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Maternal and neonatal outcomes of caesarean deliveries in a resource-limited tribal hospital in the Eastern Ghats of India

Christy Vijay ,[1] Karen Schonhofen,[2] Abhay Joseph,[3] Pravin Singarayar,[4] Ravikumar Manoharan,[4] Prema S,[4] John Michael Raj,[5] Muthumari G,[4] Lalitha Regi,[4] Regi George,[4] Naveen Ramesh[5]

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[1]Department of Obstetrics and Gynecology, James Cook University Hospital, Middlesbrough, UK
[2]Department of Pediatrics, Protestant Hospital of the Bethel Foundation, University Hospital OWL, Bielefeld University, Bielefeld, Germany
[3]Christian Medical College and Hospital Vellore, Vellore, India
[4]Tribal Health Initiative, Dharmapuri District, Tamil Nadu, India
[5]St John's Medical College, Bangalore, India

Correspondence to
Dr Abhay Joseph;
abhayjose@gmail.com

ABSTRACT

Introduction Caesarean sections (CSs) are an essential component of comprehensive emergency obstetric care to reduce maternal and neonatal mortality. The tribal population accounts for 8.4% (104 million) of the total population of India. Significant differences exist in CS rates between tribal and non-tribal women which remain poorly understood. We examined the indications, obstetric surgical techniques and outcomes of CS in a resource-poor tribal hospital located in the Eastern Ghats of India.

Methods This cross-sectional study included review of records maintained in this tribal hospital for the year 2022 (1 January–31 December 2022) with regard to the indications, surgical techniques and outcomes of CS. There were a total of 779 births in the year 2022.

Results Of the total births, 658 (84.5%) women belonged to the tribal community. The total number of CS was 112 (14.2%) in the study population, with a mean maternal age of 23.6±3.9 years. The mean gestational age was 38.3±3.2 weeks and the mean birth weight was 2.7±0.4 kg. An increased frequency of CS (Robson's Category 10) 14 (6.9%) was noted among multiparous women. A history of previous CS 59 (52.7%) was the most common indication across all age groups. Increased prevalence of (Robson's Category 10) CS was noted among women aged 20–24 years 7 (14.6%) and 25–29 years 7 (16.7%). Double-layer uterine closure was the most used surgical technique.

Conclusion The prevalence of CS in this tribal population was 14%. This study is among the first to evaluate obstetric surgical outcomes and classify caesarean deliveries using Robson's criteria in a tribal community. CS was more common among younger mothers and those with a previous CS. These findings provide baseline data for future comparative research and highlight the need for standardised adhesion quantification based on surgical technique, particularly in women with a previous CS.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Caesarean section (CS) rates are rising globally, yet remain lower among tribal populations in India due to disparities in access, awareness and healthcare infrastructure. There is limited evidence on the indications, surgical practices and outcomes of CS in resource-limited tribal settings.

WHAT THIS STUDY ADDS

⇒ This study provides one of the first detailed evaluations of CS indications, surgical techniques and maternal and neonatal outcomes in a tribal population, using Robson's classification in a rural secondary care setting. It identifies previous CS as the leading indication and highlights patterns of preterm CS and surgical practices in this underserved group.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ These findings establish baseline data for future comparative and longitudinal research in tribal health and support the need for context-specific, culturally sensitive maternal care models. They also highlight the importance of standardising surgical documentation and strengthening access to equitable emergency obstetric services in resource-limited settings.

INTRODUCTION

Caesarean sections (CSs) are an essential part of Comprehensive Emergency Obstetric and Neonatal Care (CEmONC) to reduce maternal and neonatal morbidity and mortality when indicated.[1] The main indications for performing a CS include fetal distress and asphyxia, previous CS, non-progress or prolonged labour, oligohydramnios, malpresentation (breech or transverse lie), cephalopelvic disproportion and hypertensive disorders in pregnancy.[2–4]

According to the WHO, accurate description and assessment of CS rates using defined variables is essential to monitor trends in CS globally.[1] Therefore, the Robson classification was introduced by the WHO to assess CS rates

and other obstetric outcomes by classifying every woman admitted for delivery based on her obstetric history.[1 5]

Worldwide, CS rates are rising. In 2021, 21.1% of women underwent CS, and Betran *et al* estimate that by 2030, 28.5% of women worldwide will deliver by CS.[6]

The National Family Health Survey conducted from 2015–2016 to 2019–2021 reported an increase in CS deliveries from 17% to 22% in India. In 9%, the decision for CS was made after the onset of labour, while in 12% it was decided beforehand. The CS rate was highest among primiparous women (28%) and was more common in urban areas (32%) than rural areas (18%). There was also a higher CS rate in private sector health facilities (48%).[7] Literature states that tribal populations refer to indigenous communities with distinct cultural, linguistic and social practices who have historically lived in geographically isolated or resource-constrained areas. In India, under Article 342 of the Constitution, these groups are officially recognised as scheduled tribes (STs). Socio-economic disadvantage and limited access to health services are key characteristics which differentiate the tribal from the general population.[7]

Among scheduled castes, the CS rate was 18.6%, whereas among STs it was 11.2%.[7] It was found that women with a higher number of antenatal care (ANC) visits had higher CS rates than women with few or no ANC visits. Non-governmental organisations or trust hospitals/clinics reported 41.4% CS deliveries, compared with 14.2% in public sector health facilities.[7]

CS improves maternal and neonatal outcomes only when indicated; otherwise, it may cause several complications and increase maternal and neonatal morbidity and mortality,[1] while also negatively impacting socio-economic status (catastrophic health expenditure). Common complications include obstetric complications such as abnormal placentation and uterine rupture, and gynaecological complications such as chronic pelvic pain, adhesions, irregular bleeding and fertility-related consequences.[8] Furthermore, differences in neonatal morbidity have been observed when comparing CS and vaginal delivery, including higher rates of neonates requiring respiratory support or neonatal intensive care unit (ICU) admission.[9]

Prior analyses detected lower CS rates among tribal women (9.4%) compared with non-tribal women (15.5%) in a tribal hospital in Gujarat, India.[4] Detailed research on indications and outcomes of CS in tribal women is required to understand trends in CS rates, yet there is a lack of studies focusing on these communities. Previous investigations were unable to fully explain the differences in CS rates between tribal and non-tribal women.[4]

This study was conducted in a unique tribal hospital founded in 1993 in the remote valley of Sittilingi village, Dharmapuri District, Tamil Nadu, India. The hospital was established to address the high maternal and neonatal mortality prevalent among the local tribal population during the 1990s. 'Women empowerment and health for all' was the primary vision of the tribal hospital. It was the first hospital of its kind in this rural region of India.

We conducted this study in the tribal hospital located in the forest valley of Sittilingi, deep within the Eastern Ghats. What began as a small hut-based clinic over 30 years ago has evolved into a secondary care centre and stands as an epitome of maternal and child health management in the region. The tribal hospital has been recognised nationally and internationally and has become a beacon advocating for the health rights of the tribal community in the valley.

Aims and objectives

As per the action plan implemented by the Ministry of Tribal Affairs of India to improve the health status of tribal communities, there is a paucity of data focusing on tribal health and access to emergency obstetric care services such as CS, including its indications and outcomes. This study, being among the first of its kind, aims to evaluate the maternal and neonatal outcomes of CS in a resource-poor tribal hospital located in the Eastern Ghats of India.

Main objectives

1. To assess the indications and outcomes of CS among the tribal population seeking care at the tribal hospital.
2. To evaluate obstetric surgical outcomes among the tribal population seeking care at the tribal hospital.

METHODOLOGY

The study comprised analysis of data collected at the tribal hospital in the Eastern Ghats, India. Data were obtained through review of records for the year 2022 (1 January 2022–31 December 2022). Records included pregnant women receiving routine ANC and those who presented for delivery. Women who did not deliver at this hospital were excluded.

This study was conducted in the tribal hospital located in the valley of Sittilingi, nestled between the Sitheri and Kalrayan hill ranges. The population primarily belongs to tribals known as Malevasi's (hill people), and Lambadi tribe who migrated over generations from Northern India. The valley lies at the fringe of Dharmapuri district and borders three adjacent districts. There are more than 22 villages in the valley, with a total population exceeding 12 000. Until the early 1990s, maternal and infant mortality rates in the region were among the highest in the country. In 1993, two doctors established the Tribal Health Initiative Hospital in this region to address the social determinants affecting health. After 30 years of sustained effort toward the universal goal of 'Health for All', it has evolved into a secondary care hospital with some elements of tertiary care.

Community development initiatives accompanied healthcare strengthening, including the formation of an organic farming movement—now the largest in the state—and an artisan-led association called 'Porgai', working at the grassroots level for women's empowerment and economic upliftment. What began as a small

hut-based clinic in 1993 has grown into a 35-bedded hospital with 80 staff members, three operating tables, an ICU with ventilatory support, ultrasonography, endoscopy, a laboratory with basic facilities, a well-equipped generic drug pharmacy, a neonatal high dependency unit and a labour room conducting over 800 deliveries annually.

Despite the dedicated multidisciplinary team, several challenges remain, including mental health concerns, adolescent health issues, alcoholism and more recently plastic waste and other environmental threats affecting tribal communities in this remote valley. A modest childcare setup with a play area and nutritious millet meals exists, though further infrastructure upgradation is needed. The study setting is further illustrated in the supplementary materials, which include historical and contextual resources (online supplemental file 1) and photographs of the clinic building and surrounding landscape (online supplemental file 2).

Maternal mortality and morbidity drastically decreased following the establishment of this tribal hospital, which has received national and international recognition. An obstetrician is always present in the hospital, dedicated to safeguarding maternal health. Local tribal women have been trained as auxiliary nurses—many representing the first generation to receive formal education in this agrarian forest community. Most staff members continue traditional livelihoods such as tending cattle, farming and forest work alongside their hospital duties. This is not a camp-based service model; the hospital functions continuously, 24 hours a day, 365 days a year. Medical, surgical, obstetric emergencies, snake bites, poisoning cases and basic investigations are managed at this centre. During the study period, four in-house obstetric surgeons were available, with a doctor present at all times for emergency CSs.

Maternal variables documented included number of antenatal visits, assessment of fetal growth, decreased fetal movements, abdominal pain, bleeding or leaking per vagina. Pregnancy course variables such as induction of labour and mode of delivery (vaginal or caesarean) were recorded. Complications including severe pre-eclampsia and postpartum haemorrhage were documented. Blood loss during lower segment CS was monitored and quantified as described by Baucom *et al*.[10] Antenatal, intrapartum and postnatal medication care was reviewed. APGAR scores - Appearance (skin color), Pulse (heart rate), Grimace (reflexes and how the baby responds to stimulation), Activity (muscle tone), Respiration (breathing rate and effort) and birth weight were recorded.

In our hospital, the simple continuous suturing technique was most commonly used for uterine closure (single or double layer). The next common technique observed was the first layer continuous interlocking, second layer continuous burying (double-layered technique).

Robson's criteria were applied, which consider obstetric parameters such as parity, gestational age, previous CS, onset of labour, presentation and number of fetuses to classify women into ten groups, as recommended by WHO and FIGO (**Fédération Internationale de Gynécologie et d'Obstétrique**) for comparison of caesarean rates across different settings.[11]

Statistical analysis

Data were analysed using Stata V.16. Categorical variables were expressed as frequencies and percentages. Continuous variables were presented as mean±SD or median (IQR). Shapiro-Wilk test assessed normality. χ^2, Fisher's exact test, independent t-test or Mann-Whitney U test were used as appropriate. A p value <0.05 was considered statistically significant.

RESULTS

As seen from table 1, there was a total of 779 births in the year 2022, out of which 658 (84.5%) belonged to the tribal community. Among them, 112 (14.3%) women had a CS. The mean age of the study population was 23.6±3.9 years. The mean gestational age was 38.3±3.2 weeks and the mean birth weight 2.7±0.4 kg. There were 418 (53.8%) male babies and 359 (46.2%) female babies. The mean birth weight of babies born to primiparous women was 2.6±0.4 and in multiparous women was 2.7±0.5 (p=0.011). Most of the babies born had a normal APGAR score at the first minute 702 (91.3%). Eight (1%) of the babies did not survive out of the 779 births. In our study population, out of all the women who came to the hospital, 413 (53.0%) were primipara and 366 (47.0%) were multiparous women. Tribal women were found to have a higher incidence of primipara 352 (53.5%) and preterm caesareans (Robson's Category 10) 13 (15.3%) as seen in table 1. Out of all the deliveries conducted in the hospital, 698 were term and 81 preterm babies as shown in table 2. An increased frequency of preterm caesareans (Robson's Category 10) 14 (6.9%) was noted among the multipara as inferred from table 3. History of previous caesarean 59 (52.7%) was the most common indication for CS among women of all age groups. Increased prevalence of preterm caesareans (Robson's Category 10) was noted among women of age groups 20–24 years 7 (14.6%) and 25–29 years 7 (16.7%) as depicted in table 4. Among the multipara women, previous CS remained the most common indication 59 (71.1%) followed by preterm caesareans 14 (16.9%) whereas in the primipara, spontaneous labour was the frequent cause 13 (44.8%). Double layer uterine closure was the most used technique among both the groups of women 82 (73.2%).

Women aged 20–24 years formed the majority in both groups (52.9% tribal, 57.9% non-tribal). Neonatal health was poorer among tribal babies, with 24 and 5 exhibiting severe depression at 1 and 5 min (APGAR scores), compared with normal scores among non-tribal babies. CS rates were higher among tribal women (11.4% vs 5.0%), with most cases linked to previous CS. Primigravida 352 (53.5%) and preterm caesareans (Robson's

Table 1 Association between caesarean deliveries and gestational age of babies

	Total	Term	Preterm	P value
	n=779	n=698	n=81	
LOWER UTERINE SEGMENT				0.92
Formed	47 (43.1%)	39 (43.3%)	8 (42.1%)	
Not formed	62 (56.9%)	51 (56.7%)	11 (57.9%)	
INTRAOPERATIVE ADHESIONS	18 (100.0%)	14 (100.0%)	4 (100.0%)	
UTERINE CLOSURE				0.84
Double layer	82 (73.2%)	67 (72.8%)	15 (75.0%)	
Single layer	30 (26.8%)	25 (27.2%)	5 (25.0%)	
TECHNIQUE OF UTERINE CLOSURE				0.71
Continuous mattress	2 (1.8%)	2 (2.2%)	0 (0.0%)	
Simple continuous	71 (63.4%)	59 (63.4%)	12 (63.2%)	
Double layered technique	23 (20.5%)	20 (21.5%)	3 (15.8%)	
Turin's technique	16 (14.3%)	12 (12.9%)	4 (21.1%)	
ROBSON'S CRITERIA				<0.001
1	13 (11.6%)	13 (14.3%)	0 (0.0%)	
2	8 (7.1%)	8 (8.8%)	0 (0.0%)	
3	4 (3.6%)	3 (3.3%)	1 (4.8%)	
4	1 (0.9%)	1 (1.1%)	0 (0.0%)	
5	59 (52.7%)	55 (60.4%)	4 (19.0%)	
6	6 (5.4%)	6 (6.6%)	0 (0.0%)	
7	5 (4.5%)	3 (3.3%)	2 (9.5%)	
8	1 (0.9%)	1 (1.1%)	0 (0.0%)	
10	15 (13.4%)	1 (1.1%)	14 (66.7%)	

Category 10) 13 (15.3%) were also more frequent among tribal women. Intraoperative adhesions were noted in 18 mothers who underwent CS with an average blood loss of 350 mL.

Most of the babies delivered by CS were term with higher incidence of adhesions (14 term CS) as seen in table 1. While the majority of the incisions were closed with simple continuous suture among both term and preterm caesareans, double-layered closure technique was used more in term caesareans and Turin's technique more in preterm caesareans as shown in table 1. Among the term caesarean deliveries, although the majority were previous CS (Robson's Category 5) 55 (60.4%), there were 13 (14.3%) nulliparous primi caesarean deliveries (Robson's Category 1).

Most of the CSs in multiparous mothers were due to previous caesarean (Robson's Category 5) 59 (71.1%) followed by preterm caesareans (Robson's Category 10) 14 (16.9%) whereas it was due to nulliparity in spontaneous labour in primiparous mothers followed by nulliparous breech as shown in table 2. Simple continuous suturing was the most commonly used technique across both primi and multiparous caesareans. Higher incidence of preterm caesarean (Robson's Category 10) 14 (16.9%) was noted among multiparous caesareans as seen in table 2.

Previous caesarean (Robson's Category 5) 59 (52.7%) was the most common indication among women of all age groups. Preterm deliveries (Robson's Category 10) were seen most commonly in the age groups of 20–29 years.Simple continuous suturing was the common technique used across all age groups.

DISCUSSION

Globally and in India, significant progress has been made in reducing maternal mortality rate and neonatal mortality rate over the decades. However, 99% of maternal deaths still occur in developing countries, where women face a 36-times higher lifetime risk of pregnancy-related death compared with those in developed nations, with most of these deaths being preventable and related to pregnancy and childbirth.[10 12–15]

CS forms an essential component of CEmONC and, when appropriately indicated, can significantly reduce maternal and neonatal mortality. However, access remains inequitable in low-resource settings, contributing to preventable morbidity. Although WHO guidelines suggest an upper threshold of 15% for CS rates, India has exceeded this in private facilities (47.4%) while public sector rates remain at 14.3%,[7] with an alarming 261.7% increase reported among tribal communities.[16]

Table 2 Association between caesarean deliveries and obstetric score of mothers

	Total	Primi	Multi	P value
LOWER UTERINE SEGMENT				0.004
Formed	47 (43.1%)	20 (64.5%)	27 (34.6%)	
Not formed	62 (56.9%)	11 (35.5%)	51 (65.4%)	
BLOOD LOSS	350.0 (350.0, 500.0)	350.0 (350.0, 500.0)	400.0 (350.0, 500.0)	0.59
INTRAOPERATIVE ADHESIONS	18 (100.0%)		18 (100.0%)	
UTERINE CLOSURE				0.001
Double layer	82 (73.2%)	16 (51.6%)	66 (81.5%)	
Single layer	30 (26.8%)	15 (48.4%)	15 (18.5%)	
TECHNIQUE OF UTERINE CLOSURE				0.003
Continuous mattress	2 (1.8%)	0 (0.0%)	2 (2.5%)	
Simple continuous	71 (63.4%)	12 (38.7%)	59 (72.8%)	
Double layered technique	23 (20.5%)	10 (32.3%)	13 (16.0%)	
Turin's technique	16 (14.3%)	9 (29.0%)	7 (8.6%)	
ROBSON'S CRITERIA				<0.001
1	13 (11.6%)	13 (44.8%)	0 (0.0%)	
2	8 (7.1%)	8 (27.6%)	0 (0.0%)	
3	4 (3.6%)	0 (0.0%)	4 (4.8%)	
4	1 (0.9%)	0 (0.0%)	1 (1.2%)	
5	59 (52.7%)	0 (0.0%)	59 (71.1%)	
6	6 (5.4%)	6 (20.7%)	0 (0.0%)	
7	5 (4.5%)	0 (0.0%)	5 (6.0%)	
8	1 (0.9%)	1 (3.4%)	0 (0.0%)	
10	15 (13.4%)	1 (3.4%)	14 (16.9%)	

Marginalised populations, including tribal communities, continue to face barriers to quality and affordable maternal healthcare due to illiteracy, traditional customs, poor nutrition and geographical isolation.[17–19]

There is also a lack of data regarding CS rates, maternal and neonatal outcomes, and differences in surgical techniques among tribal populations in India.[20–24] Although the overall CS rate in India increased from 8.5% in 2005 to 17.2% in 2015–2016, it remains lower in rural areas,[18 24] where limited availability, lack of awareness and financial constraints are major determinants.[25 26]

Given the paucity of comparative studies evaluating indications, outcomes and determinants of CS between tribal and non-tribal communities, this study aimed to address this gap. In 2022, there were 779 births at the tribal hospital, of which 658 (84.5%) were tribal women and 15.5% were non-tribal women who had settled in the valley through marriage customs. Although a higher proportion of tribal women underwent CS 75 (11.4%) compared with non-tribal women 6 (5.0%), the overall rate remained lower than the national average of 19–20%.[7]

Determinants influencing access to emergency obstetric care include accessibility, affordability and availability.[27–29] The hospital in our study was started with the objective of improving maternal and neonatal outcomes and continues to provide affordable, accessible, round-the-clock care at subsidised cost, which may explain the relatively higher utilisation among tribal women. The presence of nursing staff from the same tribal community likely enhanced trust and acceptance. Community-oriented antenatal services enabled early identification of high-risk conditions such as preeclampsia, obstructed labour and shoulder dystocia, warranting timely caesarean delivery. All CS procedures were performed strictly for obstetric indications. The continuous availability of trained obstetric surgeons eliminated logistic pressures influencing surgical decisions.

This model represents a community-driven healthcare system in which the tribal population was empowered and trained to participate in its own healthcare delivery. The philosophy of 'healthcare for tribals by tribals' fostered dignity, trust and cultural alignment. The most common indications for CS were previous CS (Robson's Category 5) 59 (52.7%), preterm caesarean (Robson's Category 10) 15 (13.4%) and nulliparous women in spontaneous labour (Robson's Category 1) 13 (11.6%), due to maternal or fetal indications. Higher incidences among tribal women may reflect poverty, poor nutritional status, limited antenatal access and delayed presentation.[25 27 30 31]

Table 3 Population demographics

	Total	Tribal	Non-tribal	P value
	N=779	N=658	N=121	
AGE (Mean)	23.6±3.9	23.6±3.9	23.6±3.6	0.96
Age (years)				
<20	95 (12.2%)	85 (12.9%)	10 (8.3%)	
20–24	418 (53.7%)	348 (52.9%)	70 (57.9%)	
25–29	203 (26.1%)	174 (26.4%)	29 (24.0%)	
≥30	63 (8.1%)	51 (7.8%)	12 (9.9%)	0.37
OBSTETRIC SCORE				0.53
Primigravidae	413 (53.0%)	352 (53.5%)	61 (50.4%)	
Multigravidae	366 (47.0%)	306 (46.5%)	60 (49.6%)	
GESTATIONAL AGE	38.3±3.2	38.3±3.2	38.3±3.4	0.8
GENDER OF BABY				0.23
Boy	418 (53.8%)	359 (54.7%)	59 (48.8%)	
Girl	359 (46.2%)	297 (45.3%)	62 (51.2%)	
BIRTH WEIGHT (KG)	2.7±0.4	2.6±0.4	2.9±0.4	<0.001
APGAR 1 MIN				0.072
<5	24 (3.1%)	24 (3.7%)	0 (0.0%)	
5–7	43 (5.6%)	38 (5.9%)	5 (4.2%)	
>8	702 (91.3%)	587 (90.4%)	115 (95.8%)	
APGAR 5 MIN				0.16
<5	5 (0.6%)	5 (0.8%)	0 (0.0%)	
5–7	14 (1.8%)	14 (2.2%)	0 (0.0%)	
>8	751 (97.5%)	630 (97.1%)	121 (100.0%)	
TYPE OF DELIVERY				0.033
Term	698 (89.6%)	583 (88.6%)	115 (95.0%)	
Preterm	81 (10.4%)	75 (11.4%)	6 (5.0%)	
LOWER UTERINE SEGMENT				0.12
Formed	47 (43.1%)	40 (47.1%)	7 (29.2%)	
Not formed	62 (56.9%)	45 (52.9%)	17 (70.8%)	
BLOOD LOSS	350.0 (350.0, 500.0)	375.0 (350.0, 500.0)	350.0 (350.0, 500.0)	0.91
INTRAOPERATIVE ADHESIONS	18 (100.0%)	14 (100.0%)	4 (100.0%)	
UTERINE CLOSURE				0.63
Double layer	82 (73.2%)	62 (72.1%)	20 (76.9%)	
Single layer	30 (26.8%)	24 (27.9%)	6 (23.1%)	
TECHNIQUE OF UTERINE CLOSURE				0.28
Continuous mattress	2 (1.8%)	2 (2.3%)	0 (0.0%)	
Simple continuous	71 (63.4%)	52 (60.5%)	19 (73.1%)	
Double layered technique	23 (20.5%)	17 (19.8%)	6 (23.1%)	
Turin's technique	16 (14.3%)	15 (17.4%)	1 (3.8%)	
ROBSON'S CRITERIA				0.6
1	13 (11.6%)	11 (12.9%)	2 (7.4%)	
2	8 (7.1%)	7 (8.2%)	1 (3.7%)	
3	4 (3.6%)	4 (4.7%)	0 (0.0%)	
4	1 (0.9%)	1 (1.2%)	0 (0.0%)	
5	59 (52.7%)	40 (47.1%)	19 (70.4%)	

Continued

Table 3 Continued

	Total	Tribal	Non-tribal	P value
	N=779	N=658	N=121	
6	6 (5.4%)	4 (4.7%)	2 (7.4%)	
7	5 (4.5%)	4 (4.7%)	1 (3.7%)	
8	1 (0.9%)	1 (1.2%)	0 (0.0%)	
10	15 (13.4%)	13 (15.3%)	2 (7.4%)	

The majority of deliveries occurred in women aged 20–24 years 418 (53.7%), possibly reflecting improved education and awareness regarding family planning and spacing practices.[32]

The mean birth weight in our study was 2.700 kg (±0.4), with slightly lower weights among tribal women 2.600 kg (±0.4) compared with non-tribal women 2.900 kg (±0.4). In India, maternal undernutrition, anaemia, sepsis, hypertension, obstructed labour and sociocultural practices contribute to low birth weight and under-five mortality.[33] Neonatal morbidity was also higher among tribal newborns, with 24 (3.7%) and 5 (0.8%) exhibiting severe depression at 1 and 5 min (APGAR score), respectively, compared with non-tribal newborns. Poor maternal nutrition, sanitation, cultural beliefs and limited antenatal services may contribute to these disparities.

Suturing technique is clinically important, as impaired uterine healing may increase the risk of rupture in subsequent pregnancies. In our study, most uterine incisions were closed using simple continuous suturing 71 (63.4%). Although National Institute for Health and Care Excellence guidelines recommend double-layer closure, multiple trials have not demonstrated significant differences in uterine rupture rates or myometrial thickness on postpartum ultrasonography between single-layer and double-layer techniques.[34–37] Among multiparous women, previous CS (Robson's Category 5) accounted for 59 (71.1%) of indications, followed by

Table 4 Association between caesarean deliveries and age of mothers

Parameters	Overall	Age				P value
		<20 years	20–24 years	25–29 years	≥30 years	
	N=779	N=95	N=418	N=203	N=63	
LOWER UTERINE SEGMENT						0.057
Formed	47 (43.1%)	5 (71.4%)	21 (42.9%)	19 (48.7%)	2 (14.3%)	
Not formed	62 (56.9%)	2 (28.6%)	28 (57.1%)	20 (51.3%)	12 (85.7%)	
BLOOD LOSS	350.0 (350.0, 500.0)	350.0 (350.0, 500.0)	350.0 (300.0, 500.0)	350.0 (350.0, 500.0)	500.0 (400.0, 500.0)	0.19
INTRAOPERATIVE ADHESIONS	18 (100.0%)		8 (100.0%)	8 (100.0%)	2 (100.0%)	
UTERINE CLOSURE						0.26
Double layer	82 (73.2%)	4 (57.1%)	36 (72.0%)	33 (82.5%)	9 (60.0%)	
Single layer	30 (26.8%)	3 (42.9%)	14 (28.0%)	7 (17.5%)	6 (40.0%)	
TECHNIQUE OF UTERINE CLOSURE						0.17
Continuous mattress	2 (1.8%)	0 (0.0%)	1 (2.0%)	0 (0.0%)	1 (6.3%)	
Simple continuous	71 (63.4%)	4 (57.1%)	30 (61.2%)	29 (72.5%)	8 (50.0%)	
Double layered technique	23 (20.5%)	0 (0.0%)	11 (22.4%)	6 (15.0%)	6 (37.5%)	
Turin's technique	16 (14.3%)	3 (42.9%)	7 (14.3%)	5 (12.5%)	1 (6.3%)	
ROBSON'S CRITERIA						0.002
1	13 (11.6%)	4 (57.1%)	5 (10.4%)	3 (7.1%)	1 (6.7%)	
2	8 (7.1%)	2 (28.6%)	3 (6.3%)	3 (7.1%)	0 (0.0%)	
3	4 (3.6%)	0 (0.0%)	1 (2.1%)	3 (7.1%)	0 (0.0%)	
4	1 (0.9%)	0 (0.0%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	
5	59 (52.7%)	0 (0.0%)	22 (45.8%)	24 (57.1%)	13 (86.7%)	
6	6 (5.4%)	0 (0.0%)	6 (12.5%)	0 (0.0%)	0 (0.0%)	
7	5 (4.5%)	0 (0.0%)	3 (6.3%)	2 (4.8%)	0 (0.0%)	
8	1 (0.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (6.7%)	
10	15 (13.4%)	1 (14.3%)	7 (14.6%)	7 (16.7%)	0 (0.0%)	

preterm CS (Robson's Category 10) 14 (6.9%). Among primiparous women, indications included spontaneous labour (Robson's Category 1) 13 (11.6%) and breech presentation (Robson's Category 6) 2 (7.4%), along with other maternal and fetal causes.

A key limitation was the inability to track the type of uterine closure in women with a previous CS. This would have allowed quantification of adhesion severity and evaluation of whether one surgical technique offered superior long-term outcomes. Another major limitation noted in this study that should be considered when interpreting the findings is that the cross-sectional design based on retrospective record review limits the ability to establish causal relationships between observed variables and outcomes. The study was conducted in a single rural tribal hospital, which may limit the generalisability of the findings to other tribal or non-tribal populations with differing healthcare access. Routinely maintained medical records introduce the possibility of information bias, including incomplete documentation or variability in clinical recording practices, despite strong quality control measures that were undertaken in the hospital to maintain high quality in documentation. Additionally, variations in surgical technique were based on surgeon preference rather than standardised protocols, which may introduce procedural heterogeneity. Finally, as the study captures data from a single year, temporal trends and seasonal variations in obstetric outcomes could not be assessed.

Although tribal communities constitute only 8.4% (104 million) of India's population, they represent a significantly underserved group due to limited penetration of evidence-based maternal healthcare programmes, geographical remoteness and financial constraints in resource-poor regions.

CONCLUSION

CS (C-section) is an essential component of emergency obstetric care and, when appropriately used, can significantly reduce adverse maternal and neonatal outcomes. However, it remains underused in tribal areas due to limited resources and awareness. The CS rate in the tribal community of the Eastern Ghats was 14.3%. The most common indication for CS in the tribal valley was Robson's Category 5, which accounted for more than half of the total CS cases. The preferred surgical technique for uterine closure at the tribal hospital was simple continuous suturing (63.4%). Double-layer uterine closure was also frequently practised, likely reflecting surgeon preference. Intraoperative adhesions were observed in 16.07% of CS procedures.

In a country where childbirth and maternal care practices are deeply intertwined with cultural beliefs, lack of cultural sensitivity in healthcare delivery may lead to misalignment with tribal socio-cultural values, resulting in mistrust and reduced engagement with formal health systems. This can contribute to inadequate utilisation of antenatal, intrapartum and postnatal services among tribal women. Therefore, sensitising healthcare workers and integrating culturally competent practices may improve maternal and neonatal outcomes by promoting community engagement and empowerment rather than relying solely on incentive-based approaches to increase institutional healthcare utilisation.

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ORCID iD

Christy Vijay https://orcid.org/0000-0003-4098-6217

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