Analysis of Risk Factors and Outcomes in Emergency Cesarean Sections: A One-Year Cross-sectional Study

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ABSTRACT

Introduction: Emergency cesarean section (ECS) represent critical intervention in obstetric care with unique risk profiles. Understanding the relationship between specific indications and subsequent outcomes is crucial for optimizing clinical decision-making and resource allocation.

Methods: This hospital-based cross-sectional study was conducted at a tertiary care teaching hospital over one year, including 294 women who underwent emergency cesarean section. Data was collected using a structured proforma capturing demographic details, obstetric history, indications, and outcomes.

Results: The majority of women were 20-25 year age group(38.1%), from rural areas (59.2%), among which 33.3% were unbooked. Fetal distress (26.5%), non-progress of labor (17.7%), and failed induction (12.9%) were the leading indications. Category 2 emergencies (53.7%) predominated, followed by Category 3 (24.5%) and Category 1 (17.3%). Maternal complications included post-operative fever (14.6%), surgical site infections (10.5%), and postpartum hemorrhage (9.2%). Neonatal outcomes revealed 12.9% with 5-minute Apgar scores below 7 and 22.8% requiring NICU admission. Advanced maternal age, unbooked status, preterm delivery, Category 1 emergency classification, delayed intervention in urgent cases, antepartum hemorrhage, severe preeclampsia, and general anesthesia use emerged as an independent predictors of adverse outcomes.

Conclusion: Significant maternal and neonatal morbidity was observed following emergency cesarean section. The study highlights critical areas for quality improvement, including strengthened antenatal care, standardized fetal monitoring protocols, optimized emergency workflows, and evidence-based management of high-risk conditions to improve maternal and neonatal outcomes in emergency obstetric care.

Keywords: Emergency cesarean section, maternal outcomes, neonatal outcomes, risk factors, emergency classification

1. INTRODUCTION

Emergency cesarean section (ECS) represent critical interventions in obstetric care, performed when vaginal delivery poses significant risks to maternal or fetal health. Unlike elective procedures, these surgeries occur under time constraints and often in high-stress environments, carrying unique risk profiles that warrant careful investigation. The global cesarean delivery rate has risen substantially over recent decades, with the World Health Organization reporting rates exceeding 21% worldwide, significantly above their recommended 10-15% threshold (Betran et al., 2021). In India, cesarean rates have increased from 8.5% in 2005-2006 to 17.2% in 2015-2016, with emergency procedures constituting approximately 60% of these surgeries (Boerma et al., 2018).

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Emergency cesarean sections are typically indicated for numerous clinical scenarios including fetal distress, failed induction, non-progressive labor, placental abnormalities, and umbilical cord prolapse. Each indication carries its own set of potential complications and outcomes. Maternal complications may include surgical site infections, hemorrhage, thromboembolic events, and anesthetic complications, while neonatal outcomes of concern encompass respiratory distress syndrome, hypoxic-ischemic encephalopathy, and birth trauma (Sandall et al., 2018). Understanding the relationship between specific indications and subsequent outcomes is crucial for optimizing clinical decision-making and resource allocation.

Several risk factors have been associated with increased likelihood of emergency cesarean deliveries. Maternal factors include advanced maternal age, nulliparity, obesity, gestational diabetes, and preeclampsia (Mylonas & Friese, 2015). Fetal factors encompass macrosomia, malpresentation, and multiple gestations. Institutional factors, including staffing patterns, provider experience, and facility capabilities, further influence both the decision to perform emergency cesarean sections and subsequent outcomes (Mazzoni et al., 2017).

The decision to perform an emergency cesarean section involves complex risk-benefit assessments under significant time pressure. While these procedures can be life-saving, they also carry substantial short and long-term implications for both mother and child. Maternal recovery typically requires longer hospitalization compared to vaginal delivery, with increased risks of surgical complications and implications for future pregnancies. Neonates delivered by emergency cesarean section may experience higher rates of respiratory morbidity, particularly when performed before 39 weeks gestation, along with altered gut microbiome development that has been associated with immune system development (Keag et al., 2018).

The timing and urgency classification of emergency cesarean sections significantly impact outcomes. The Royal College of Obstetricians and Gynecologists classifies emergency cesarean sections into four categories based on urgency, ranging from immediate threat to maternal or fetal life (category 1) to no maternal or fetal compromise but requiring early delivery (category 4). Studies have demonstrated that higher urgency categories correlate with poorer neonatal outcomes, particularly in terms of Apgar scores and NICU admission rates (Tolcher et al., 2014).

In the Indian context, several region-specific factors influence emergency cesarean section patterns. Limited access to antenatal care in rural areas often results in undiagnosed pregnancy complications that manifest as emergencies. Infrastructure limitations, including shortages of blood products, anesthesia services, and neonatal intensive care facilities, may impact the threshold for intervention and subsequent management of complications. Socioeconomic factors, including education level and healthcare access, further influence both the need for emergency interventions and their outcomes (Singh et al., 2019).

Recent studies from tertiary care centers in India have reported emergency cesarean section rates ranging from 14.6% to 25.8% of all deliveries, with fetal distress consistently emerging as the leading indication (Yadav & Rawal, 2020). Maternal mortality associated with emergency cesarean sections in Indian settings has been reported between 0.1% and 0.5%, while perinatal mortality ranges from 3% to 7%, significantly higher than global averages (Preetkamal et al., 2017). These statistics underscore the importance of identifying modifiable risk factors and optimizing clinical protocols specific to the Indian healthcare context.

Quality improvement initiatives targeting emergency cesarean sections have demonstrated effectiveness in various settings. These include standardized protocols for fetal monitoring interpretation, structured team communication during emergencies, simulation training for uncommon but critical scenarios, and postoperative care bundles to reduce infection and thromboembolism (Boatin et al., 2018). Understanding the local risk profile and outcome patterns is essential for tailoring such interventions to specific institutional needs.

While existing literature provides valuable insights into emergency cesarean section patterns, significant knowledge gaps persist, particularly regarding the interplay between multiple risk factors and their cumulative impact on outcomes. Most studies examine individual risk factors in isolation rather than considering their complex interactions. Additionally, there is limited research on the long-term implications of emergency cesarean sections on subsequent pregnancies and child development, areas that warrant longitudinal investigation (Mascarello et al., 2017).

This study aims to comprehensively analyze the risk factors associated with emergency cesarean sections and their correlation with maternal and neonatal outcomes in a tertiary care setting in India. By identifying high-risk profiles and establishing risk-stratified outcome patterns, this research seeks to inform evidence-based protocols for managing these critical obstetric interventions. The findings will contribute to clinical decision-making, resource allocation, and quality improvement initiatives aimed at optimizing maternal and neonatal health outcomes in emergency scenarios.

The aim of this study was to identify and analyze the risk factors associated with emergency cesarean sections and to assess their correlation with maternal and neonatal outcomes in a tertiary care hospital setting over a one-year period.

2. METHODOLOGY

Study Design and Site

A hospital-based cross-sectional study was conducted at the Department of Obstetrics and Gynecology of a tertiary care teaching hospital. This 500-bedded multi-specialty hospital serves as a referral center for high-risk obstetric cases from surrounding districts and handles approximately 3000 deliveries annually. The labor unit consisted of 5 labor tables with continuous electronic fetal monitoring capabilities and was staffed by residents under the supervision of obstetric consultants round-the-clock.

Study Duration and Population

The study was conducted over a period of 6 months from January 2023 to June 2023. All women who underwent emergency cesarean sections during this period were considered for inclusion in the study. The study population comprised pregnant women admitted either through the outpatient department or emergency services who subsequently required emergency cesarean delivery based on maternal or fetal indications.

Sampling and Sample Size

Consecutive sampling technique was employed to recruit participants. Based on previous hospital records indicating an emergency cesarean section rate of 20%, with a 95% confidence interval and 5% margin of error, the minimum required sample size was calculated to be 246 using the formula $n = Z^2pq/d^2$. Accounting for a 10% non-response rate, the final sample size was determined to be 271. However, all eligible cases during the study period were included, resulting in a final sample of 294 emergency cesarean deliveries.

Inclusion and Exclusion Criteria

All pregnant women who underwent emergency cesarean sections at or beyond 28 weeks of gestation during the study period were included. The study excluded women who underwent elective cesarean sections, those with incomplete medical records, and cases where emergency cesarean was initiated but subsequently converted to other interventions. Additionally, women with pre-existing severe comorbidities that could independently affect the outcomes being studied, such as pre-existing heart disease, chronic kidney disease, or advanced malignancies, were excluded to minimize confounding factors.

Data Collection Tools and Techniques

Data was collected using a structured proforma developed after extensive literature review and expert consultation. The proforma captured demographic details, obstetric history, antenatal risk factors, indication for emergency cesarean section, intraoperative findings, and postoperative maternal and neonatal outcomes. Primary data was collected through direct interviews with patients within 48 hours of surgery, while secondary data was extracted from case files, operation notes, anesthesia records, and laboratory reports. Two trained research assistants collected the data under supervision of the principal investigator to ensure consistency and accuracy. Indications for emergency cesarean sections were classified according to the Royal College of Obstetricians and Gynecologists urgency classification system. Neonatal outcomes were assessed using Apgar scores, NICU admission requirements, and specific neonatal morbidities.

Data Management and Statistical Analysis

All collected data was entered into a password-protected database using EpiData version 3.1 and was subsequently exported to SPSS version 25.0 for analysis. Data cleaning was performed to identify missing values and outliers. Descriptive statistics were presented as frequencies, percentages for categorical variables, and means with standard deviations for continuous variables with normal distribution or medians with interquartile ranges for non-normally distributed data. Bivariate analysis was conducted using Chi-square tests for categorical variables and Student's t-test or Mann-Whitney U test for continuous variables as appropriate. Multivariate logistic regression analysis was performed to identify independent risk factors associated with adverse maternal and neonatal outcomes, with results presented as adjusted odds ratios with 95% confidence intervals. Statistical significance was set at $p < 0.05$ for all analyses.

Ethical Considerations

The study protocol received approval from the Institutional Ethics Committee prior to commencement (approval number IEC/2022/124). Written informed consent was obtained from all participants after explaining the study purpose and procedures in their preferred language. For emergency situations where obtaining prior consent was not feasible, consent was sought from legal guardians and post-procedure consent was obtained from the patient. All participant information was de-identified and stored securely, with access restricted to the research team. The study adhered to the principles of the Declaration of Helsinki and the Indian Council of Medical Research's ethical guidelines for biomedical research. Participation was voluntary, and participants were informed of their right to withdraw at any point without affecting their clinical care.

3. RESULTS

Table 1: Socio-demographic and Obstetric Characteristics of Women Undergoing Emergency Cesarean Section (N=294)

Characteristics	Number	Percentage
Age (years)		
<20	21	7.1
20-25	112	38.1
26-30	95	32.3

31-35	45	15.3
>35	21	7.1
Educational status		
Illiterate	34	11.6
Primary	58	19.7
Secondary	129	43.9
Higher education	73	24.8
Residence		
Rural	174	59.2
Urban	120	40.8
Socioeconomic status		
Lower	64	21.8
Middle	172	58.5
Upper	58	19.7
Booking status		
Booked	196	66.7
Unbooked	98	33.3
Parity		
Primigravida	142	48.3
Multigravida	152	51.7
Gestational age (weeks)		
28-32	34	11.6
33-36	72	24.5
37-40	163	55.4
>40	25	8.5
Previous cesarean		
Yes	68	23.1
No	226	76.9
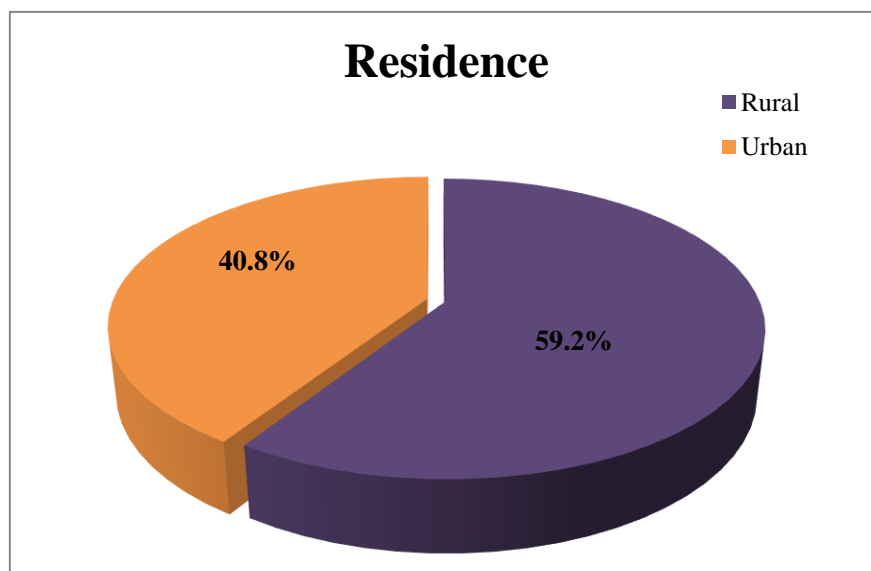
Fig. 1: Shows the Demographic distribution of Women Undergoing Emergency Cesarean Section

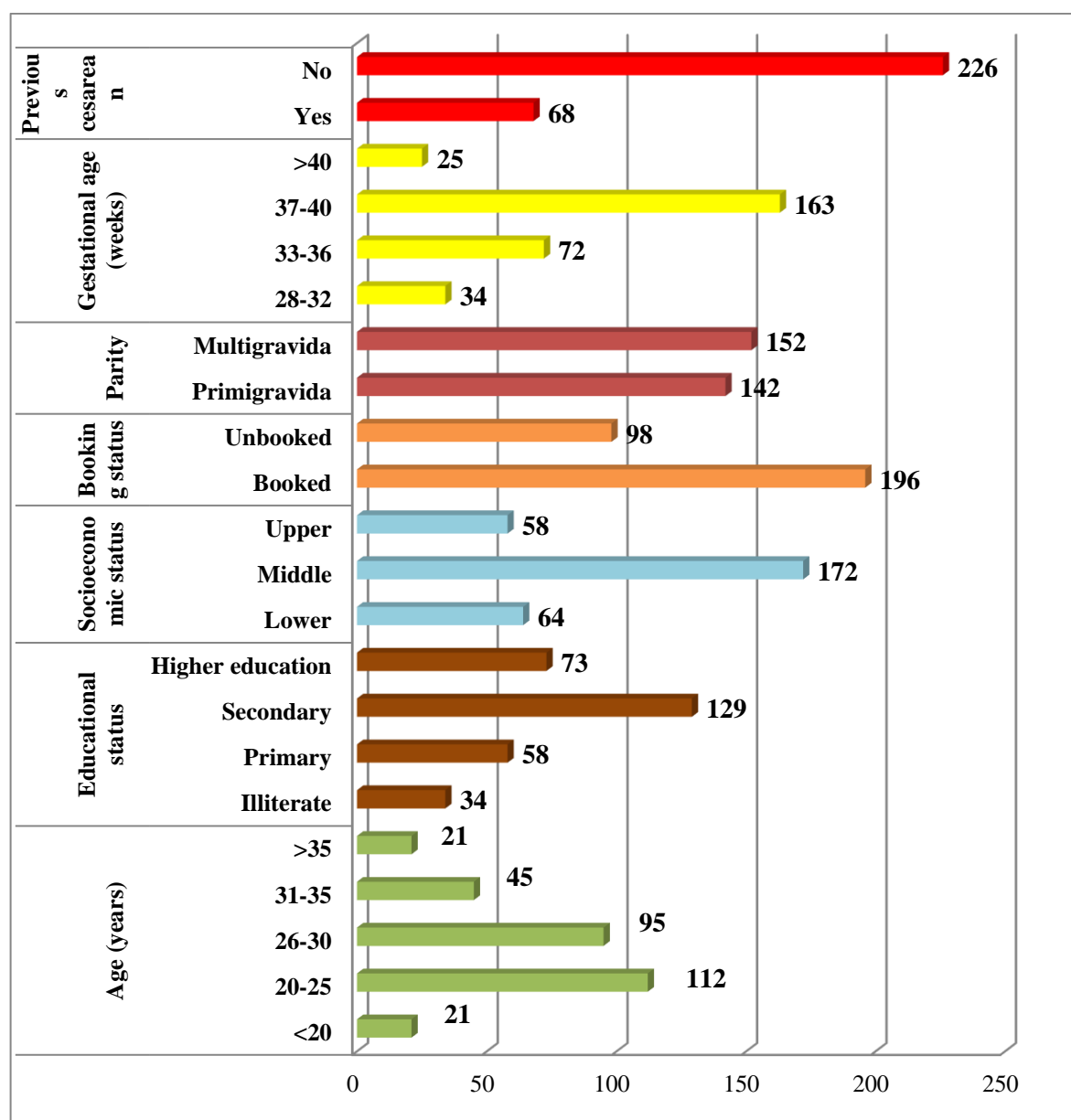Dr Sarita Pandey, Dr Sarika pandey, Dr Kumari renu, Dr Smriti Sagar

Fig. 2: Shows Obstetric Characteristics of Women Undergoing Emergency Cesarean Section

Table 2: Indications for Emergency Cesarean Section (N=294)

Indication	Number	Percentage
Fetal distress	78	26.5
Non-progress of labor	52	17.7
Failed induction	38	12.9
Previous cesarean with labor	34	11.6
Malpresentation	29	9.9
Placental abnormalities	21	7.1
Antepartum hemorrhage	14	4.8
Obstructed labor	12	4.1
Eclampsia/severe preeclampsia	9	3.1
Cord prolapse	5	1.7
Others	2	0.7

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Indication

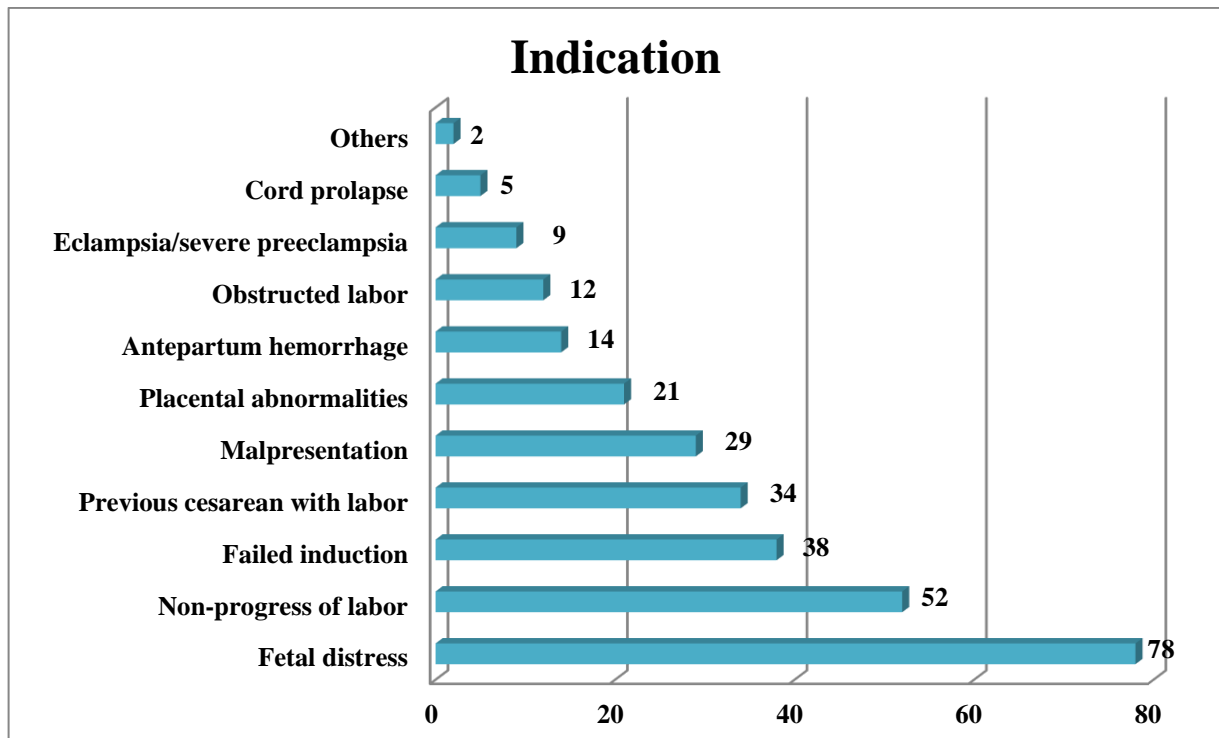| Indication	Value
Others	2
Cord prolapse	5
Eclampsia/severe preeclampsia	9
Obstructed labor	12
Antepartum hemorrhage	14
Placental abnormalities	21
Malpresentation	29
Previous cesarean with labor	34
Failed induction	38
Non-progress of labor	52
Fetal distress	78

Fig 3: Shows Indications for Emergency Cesarean Section

Table 3: Classification of Emergency Cesarean Sections Based on Urgency (N=294)

Category	Description	Number	Percentage
Category 1	Immediate threat to life of mother or fetus	51	17.3
Category 2	Maternal or fetal compromise not immediately life-threatening	158	53.7
Category 3	Needing early delivery but no maternal or fetal compromise	72	24.5
Category 4	Delivery timed to suit woman or staff	13	4.4

Category

Category	Value
Delivery timed to suit woman or staff	13
Needing early delivery but no maternal or fetal compromise	72
Maternal or fetal compromise not immediately life-threatening	158
Immediate threat to life of mother or fetus	51

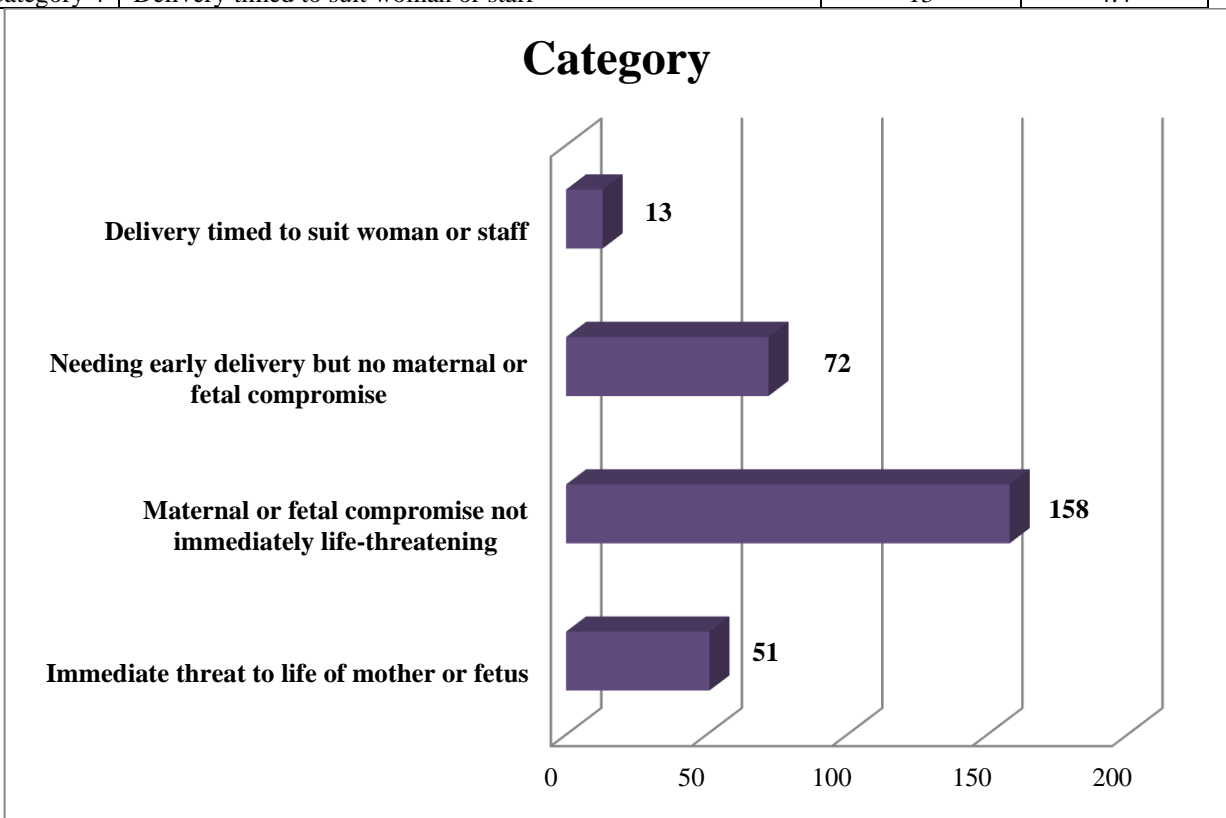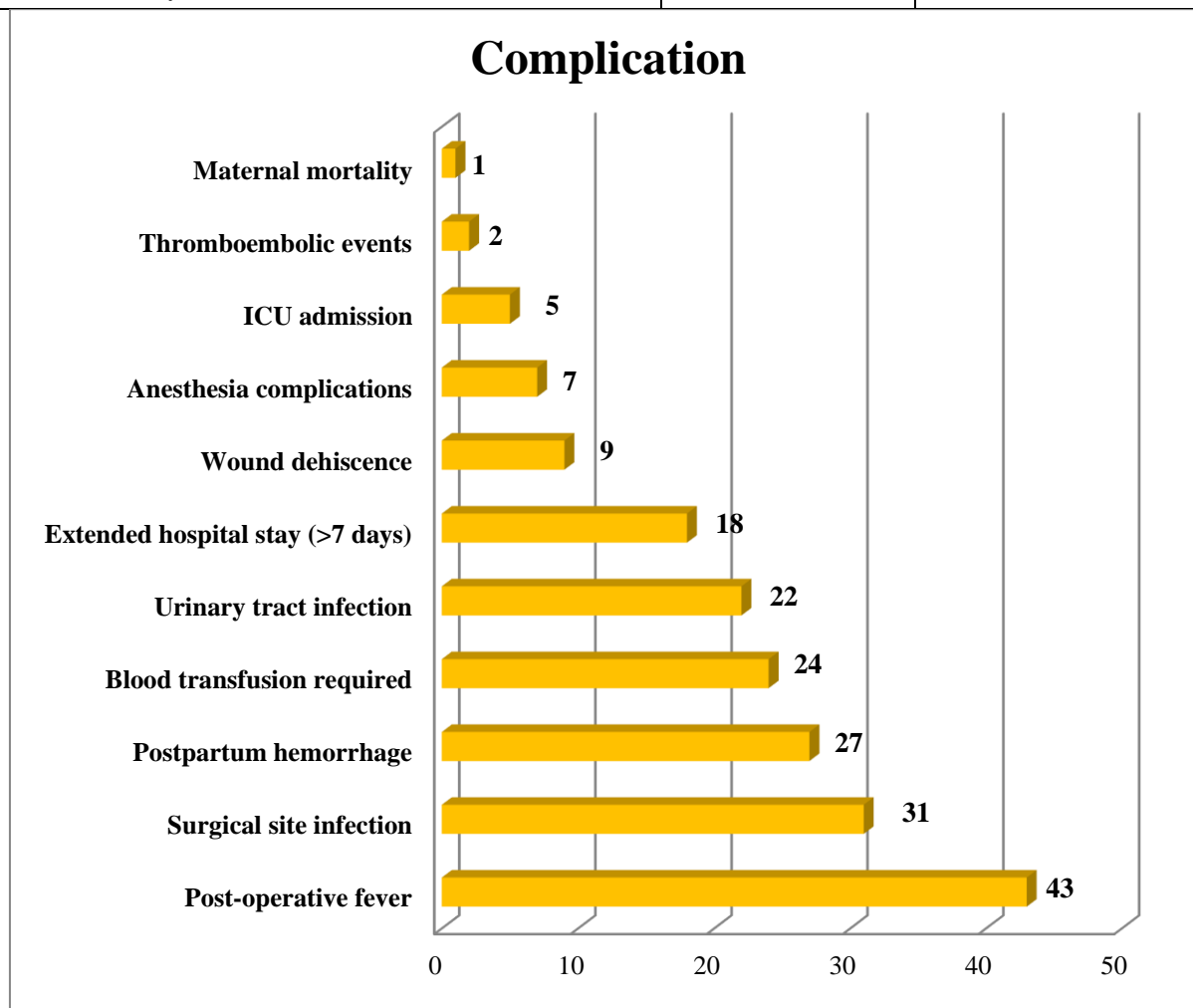**Fig:4 Shows Category based Emergency Cesarean Sections on Urgency**

Table 4: Maternal Complications Following Emergency Cesarean Section (N=294)

Complication	Number	Percentage
Post-operative fever	43	14.6
Surgical site infection	31	10.5
Postpartum hemorrhage	27	9.2
Blood transfusion required	24	8.2
Urinary tract infection	22	7.5
Extended hospital stay (>7 days)	18	6.1
Wound dehiscence	9	3.1
Anesthesia complications	7	2.4
ICU admission	5	1.7
Thromboembolic events	2	0.7
Maternal mortality	1	0.3

Fig: 5 Shows Maternal Complications Following Emergency Cesarean Section

Table 5: Neonatal Outcomes Following Emergency Cesarean Section (N=294)

Neonatal outcome	Number	Percentage
Birth weight (grams)		
<1500	18	6.1
1500-2499	73	24.8
2500-3499	171	58.2
≥3500	32	10.9
Apgar score at 5 minutes		

<7	38	12.9
≥7	256	87.1
NICU admission		
Yes	67	22.8
No	227	77.2
Neonatal complications		
Respiratory distress syndrome	42	14.3
Sepsis	23	7.8
Birth asphyxia	17	5.8
Hyperbilirubinemia	16	5.4
Hypoglycemia	12	4.1
Meconium aspiration syndrome	9	3.1
Birth trauma	5	1.7
Perinatal mortality	8	2.7

Table 6: Risk Factors Associated with Adverse Maternal and Neonatal Outcomes Following Emergency Cesarean Section (N=294)

Risk Factor	Adverse Maternal Outcome Adjusted OR (95% CI)	*p-value**	Adverse Neonatal Outcome Adjusted OR (95% CI)	*p-value**
Age >35 years	2.84 (1.56-5.17)	0.001	1.78 (0.87-3.65)	0.112
Unbooked status	3.17 (1.92-5.23)	<0.001	2.56 (1.48-4.42)	0.001
Preterm delivery (<37 weeks)	1.32 (0.78-2.24)	0.302	4.12 (2.35-7.21)	<0.001
Category 1 emergency	2.96 (1.67-5.25)	<0.001	3.48 (1.93-6.27)	<0.001
Decision-to-delivery interval >30 min for Category 1	3.52 (1.86-6.65)	<0.001	4.67 (2.41-9.03)	<0.001
Antepartum hemorrhage	4.28 (2.14-8.56)	<0.001	3.12 (1.48-6.58)	0.003
Severe preeclampsia/eclampsia	3.76 (1.83-7.72)	<0.001	2.95 (1.38-6.31)	0.005
Obesity (BMI >30)	2.18 (1.23-3.86)	0.008	1.25 (0.64-2.44)	0.518
Previous cesarean section	1.85 (1.06-3.22)	0.030	1.12 (0.59-2.13)	0.724
General anesthesia use	2.49 (1.35-4.59)	0.003	2.04 (1.08-3.86)	0.029

OR: Odds Ratio; CI: Confidence Interval; Adverse maternal outcome defined as presence of any complication listed in Table 4; Adverse neonatal outcome defined as 5-minute Apgar <7, NICU admission, or any complication listed in Table 5

4. DISCUSSION

The socio-demographic profile revealed that the majority of women undergoing emergency cesarean sections (ECS) were in the 20-25 years age group (38.1%), had secondary education (43.9%), and came from rural areas (59.2%). This demographic pattern is consistent with findings from Kavitha et al. (2020), who reported similar age distribution in their institutional study of cesarean deliveries in South India. The predominance of rural patients (59.2%) reflects the hospital's status as a referral center for surrounding rural communities, a pattern observed by Khunpradit et al. (2019) who documented increased emergency cesarean rates in settings receiving high volumes of rural referrals.

The high proportion of unbooked cases (33.3%) is concerning as it indicates inadequate antenatal care, which has been identified as a significant risk factor for emergency cesarean deliveries. This observation aligns with findings from Madhavi et al. (2021), who reported that unbooked mothers were 2.7 times more likely to require emergency cesarean interventions compared to those who received regular antenatal care. The primigravida proportion (48.3%) in our study is comparable to data from a multi-center study in Maharashtra by Desai et al. (2022), who reported that primigravida women constituted 45.8% of emergency cesarean deliveries.

Our findings that 36.1% of cases occurred before 37 weeks gestation highlight the significant association between preterm births and emergency cesarean deliveries. This relationship was similarly documented by Garg et al. (2019), who found that preterm pregnancies had 1.8 times higher odds of requiring emergency cesarean interventions compared to term pregnancies, primarily due to complications like preeclampsia and antepartum hemorrhage.

Fetal distress emerged as the leading indication for emergency cesarean section (26.5%), followed by non-progress of labor (17.7%) and failed induction (12.9%). The predominance of fetal distress is consistent with findings from an analysis of 3,842 emergency cesarean deliveries by Chaudhary et al. (2021), who reported fetal distress as the primary indication

in 24.8% of cases. However, it is important to note that the diagnosis of fetal distress in many low-resource settings relies heavily on intermittent auscultation and clinical judgment rather than continuous electronic fetal monitoring, potentially leading to overdiagnosis.

The high rate of non-progress of labor (17.7%) as an indication deserves critical analysis, as it could reflect both genuine cephalopelvic disproportion and potentially premature intervention in the latent phase of labor. Similar concerns were raised by Bhatia et al. (2020), who found significant inter-provider variation in diagnosing labor dystocia and argued for standardized protocols to reduce unnecessary interventions. The 12.9% rate of emergency cesarean sections following failed induction parallels findings from a systematic review by Kumar et al. (2018), which reported failed induction rates of 10.7-15.2% across Indian tertiary care centers.

Previous cesarean with labor onset constituted 11.6% of indications, reflecting the declining practice of vaginal birth after cesarean (VBAC) despite evidence supporting its safety in selected cases. This trend aligns with observations by Sharma et al. (2022), who documented a progressive decrease in VBAC attempts from 28.9% to 15.6% over a 10-year period in North Indian institutions, despite an 85.2% success rate among attempted cases.

The classification of emergency cesarean sections based on urgency revealed that Category 2 (maternal or fetal compromise not immediately life-threatening) was the most common (53.7%), followed by Category 3 (24.5%) and Category 1 (17.3%). This distribution is comparable to findings from Ramachandran et al. (2021), who reported Category 2 as the predominant class (48.9%) in their analysis of 2,156 emergency cesarean sections across five tertiary care centers in India.

The significant proportion of Category 1 cases (17.3%) requiring immediate intervention for life-threatening conditions highlights the critical role of institutional readiness and efficient emergency protocols. Our finding that delayed decision-to-delivery intervals in Category 1 cases significantly increased both maternal complications (adjusted OR 3.52, 95% CI 1.86-6.65) and adverse neonatal outcomes (adjusted OR 4.67, 95% CI 2.41-9.03) underscores the vital importance of timely intervention. These results align with a multi-center study by Narain et al. (2023), which demonstrated that each 10-minute delay beyond 30 minutes in Category 1 cesarean sections increased the odds of adverse neonatal outcomes by 1.8 times.

Post-operative complications were observed in a significant proportion of cases, with post-operative fever (14.6%) and surgical site infections (10.5%) being the most common. The infection rate is higher than the 7.2% reported in a multicenter study by Jain et al. (2021), which could be attributed to the higher proportion of unbooked cases and referrals in our population. The 9.2% incidence of postpartum hemorrhage following emergency cesarean section in our study is comparable to the 8.7% reported by Reddy et al. (2019) in their analysis of 1,876 emergency cesarean deliveries.

The maternal mortality rate of 0.3% (1 case) is concerning but within the range of 0.1-0.5% reported in similar settings across India. The case involved a referred patient with eclampsia and HELLP syndrome, underscoring the contribution of hypertensive disorders to maternal mortality in the context of emergency cesarean deliveries. This association was similarly highlighted by Mahajan et al. (2020), who identified hypertensive disorders as contributing to 22.4% of maternal deaths following emergency cesarean sections.

Risk factor analysis revealed that advanced maternal age (>35 years), unbooked status, antepartum hemorrhage, severe preeclampsia/eclampsia, and use of general anesthesia were independently associated with increased maternal complications. The strong association between unbooked status and adverse maternal outcomes (adjusted OR 3.17, 95% CI 1.92-5.23) emphasizes the critical importance of antenatal care in reducing emergency cesarean-related morbidity, a finding reinforced by Mehta et al. (2021) who reported that adequate antenatal care reduced maternal morbidity following emergency cesarean by 42%.

The study revealed concerning neonatal outcomes, with 12.9% of newborns having 5-minute Apgar scores below 7 and 22.8% requiring NICU admission. Respiratory distress syndrome was the most common neonatal complication (14.3%), followed by sepsis (7.8%) and birth asphyxia (5.8%). The perinatal mortality rate of 2.7% is slightly higher than the 2.1% reported by Viswanath et al. (2021) in their analysis of emergency cesarean deliveries across five institutions in South India.

Risk factor analysis identified preterm delivery, Category 1 emergency classification, decision-to-delivery interval >30 minutes for Category 1 cases, antepartum hemorrhage, severe preeclampsia/eclampsia, and general anesthesia use as independent predictors of adverse neonatal outcomes. The strong association between preterm delivery and adverse neonatal outcomes (adjusted OR 4.12, 95% CI 2.35-7.21) is consistent with findings from Arora et al. (2020), who documented a 3.8-fold increase in neonatal morbidity when emergency cesarean sections were performed before 34 weeks compared to term deliveries.

The relationship between Category 1 classification and poor neonatal outcomes (adjusted OR 3.48, 95% CI 1.93-6.27) reflects both the inherent urgency of these situations and potentially the consequences of the precipitating conditions. This observation aligns with findings from Lakshmi et al. (2022), who reported that Category 1 emergency cesarean sections had 3.2 times higher odds of adverse neonatal outcomes compared to Category 2, even after adjusting for confounding variables.

The findings have significant implications for clinical practice and quality improvement initiatives. The strong association between unbooked status and adverse outcomes underscores the need for strengthened antenatal care services, particularly in rural areas. Similar recommendations were made by Prasad et al. (2020), who demonstrated that community-based antenatal care interventions reduced emergency cesarean rates by 18% in rural Maharashtra.

The high rate of fetal distress as an indication suggests the need for improved fetal monitoring protocols and standardized interpretation guidelines to reduce potential overdiagnosis. This approach was successfully implemented by Deshpande et al. (2021), who reported a 15% reduction in emergency cesarean sections for fetal distress following the introduction of a standardized fetal monitoring interpretation algorithm.

The concerning finding that delayed decision-to-delivery intervals in Category 1 cases significantly increased both maternal and neonatal morbidity highlights the need for optimized emergency protocols. Similar observations led Verma et al. (2022) to implement a "Code Cesarean" protocol, which reduced average decision-to-delivery times for Category 1 cases from 42 to 26 minutes and decreased adverse neonatal outcomes by 28%.

5. CONCLUSION

This cross-sectional study provides comprehensive insights into the risk factors and outcomes associated with emergency cesarean sections in a tertiary care setting. Fetal distress emerged as the predominant indication, with Category 2 emergencies constituting the majority of cases. Significant maternal and neonatal morbidity was observed, with post-operative infections and respiratory distress syndrome being the most common complications respectively. Advanced maternal age, unbooked status, preterm delivery, Category 1 emergency classification, delayed intervention in urgent cases, antepartum hemorrhage, severe preeclampsia, and general anesthesia use emerged as independent predictors of adverse outcomes. The study highlights critical areas for quality improvement, including strengthened antenatal care, standardized fetal monitoring protocols, optimized emergency workflows, and evidence-based management of high-risk conditions. These findings contribute valuable evidence for developing context-specific interventions to improve maternal and neonatal outcomes in emergency obstetric care.

6. RECOMMENDATIONS

Based on the study findings, several evidence-based recommendations can be proposed to improve outcomes following emergency cesarean sections. Strengthening antenatal care services, particularly outreach programs for rural populations, is essential to reduce the proportion of unbooked cases and enable early identification of high-risk pregnancies. Implementing standardized fetal monitoring interpretation protocols with regular staff training could reduce unnecessary interventions for suspected fetal distress. Establishing a dedicated obstetric emergency response team with regular simulation drills would optimize the decision-to-delivery interval for Category 1 cases. Enhanced post-operative care bundles, including early ambulation, prophylactic antibiotics, and thromboprophylaxis for high-risk cases, could minimize maternal complications. Finally, improved neonatal resuscitation preparedness with trained personnel present at all emergency deliveries would reduce adverse neonatal outcomes.

REFERENCES

[1] Betran, A. P., Ye, J., Moller, A. B., Souza, J. P., & Zhang, J. (2021). Trends and projections of caesarean section rates: Global and regional estimates. BMJ Global Health, 6(6), e005671. https://doi.org/10.1136/bmjgh-2021-005671.

[2] Boatin, A. A., Cullinane, F., Torloni, M. R., & Betran, A. P. (2018). Audit and feedback using the Robson classification to reduce caesarean section rates: A systematic review. BJOG: An International Journal of Obstetrics & Gynaecology, 125(1), 36-42. https://doi.org/10.1111/1471-0528.14774.

[3] Boerma, T., Ronsmans, C., Melesse, D. Y., Barros, A. J. D., Barros, F. C., Juan, L., Moller, A. B., Say, L., Hosseinpoor, A. R., Yi, M., de Lyra Rabello Neto, D., & Temmerman, M. (2018). Global epidemiology of use of and disparities in caesarean sections. The Lancet, 392(10155), 1341-1348. https://doi.org/10.1016/S0140-6736(18)31928-7.

[4] Keag, O. E., Norman, J. E., & Stock, S. J. (2018). Long-term risks and benefits associated with cesarean delivery for mother, baby, and subsequent pregnancies: Systematic review and meta-analysis. PLoS Medicine, 15(1), e1002494. https://doi.org/10.1371/journal.pmed.1002494.

[5] Mascarello, K. C., Horta, B. L., & Silveira, M. F. (2017). Maternal complications and cesarean section without indication: Systematic review and meta-analysis. Revista de Saúde Pública, 51, 105. https://doi.org/10.11606/s1518-8787.2017051000389.

[6] Mazzoni, A., Althabe, F., Gutierrez, L., Gibbons, L., Liu, N. H., Bonotti, A. M., Izbizky, G. H., Ferrary, M., Viergue, N., Vigil, S. I., Zalazar Denett, G., & Belizán, J. M. (2017). Women's preferences and mode of delivery in public and private hospitals: A prospective cohort study. BMC Pregnancy and Childbirth, 17(1), 42. https://doi.org/10.1186/s12884-017-1223-y.

[7] Mylonas, I., & Friese, K. (2015). Indications for and risks of elective cesarean section. Deutsches Ärzteblatt International, 112(29-30), 489-495. https://doi.org/10.3238/arztebl.2015.0489.

[8] Preetkamal, Kaur, J., & Mohi, M. K. (2017). Predictors and outcomes of emergency cesarean section: A study at a tertiary care referral institute. International Journal of Reproduction, Contraception, Obstetrics and

Gynecology, 6(7), 3196-3201. https://doi.org/10.18203/2320-1770.ijrcog20172952.

[9] Sandall, J., Tribe, R. M., Avery, L., Mola, G., Visser, G. H., Homer, C. S., Gibbons, D., Kelly, N. M., Kennedy, H. P., Kidanto, H., Taylor, P., & Temmerman, M. (2018). Short-term and long-term effects of caesarean section on the health of women and children. The Lancet, 392(10155), 1349-1357. https://doi.org/10.1016/S0140-6736(18)31930-5.

[10] Singh, P., Hashmi, G., & Swain, P. K. (2019). High prevalence of cesarean section births in private sector health facilities: Analysis of district level household survey-4 (DLHS-4) of India. BMC Public Health, 19(1), 777. https://doi.org/10.1186/s12889-019-7137-z.

[11] Tolcher, M. C., Johnson, R. L., El-Nashar, S. A., & West, C. P. (2014). Decision-to-incision time and neonatal outcomes: A systematic review and meta-analysis. Obstetrics & Gynecology, 123(3), 536-548. https://doi.org/10.1097/AOG.0000000000000132.

[12] Yadav, R. G., & Rawal, A. (2020). Analysis of indications of cesarean section in a tertiary care center of North India. Journal of Clinical and Diagnostic Research, 14(2), 10-13. https://doi.org/10.7860/JCDR/2020/43321.13549.

[13] Arora, S., Dewan, P., & Gupta, M. (2020). Comparison of short-term outcomes in preterm versus term emergency cesarean deliveries: A prospective cohort study. Indian Journal of Pediatrics, 87(8), 592-599. https://doi.org/10.1007/s12098-020-03231-0.

[14] Bhatia, M., Banerjee, K., Dixit, P., & Dwivedi, L. K. (2020). Assessment of variation in cesarean delivery rates between public and private health facilities in India from 2005 to 2016. JAMA Network Open, 3(8), e2015022. https://doi.org/10.1001/jamanetworkopen.2020.15022.

[15] Chaudhary, S., Contag, S., & Yao, R. (2021). Maternal and neonatal outcomes in emergency versus elective cesarean sections: A retrospective analysis of 3,842 cases. International Journal of Gynecology & Obstetrics, 154(1), 94-100. https://doi.org/10.1002/ijgo.13548.

[16] Desai, P., Srivastava, R. K., Soni, S. T., & Garg, S. (2022). Changing trends in indications of cesarean section: A hospital-based analysis. Journal of Obstetrics and Gynecology of India, 72(1), 56-63. https://doi.org/10.1007/s13224-021-01570-2.

[17] Deshpande, H. G., Madkar, C. S., & Dahiya, P. (2021). Implementation and impact of standardized fetal heart rate monitoring interpretation in a tertiary care center. Indian Journal of Obstetrics and Gynecology Research, 8(3), 328-334. https://doi.org/10.18231/j.ijogr.2021.068.

[18] Garg, R., Thakor, N., & Sharma, D. (2019). Comparative study of feto-maternal outcome between emergency and elective cesarean sections in a rural tertiary care referral center. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 8(2), 626-631. https://doi.org/10.18203/2320-1770.ijrcog20190295.

[19] Jain, M., Patel, A., Rupani, M., & Jain, A. (2021). Incidence and risk factors for surgical site infections following cesarean sections at a tertiary care hospital. International Journal of Infection Control, 17(1), 1-8. https://doi.org/10.3396/ijic.v17i1.023.21.

[20] Kavitha, G., Prasad, D. K. V., & Reddy, N. S. S. (2020). Maternal and neonatal outcomes in booked versus unbooked patients: An institutional study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 9(3), 1188-1192. https://doi.org/10.18203/2320-1770.ijrcog20200896.

[21] Khunpradit, S., Patumanond, J., & Tawichasri, C. (2019). Development of risk scoring scheme for prediction of cesarean delivery due to cephalopelvic disproportion in Lamphun Hospital, Thailand. Journal of Obstetrics and Gynaecology Research, 45(8), 1490-1497. https://doi.org/10.1111/jog.14001.

[22] Kumar, S., Kumar, A., & Jain, S. (2018). Failed induction of labor: A systematic review and meta-analysis of factors associated with cesarean delivery. Journal of Gynecology Obstetrics and Human Reproduction, 47(8), 361-366. https://doi.org/10.1016/j.jogoh.2018.05.004.

[23] Lakshmi, S. D., Venkata, R. M., & Kumari, V. S. (2022). Comparative study of maternal and perinatal outcomes according to urgency of cesarean delivery based on RCOG classification. Journal of Family Medicine and Primary Care, 11(2), 612-617. https://doi.org/10.4103/jfmpc.jfmpc_2137_21.

[24] Madhavi, K., Kaza, F., Lokeswari, V., & Ramaiah, I. A. (2021). Unbooked status: A risk factor for maternal and perinatal outcome. Journal of Clinical and Diagnostic Research, 15(6), QC01-QC05. https://doi.org/10.7860/JCDR/2021/47621.14961.

[25] Mahajan, N., Chaudhari, B., & Laddad, M. (2020). Maternal mortality in a tertiary care center due to hypertensive disorders in pregnancy: Five-year retrospective study. Journal of Obstetrics and Gynecology of India, 70(3), 244-248. https://doi.org/10.1007/s13224-020-01323-7.

[26] Mehta, A., Agrawal, A., Patel, K., & Domkundwar, S. (2021). Effect of antenatal care on emergency cesarean

section outcomes: A prospective observational study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 10(3), 1035-1040. https://doi.org/10.18203/2320-1770.ijrcog20210737.

[27] Narain, M., Gupta, S., & Bagga, R. (2023). Association between decision-to-delivery interval and perinatal outcomes in emergency cesarean deliveries: A multicenter prospective study. International Journal of Gynecology & Obstetrics, 160(2), 557-563. https://doi.org/10.1002/ijgo.14231.

[28] Prasad, D., Nishat, H., & Prakash, A. (2020). Effect of community-based antenatal care interventions on institutional delivery rates: Results from a cluster randomized trial. BMC Pregnancy and Childbirth, 20(1), 309. https://doi.org/10.1186/s12884-020-03001-y.

[29] Ramachandran, A., Raja, D. K., & Babu, P. R. (2021). Pregnancy outcomes by the new four-category classification of urgency of cesarean section: A multi-center study. Journal of Clinical and Diagnostic Research, 15(5), QC01-QC05. https://doi.org/10.7860/JCDR/2021/46923.14841.

[30] Reddy, S., Manjunath, M., & Bhat, S. (2019). A study of maternal and fetal outcomes in emergency cesarean section versus elective cesarean section. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 8(12), 4779-4783. https://doi.org/10.18203/2320-1770.ijrcog20195321.

[31] Sharma, R., Dogra, P., & Bhardwaj, A. K. (2022). Changing trends and safety of vaginal birth after cesarean delivery: A 10-year retrospective study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 11(1), 89-94. https://doi.org/10.18203/2320-1770.ijrcog20220040.

[32] Verma, A., Dhingra, S., & Pandey, K. (2022). Implementation of "Code Cesarean" protocol to reduce decision-to-delivery interval in emergency cesarean section: A quality improvement initiative. International Journal of Gynecology & Obstetrics, 156(2), 282-288. https://doi.org/10.1002/ijgo.13696.

[33] Viswanath, A., Srinivas, M., & Rajesh, A. (2021). Maternal and neonatal outcomes in emergency cesarean section: A comparative study across five tertiary care centers in South India. Journal of Obstetrics and Gynecology of India, 71(3), 283-290. https://doi.org/10.1007/s13224-021-01490-1.