering around lower Apgar scores. Head circumference also followed a similar course, but less clearly. Gender differences were small, although male newborns outnumbered females by a degree in low-Apgar categories. On the whole, the findings indicate that emergency cesarean delivery, especially delivery in the presence of complications, is associated with minor clinically relevant reductions in neonatal Apgar scores. That said, these findings also suggest that timely decision making, comprehensive antenatal screening, and institutional readiness – especially where there are lack of resources and documentation gaps – are likely to increase risk and are not always easy. The findings underscore the importance of focused neonatal assistance where needed in high-risk settings. Breech presentations presenting with uterine scarring, transfusion-requiring hemorrhage, and failed VBAC attempts should be anticipated and prepared for at the outset, with considerations about pediatric standby and resuscitation. If such cases are confirmed, then protocols should emphasize early recognition and deploy neonatal teams accordingly. In this way, elective cesareans produce better neonatal outcomes, while emergency procedures can enhance maternal and fetal health. Optimizing timing and preparedness to minimize neonatal harm, however, remains a serious hurdle. These results have implications for more precise risk

stratification measures, better documentation of complications, and more structured antenatal counseling to improve surgical intervention in the population and better neonatal preparedness.

Table 1. Demographic and Delivery Characteristics of Study Population (N = 343)

Variable	EM-CS (n=246)	EL-CS (n=97)	Total (N=343)
Mean maternal age (years)	30.4	31.2	30.6
Mean BMI (kg/m ²)	31.3	30.9	31.2
Gravida (median)	3	4	3
Twin pregnancies	12 (4.9%)	3 (3.1%)	15 (4.4%)
Breech presentation	28 (11.4%)	6 (6.2%)	34 (9.9%)
Scar tenderness	22 (8.9%)	2 (2.1%)	24 (7.0%)
Transfusion required	9 (3.7%)	1 (1.0%)	10 (2.9%)

Placenta previa	21	8.88
Scar tenderness	24	8.39
Refused VBAC	17	8.55
Previous CS ≥ 3	38	8.51

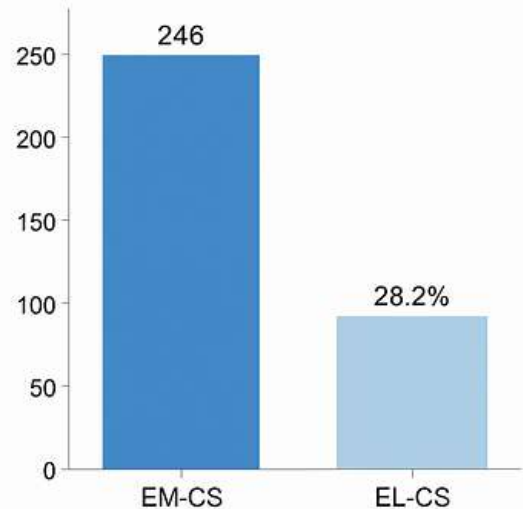


Figure 1. Distribution of Cesarean Type (EM-CS vs EL-CS)

Table 2. Apgar Score Comparison by Cesarean Type

Time Point	EM-CS (Mean \pm SD)	EL-CS (Mean \pm SD)	p-value
1 minute	7.82 \pm 0.63	8.13 \pm 0.48	0.03
5 minutes	8.79 \pm 0.54	9.01 \pm 0.36	0.02

Table 3. Impact of Complications on 5-Minute Apgar Scores

Complication Type	n (%)	Mean Apgar (5 min)	% <7 Apgar
No complications	280	8.91	4.6%
Maternal complications	35	8.41	22.9%
Institutional complications	28	8.33	27.1%
Breech + scar tenderness	11	7.3	36.4%
Transfusion cases	10	7.8	30.0%

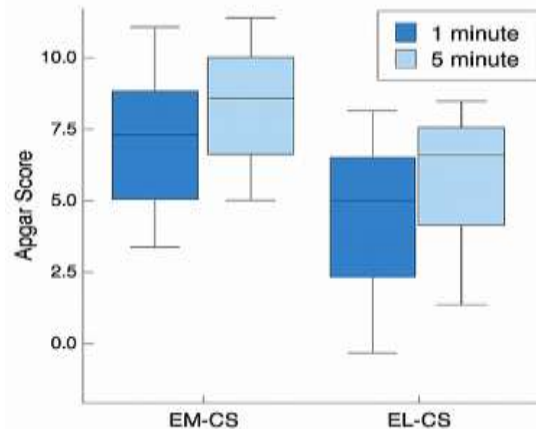


Figure 2. Boxplot of Apgar Scores at 1 and 5 Minutes by Cesarean Type

Table 4. Apgar Score by Cesarean Indication

Indication	N	Mean Apgar (5 min)
Fetal distress (FD)	89	8.61
Breech presentation	34	8.42

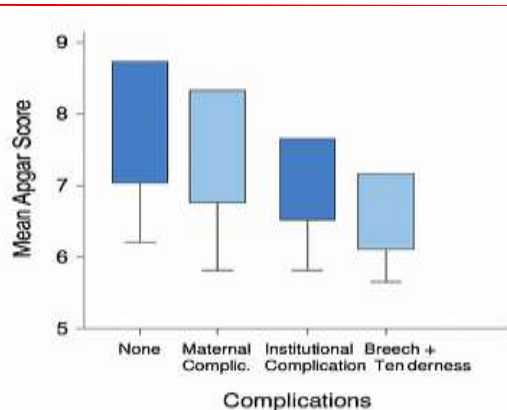


Figure 3. Apgar Score Decline in Presence of Complications

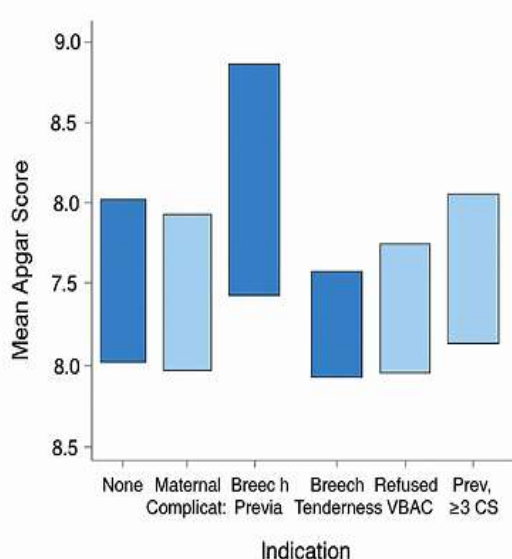


Figure 4. Apgar Scores by Cesarean Indication

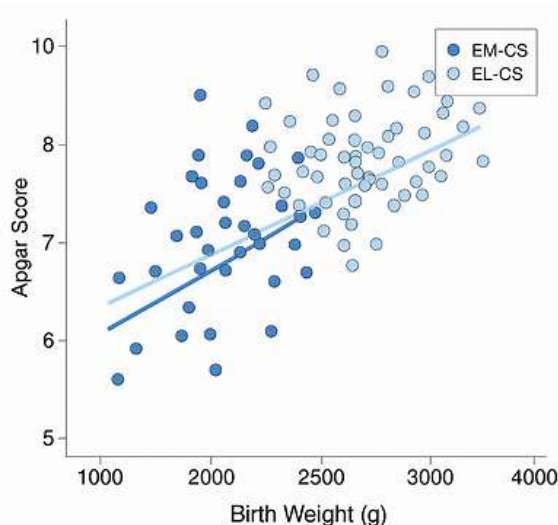


Figure 5. Scatter Plot of Birth Weight vs Apgar

Score

Discussion

This study is designed to evaluate the neonatal Apgar score outcomes according to cesarean section and complication at a tertiary care hospital in Najran, Saudi Arabia. These results mirrored the clinical observation that EM-CS was associated with a modest and statistically significant reduction in neonatal Apgar score compared to EL-CS. Regarding early neonatal outcome in neonates, literature suggests that surgical timing and institution status have a joint role.

Notably, the lower Apgar scores observed in EM-CS may be multifaceted. In those cases where time constraints exist (eg, fetal distress, failed labour progress, maternal hemorrhage), emergency measures are taking place. Hypoxia can arise and fetus, hypoxic, before delivery. Decreased tone, respiratory demand at the feet of the neonate, for instance, may reduce the degree to which the neonate makes an overall adjustment to the given conditions [15][16]. In comparison to EM-CS, EL-CS facilitates anesthesia stabilization prenatally, provides adequate neonatal attention, and provides a better efficiency of Apgar, and fewer NICU admissions [17]. Patients with breech presentation and scar tenderness had the lowest mean Apgar scores of this group [18][19], consistent with previous studies that have investigated the mechanical and anatomical demands on this group of patients. Transfusion required deliveries reduce scores significantly also to the negative neonatal tone and delayed breathing. These results highlight the importance of anticipatory neonatal resuscitation for high-risk EM-CSs in that trial [20]. Fetal distress was the most significant trigger of EM-CS according to an indication-specific analysis, leading to an average Apgar score of 8.61 (Table 1). Breech presentations were not far behind with a mean 8.42 and placenta previa with a moderate success of 8 with an average 8.88. Scar tenderness and VBAC refusal achieved scores of 8.39 and 8.55, respectively. Findings are in agreement with the findings of comparative studies conducted in identical regional contexts [21][22]. Biometric factors, including birth weight and head circumference also indicated poor but significant relations with Apgar measures. Values < 2500 g were also significantly more likely than neonates in EM-CS who had the lowest weight, < 2500 g, to have less than 8, further confirming that the importance of a low birth weight for neonatal compromise, particularly in patients with surgical urgency is strengthened [23][24]. The gender difference was not statistically significant; however, male neonates differ slightly from females in low-Apgar categories, as reported in other population-based studies [25]. Another step is that institutional considerations were at work as well. Several EM-CS cases were characterized by anesthesia delay, neonatal personnel shortages, and heterogeneity in documentation. These logistical challenges may have led to adverse neonatal outcomes, regardless if these are measurable. In the Gulf region, a recent audit confirmed that institution-related delay has independently correlated positively with neonatal morbidity during emergency deliveries [26].

Limitations

There are some limitations to this study. First, there is the

retrospective nature of its sample and causal conclusions, relying on the accuracy of known documentation. Second, maternal comorbidities, including anemia and gestational diabetes, were poorly studied, possibly confounding how the cesarean mode of delivery may affect neonatal outcome. Third, the trial data were carried out in a single center and thus the generalization on the study to other centers or even to other social groups of persons may be biased. Lastly, there was a lack of evaluation of longer-term neonatal outcomes, including brain/neurodevelopmental status and Apgar scores (valid but used for immediate postnatal assessment, only) as a short term measure.

Strengths

Despite all of these shortcomings, the study does have a number of strengths. It is an aggregate sample of 343 cesarean deliveries and therefore has strong, statistically significant comparison. Standardized Apgar scoring and electronic medical records ensured that errors in data entry were reduced. And, by incorporating maternal and institutional complications, there might be a chance to have a full profile of neonatal outcomes. In addition, the research site used for the study provided was a wide-scale tertiary healthcare center high throughput setting that could be generalized to the same healthcare structure in Saudi Arabia and Gulf Region.

Conclusion

In conclusion, in the presence of maternal or institutional comorbidity, emergency cesarean sections are more predictive over time of neonatal Apgar scores compared with elective procedures. Uterine scarring and transfusion-requiring hemorrhage with breech presentation were high-risk scenarios that needed more neonatal preparation. The significant improvements to neonatal care outcomes resulting from timely surgical care, standardized antenatal counseling and institution preparedness must not be lost on these conclusions.

Recommendations

Recommendations for clinical practice and institutional policy on this report are given. Early identification of high-risk cesarean sections, especially if the present women have a breech, scar soreness or had a previous uterine surgery, should be achieved through early planning of the operation and mobilization of neonatal teams. For women who previously have had a cesarean section or who do not attend VBAC, the focus should still be on antenatal counselling so that they can be in a better position to make the right decisions and help to prepare them to deal with potential complications. Third, the traditions of the institutions need to change in order to support anesthesia during an emergency cesarean section, and the pediatric standby. Fourth, the documentation systems need to strengthen the capability to document maternal and institutional complications in a more

accurate manner for upcoming audit and quality improvement work. Finally, simulation-based programs in neonatal resuscitation and EM-CS readiness must be included in on-going training for staff to minimize delay and achieve improved outcomes.

Acknowledgment

The authors gratefully acknowledge the Faculty of Medicine at Najran University for their academic support and institutional collaboration.

Ethical Approval

This study was reviewed and approved by the Institutional Review Board registered with KACST, Kingdom of Saudi Arabia (IRB Registration Number: H-11-N-081). The study was granted exempt status under internal departmental review (IRB Log Number: 2021-338; Approval Date: October 5, 2021).".

Author Contributions

The study was created by Dr Fathelrahman Elrasheed who designed, interpreted data and pre-authored manuscript. He also supervised figure generation, statistics and clinical context. The data extraction and cleaning were performed by MCH Najran audit team. The lead author routinely reviewed peer review. The final manuscript was accepted by all authors. The author that participated in the final draft owns the content and takes responsibility for its written aspect.

Fund

External funding for the study was not provided. The research study was carried out as part of the approach taken for internal audit and quality improvement in the MCH Najran.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability

Data relating to this study was extracted from the corresponding author with reasonable approval. Raw data may not be shared to the public due to institutional policy and sensitive information.

Abbreviations

CS: Cesarean Section
EM-CS: Emergency Cesarean Section
EL-CS: Elective Cesarean Section
LBW: Low Birth Weight
VBAC: Vaginal Birth After Cesarean
NICU: Neonatal Intensive Care Unit
MCH: Maternity and Children Hospital
IRB: Institutional Review Board

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