DISPARITIES IN CESAREAN SECTION RATES AMONG ROBSON GROUPS IN HIGH- VS. LOW-RESOURCE SETTINGS

ABSTRACT

Background and Aims: Cesarean section (CS) rates have significantly increased globally, with both overuse in high-resource settings and underuse in low-resource settings posing maternal and neonatal risks. The World Health Organization (WHO) recommends the Robson Ten-Group Classification System (RTGCS) as a standard for monitoring and comparing CS rates. However, disparities persist, particularly in Groups 1, 2, and 5, where CS may be unnecessarily high in high-resource settings and inadequately available in low-resource settings. This study aimed to analyze disparities in CS rates among Robson groups in high- vs. low-resource settings and identify contributing factors.

Methods: This retrospective observational study was conducted from October 2023 to April 2024 at two tertiary care hospitals—one in a high-resource urban setting and the other in a low-resource rural setting. Data were collected from 200 antenatal patients (100 from each center) who underwent CS. Participants were categorized using the RTGCS, and indications for CS were analyzed. Ethical approval was obtained, and statistical analysis was performed using MedCalc version 6.1, applying Chi-square tests for categorical variables and t-tests for continuous data ($p < 0.05$).

Results: Significant differences were observed in CS indications and maternal characteristics between the two settings. High-resource hospitals had higher elective CS rates, increased VBAC reluctance, and a lower threshold for fetal distress diagnosis. Conversely, low-resource centers had more emergency CS, higher induction failure rates, and delayed obstetric interventions due to infrastructure limitations.

Conclusion: CS disparities between high- and low-resource settings stem from healthcare accessibility, clinical decision-making, and patient-related factors. Reducing unnecessary CS in high-resource hospitals while improving timely access in low-resource settings requires better antenatal care, labor management, and VBAC promotion.

Keywords: Cesarean Section; Robson Classification; Maternal Health; Obstetric Care Disparities; Vaginal Birth After Cesarean (VBAC).

INTRODUCTION

Cesarean section (CS) rates have risen dramatically worldwide over the past few decades, particularly in middle- and high-income countries, leading to concerns about both overuse and underuse in different settings (1). While CS is a life-saving intervention, its unnecessary use without clear medical indications can pose risks to maternal and neonatal health, while limited access to CS in low-resource settings can contribute to poor outcomes (2). The World Health Organization (WHO) in 2015 recommended the use of the Robson Ten-Group Classification System (RTGCS) as a global standard for analyzing CS rates, allowing for cross-comparison between hospitals and regions over time (3). This system categorizes pregnant women based on parity, gestational age, fetal presentation, previous CS, and labor onset, making it a useful tool for identifying disparities in CS rates (4).

Despite these efforts, significant disparities exist among Robson groups between high- and low-resource settings. In high-income countries, Robson Group 5 (previous CS, singleton, cephalic, term) is one of the largest contributors to rising CS rates due to restrictive VBAC (Vaginal Birth After Cesarean) policies (5). Conversely, in low-resource settings, Robson Group 1 (nulliparous, term, spontaneous labor) often lacks access to timely CS when needed, leading to increased maternal and neonatal morbidity and mortality (6). Even within the same country, high-resource setting hospitals report higher elective CS rates, whereas low-resource setting facilities experience delayed interventions due to lack of healthcare infrastructure and skilled personnel (7).

To further investigate these disparities, we applied the RTGCS in two tertiary care centers in India—one high-resource setting and one low-resource setting—and observed significant differences in CS rates between these settings. Robson Groups 1 and 3 (low-risk nulliparous and multiparous women in spontaneous labor) had higher CS rates in high-resource settings, whereas low-resource settings had a greater number of emergency CS due to delayed referrals and inadequate labor monitoring (8). These findings align with global trends, where CS is overused in well-equipped settings and underused in resource-limited areas (9).

A major limitation of Robson classification is that it identifies "who" undergoes a CS but not "why" (10). The disparities in CS rates arise due to multiple factors, including healthcare infrastructure, physician preference, medical-legal concerns, economic incentives, and patient demand (11). In low-income countries, vaginal instrumental deliveries are rarely performed, leading to higher reliance on CS even when not medically necessary (12). Conversely, in high-resource settings, defensive medicine and maternal request CS contribute to unnecessary procedures (13).

Despite WHO's 2015 recommendation to adopt the Robson classification, disparities in CS rates persist, and policymakers continue to seek explanations for these variations (3). The UK Medical Research Council's C-Safe Programme is working to refine CS classification by integrating an indication-based metric, addressing the "why" behind cesarean deliveries (6). This approach is essential, as studies in Ethiopia and Brazil have shown that Robson Groups 1 and 3 experience high CS rates without clear medical justification in high-resource setting settings, while these same groups face barriers to CS access in low-resource setting hospitals (5,6).

To reduce disparities in CS rates among Robson groups, global health experts must not only analyze which groups are undergoing CS but also the underlying reasons driving these decisions. A combined "who" and "why" approach is crucial for formulating targeted interventions that ensure equitable CS access in underuse settings while mitigating overuse in high-resource environments. Standardizing indication-based CS classification across different Robson groups and settings will be key to optimizing maternal and neonatal outcomes globally. We aimed to assess disparities in cesarean section rates among Robson groups across high- and low-resource settings to identify contributing factors.

MATERIAL AND METHODS

Study Design and Duration

This retrospective observational study was conducted to assess disparities in cesarean section rates among Robson groups in high- vs. low-resource settings. The study period spanned October 2023 to April 2024. Data were collected from hospital records of antenatal patients who underwent cesarean delivery at two tertiary care centers—one located in a high-resource setting and the other in a low-resource setting.

Study Population and Sample Size

A total of 200 participants were included in the study, with 100 from the high-resource settings and 100 from the low-resource settings.

Selection Criteria

Inclusion Criteria:

1. All antenatal patients who underwent cesarean section during the study period.

Exclusion Criteria:

1. Patients with incomplete medical records.
2. Patients admitted with missed or inevitable abortion.
3. Patients opting for induced abortion.

Data Collection and Classification

Data were collected on age, booking status, parity, number and route of previous deliveries, gestational age, and fetal presentation. Participants undergoing cesarean section at each center were classified according to the Robson Ten-Group Classification System (RTGCS). The relative proportions of cesarean sections within each group were compared between high-resource and low-resource hospitals. Additionally, indications for cesarean section were

documented and analyzed to assess differences in clinical decision-making across healthcare settings.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethical Committees of both participating hospitals before data collection.

Statistical Analysis

Statistical analysis was performed using MedCalc version 6.1. Data normality was assessed using the Shapiro-Wilk test, and continuous variables were compared using either the Student's t-test or Mann-Whitney U test, depending on data distribution. Categorical variables were analyzed using the Chi-square test, with statistical significance set at $p < 0.05$ (α error = 0.05, β error = 0.2).

This methodology allowed for a systematic evaluation of disparities in cesarean section rates among Robson groups between high-resource and low-resource settings, providing insights into the factors influencing CS rates in these distinct healthcare environments.

RESULTS

A comparative analysis of demographic and clinical characteristics of women undergoing cesarean sections in high- and low-resource settings. Significant disparities were observed, with lower BMI, hemoglobin levels, and antenatal care attendance in low-resource settings. In contrast, higher elective cesarean rates and greater access to healthcare were notable in high-resource settings, highlighting the need for targeted obstetric interventions to optimize maternal health outcomes as shown in Table 1.

Table 1: Demographic Parameters of Women Undergoing Cesarean Section in High- vs. Low-Resource Settings

Participant Parameters	Low-Resource Setting (N=100)	High-Resource Setting (N=100)	P-value
Age (in years)	21.54 ± 5.55	20.54 ± 7.85	n.s
BMI (Kg/m²)	17.53 ± 0.72	20.23 ± 1.16	≤ 0.001
At least 3 antenatal visits	56% (56/100)	89% (89/100)	≤ 0.001
Education (secondary level)	77% (77/100)	77% (77/100)	n.s
Monthly Family Income (in Rupees)	4961 ± 353.55	10110 ± 707	≤ 0.0001
Parity	0 (0-4)	0 (0-3)	n.s
Women with previous vaginal delivery	3% (3/100)	11% (11/100)	0.02
Period of gestation (in weeks)	38 ± 2	37 ± 3	n.s
Hb%	8.45 ± 0.5	9.7 ± 0.7	≤ 0.001

A comparative analysis of cesarean section indications in high- and low-resource settings. Post-cesarean pregnancy, fetal distress, and induction failure were the most common indications in both settings, with higher fetal distress cases in high-resource hospitals and more induction failures in low-resource centers. These findings highlight the influence of healthcare infrastructure and clinical decision-making on cesarean indications as shown in Table 2.

Table 2: Indications of Cesarean Section in High- vs. Low-Resource Settings

Indication of Cesarean Section	Low-Resource Setting (N=100)	High-Resource Setting (N=100)
Obstructed Labour	4 (4%)	2 (2%)
Fetal Distress	14 (14%)	29 (29%)
Post C/S	41 (41%)	27 (27%)
Induction Failure	24 (24%)	18 (18%)
PROM	3 (3%)	5 (5%)
Post Dated	7 (7%)	4 (4%)
PIH	20 (20%)	9 (9%)
Placenta Previa	3 (3%)	2 (2%)
Abruptio Placenta	2 (2%)	0 (0%)
CPD	4 (4%)	4 (4%)
Non-Progress	15 (15%)	6 (6%)
Breech	2 (2%)	5 (5%)
Cord Prolapse	0 (0%)	1 (1%)
Transverse Lie	1 (1%)	1 (1%)
Face Presentation	0 (0%)	1 (1%)
Twin Pregnancy	1 (1%)	2 (2%)

DISCUSSION

This study evaluated disparities in cesarean section (CS) rates and indications between high-resource high-resource setting and low-resource settings. The overall CS rate was higher in high-resource setting hospitals (49.55%) than in low-resource setting hospitals (36%), with post-cesarean pregnancy (41% low-resource setting, 27% high-resource setting) and induction failure (24% low-resource setting, 18% high-resource setting) being the primary indications. Groups 1, 2, and 5 accounted for 90% of CS deliveries in the low-resource setting, while Groups 2, 5, and 10 contributed to 80% in the high-resource setting center, aligning with previous studies, including Nakamura-Pereira et al. (5) and Betrán et al. (9). The RTGCS has proven effective in international comparisons, as seen in studies by Brennan et al. (8), making it a valuable tool for analyzing CS trends across different hospital settings.

Significant demographic and clinical differences were observed between the two groups. The mean age of women undergoing CS was similar, but BMI was significantly lower in the low-resource setting group (17.53 ± 0.72 vs. 20.23 ± 1.16, $p \leq 0.001$), indicating poor nutritional status. Hemoglobin levels were also lower in low-resource setting women (8.45 ± 0.5 vs. 9.7 ± 0.7, $p \leq 0.001$), reflecting a higher prevalence of anemia. Antenatal care access was significantly better in high-resource setting settings, with 89% of women attending at least three antenatal visits compared to 56% in low-resource settings ($p \leq 0.001$). These findings are consistent with Mangla et al. (7), who highlighted gender-based nutritional disparities and limited healthcare access in low-resource settings.

Indications for CS varied between the two settings. Fetal distress was more commonly diagnosed in high-resource setting hospitals (29% vs. 14% low-resource settings), possibly due to a lower threshold for intervention. Non-progress of labor accounted for a higher percentage in low-resource settings (15% vs. 6% high-resource setting), likely due to delayed referrals and inadequate monitoring. Hypertensive disorders (PIH) were more prevalent in low-resource setting settings (20% vs. 9% high-resource setting), which may be linked to poor

antenatal screening. Preterm pregnancies (Group 10) contributed significantly to high-resource setting CS cases (22.1%) but were less common in low-resource settings (3.1%), reflecting differences in neonatal care capabilities.

Higher CS rates in the high-resource setting hospital were influenced by greater access to private healthcare, increased patient preference for elective CS, and a lower threshold for surgical intervention. In contrast, low-resource settings had higher induction rates, often due to staff shortages and pressure on obstetricians to expedite deliveries. These trends are similar to findings by Tampakoudis et al. (13), who reported that high-resource setting hospitals often perform CS at a lower threshold for safety. VBAC rates remained low (10.1% low-resource setting, 12% high-resource setting), despite evidence from Gyamfi et al. (14) indicating that 60-80% of women can safely attempt VBAC.

To optimize CS rates, efforts should focus on enhancing VBAC accessibility, improving labor monitoring through better partograph use, and strengthening antenatal care in low-resource setting settings. The 2015 WHO (3) Statement on Cesarean Section Rates emphasizes performing CS only when medically necessary, yet global rates continue to rise, nearing Brazil's 56% rate—the highest worldwide. Studies by Rosa et al. (15) and Kamath et al.(16) confirm that CS increases the risk of maternal and neonatal complications, particularly in low-resource settings. In this study, low-resource setting reported more postoperative complications, such as postpartum hemorrhage (PPH) and sepsis, due to anemia, malnutrition, and inadequate postoperative monitoring. Meanwhile, high-resource setting hospitals had a higher incidence of preterm CS, increasing neonatal risks such as transient tachypnea. Addressing these disparities through evidence-based obstetric practices and better clinical decision-making is crucial to reducing unnecessary CS and improving maternal and neonatal health outcomes.

CONCLUSION

We concluded that cesarean section disparities between high- and low-resource settings stem from differences in healthcare access, clinical practices, and patient preferences. Unnecessary elective CS rates were higher in high-resource setting

hospitals, while low-resource settings faced delayed interventions leading to emergency CS. Addressing these disparities requires strengthening antenatal care, optimizing labor management, and promoting VBAC where appropriate. A balanced, evidence-based approach to CS is essential to improve maternal and neonatal outcomes globally.

STRENGTHS

This study systematically compared cesarean section rates using the Robson classification in high- and low-resource settings, providing insights into disparities in clinical decision-making. Its robust methodology, inclusion of diverse populations, and comprehensive statistical analysis enhance its reliability and applicability to obstetric healthcare planning.

LIMITATIONS

Being retrospective, the study relies on hospital records, which may introduce data limitations. Additionally, variations in clinical protocols and staffing across centers could influence findings. The study focuses on institutional deliveries, limiting generalizability to non-hospital births in resource-limited areas.

Conflict of Interest: None.

Funding: None.

Ethical Approval: Obtained.

Consent: Written consent secured.

REFERENCES

1. Betrán AP, Ye J, Moller AB, Souza JP, Zhang J. Trends and projections of caesarean section rates: global and regional estimates. *BMJ Glob Health*. 2021 Jun;6(6):e005671.
2. Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L. Global epidemiology of use of and disparities in caesarean sections. *Lancet*. 2018;392(10155):1341-1348.
3. World Health Organization Human Reproduction Programme. WHO Statement on caesarean section rates. *Reprod Health Matters*. 2015 May;23(45):149-150.
4. Betrán AP, Vindevoghel N, Souza JP, Gulmezoglu AM, Torloni MR. A systematic review of the Robson classification for caesarean section: what works, doesn't work, and how to improve it. *PLoS One*. 2014 Jun 3;9(6):e97769.
5. Nakamura-Pereira M, do Carmo Leal M, Esteves-Pereira AP, Dominques RM, Torres JA, Dias MA, Moreira ME. Use of Robson classification to assess cesarean section rate in Brazil: the role of source of payment for childbirth. *Reprod Health*. 2016 Oct 17;13(Suppl 3):128.
6. Abubeker FA, Gashawbeza B, Gebre TM, Wondafrash M, Teklu AM, Degu D, et al. Analysis of cesarean section rates using Robson ten group classification system in a tertiary teaching hospital, Addis Ababa, Ethiopia: a cross-sectional study. *BMC Pregnancy Childbirth*. 2020 Dec 9;20(1):767.
7. Mangla M et al. *Int J Reprod Contracept Obstet Gynecol*. 2016 Oct;5(10):3500-3505.
8. Brennan DJ, Robson MS, Murphy M, O'Herlihy C. Comparative analysis of international cesarean delivery rates using 10-group classification identified significant variation in spontaneous labor. *Am J Obstet Gynecol*. 2009;201(3):308.e1–e8.
9. Betrán AP, Merialdi M, Lauer JA, Bing-shun W, Thomas J, Van Look P, et al. Rates of caesarean section: analysis of global, regional and national estimates. *Paediatr Perinat Epidemiol*. 2007;21(2):98-113.

10. Giaxi P, Gourounti K, Vivilaki VG, Lykeridou A. Which classification system could empower the understanding of caesarean section rates in Greece? A review of systematic reviews. European Journal of Midwifery. 2022;6(June):1-7. doi:10.18332/ejm/147993.
11. Kingdon C, Downe S, Betran AP. Non-clinical interventions to reduce unnecessary caesarean section targeted at organizations, facilities, and systems: Systematic review of qualitative studies. *PLoS One*. 2018 Sep 4;13(9):e0203274.
12. Naidoo N, Moodley J. Rising rates of Caesarean section: an audit of Caesarean sections in a specialist private practice. *SA Fam Pract*. 2009;51(3):254-8.
13. Tampakoudis P, Assimakopoulos E, Grimbizis G, et al. Cesarean section rates and indications in Greece: data from a 24-year period in a teaching hospital. *Clin Exp Obstet Gynecol*. 2004;31:289-92.
14. Gyamfi C, Juhasz G, Gyamfi P, Stone J. Increased success of trial of labor after previous vaginal birth after cesarean. Obstet Gynecol 2004;104:715-19
15. Rosa F, Perugin G, Schettini D, Romano N, Romeo S, Podestà R, Guastavino A, Casaleggio A, Gandolfo N. Imaging findings of cesarean delivery complications: cesarean scar disease and much more. Insights Imaging. 2019 Sep 23;10(1):98. doi: 10.1186/s13244- 019-0780-0. PMID: 31549248; PMCID: PMC6757074.
16. Kamath BD, Todd JK, Glazner JE, Lezotte D, Lynch AM. Neonatal outcomes after elective cesarean delivery. Obstet Gynecol. 2009 Jun;113(6):1231-1238. doi: 10.1097/AOG.0b013e3181a66d57. PMID: 19461417; PMCID: PMC3620716.

Authors Name:-

1st Author - Dr. Niyati Singhal , Senior Resident , AUTONOMOUS STATE MEDICAL COLLEGE, ETAH

2nd Author - Dr Sadhana Singh , MBBS ,MS (OBGY), Assistant Professor

3rd Authore - Dr. Payal jadaun , ASSOCIATE PROFESSOR , AUTONOMOUS STATE MEDICAL COLLEGE, AURAIYA