Original Research Article

Differentials and Determinants of Cesarean Deliveries in India: Insights from High Prevalent States

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ABSTRACT

Purpose: With the increasing prevalence of cesarean deliveries in India, this study aimed to assess the differentials and determinants of these deliveries in highly prevalent states across India. This study used mixed methods (quantitative and qualitative) to fulfil the objectives.

Design/methodology/approach: The research team collected quantitative data from recently delivered mothers through normal vaginal delivery and cesarean delivery. Moreover, qualitative data was collected via in-depth interviews (IDIs) from 37 obstetrician-gynaecologists. While analyzing quantitative data, proportion tests and multivariable logistic regression analysis were used.

Findings: Proportion tests suggest that the prevalence of cesarean delivery was significantly higher in private health facilities, obese women, and women who had a history of cesarean delivery and who were living in households with business- or salary-based income. After adjusting for other covariates, the regression results suggest that women who delivered in private health facilities and those who were obese were more likely to have a cesarean delivery compared to women who delivered in public health facilities and those who were not obese, respectively. We did not find any association between cesarean deliveries with age and physical stature of women. Women who are obese, delivered in private health facilities, and had a previous history of cesarean delivery are more likely to be delivered through cesarean delivery. The qualitative data support these findings.

Originality: To tackle increasing cesarean rates, the government needs to develop strict policies centric on primigravida and obese women. Moreover, rigorous monitoring of private health facilities might help control increased cesarean rates.

Keywords: Cesarean delivery, qualitative, quantitative, differentials and determinants, India.

INTRODUCTION

Worldwide, approximately 213 million mothers become pregnant and give birth each year, with about 18.5 million undergoing cesarean deliveries[1]. The rate of cesarean deliveries is regarded as a proxy indicator in maternal health to track the progress of health services. World Health Organization (WHO) recommends that the prevalence of medically indicated CS births be between 10 and 15%[2]. Nonetheless, a tremendous increase in cesarean has been observed globally[2]. Cesarean deliveries in India are increasing at an alarming rate; it

has risen to 22% in 2019-20 from 17% in 2015-16[3]. Across various regions of India, cesarean deliveries are more prevalent in certain states. Notably, Jammu & Kashmir (41.7%) in North, Sikkim (32.8%) in East, Chhattisgarh (15.2%) in Central region, Maharashtra (25.4%) in West, and Telangana (60.7%) in South exhibit higher rates of cesarean deliveries[3]. When comparing these states to the remaining ones, the combined prevalence in these specific states is nearly 30%, whereas it stands at 20% for the rest of India[3]. Exploring these states with high cesarean delivery prevalence across India is anticipated to offer a deeper insight into factors contributing to the rising rates of cesarean deliveries in the country.

Multiple studies investigating factors associated with cesarean deliveries have found various factors, including age[4], education[5], obesity[6], place of delivery[7], and residence[8,9]. A systematic review of 22 studies while studying the association between age and risks of cesarean delivery found an increased risk of cesarean delivery among older women[4]. Moreover, the educational status of pregnant women has been reported as a significant factor in decision-making regarding cesarean delivery. Studies have shown that women in higher economic classes with superior education underwent cesarean deliveries more frequently than those with formal education and lower economic status[5]. Similarly, women opting for private facilities over government ones for delivery experienced a higher incidence of cesarean deliveries[7]. Furthermore, it has been extensively documented that women's access to healthcare facilities with trained birth attendants (TBAs), coupled with an adequate supply of drugs and essential resources, substantially elevated the probability of cesarean deliveries[10].

The present study aims to comprehend the differentials and determinants of cesarean deliveries by examining states/UTs with a high prevalence of such deliveries. This will be achieved through an analysis of qualitative and quantitative data. The present study is the first of its kind, and it used the mixed methods approach to determine factors associated with cesarean deliveries. By examining the determinants of cesarean deliveries, the study aims to identify the gaps and challenges in providing quality and women-centred care. This research seeks to inform healthcare policies and interventions by exploring multifaceted factors contributing to the high prevalence of cesarean deliveries in India, aiming to improve maternal and neonatal health outcomes and reduce health inequalities. By utilising qualitative and quantitative methods, the present study aimed to assess differentials and determinants of cesarean deliveries across various sociodemographic, economic, and health characteristics in India.

MATERIALS & METHODS
Data source
From five regions in India (North, Central, East and Northeast, West, and South), one state/UT was chosen based on the highest prevalence of cesarean deliveries from the NFHS-5 data. In each selected state, two or three districts were picked based on cesarean delivery rates, with one from the top three and another from the bottom three. Eleven districts from Jammu & Kashmir, Chhattisgarh, Sikkim, Maharashtra, and Telangana were included. In each district, we selected one hospital from the district headquarters, one from a Taluk, and one SDH/CHC from another Taluk for public healthcare interviews. Additionally, at least two leading private hospitals/nursing homes with the highest delivery rates were chosen from each Taluk to match the number of public healthcare respondents. Since the study was conducted in the states with the highest prevalence of cesarean delivery, for the present study, the prevalence of cesarean delivery is considered as 50%, and the sample size was calculated by using the formula:

$$n = \frac{z^2 pq * (1 + R)}{d^2}$$

Where n = Sample size required; z= z value (1.96 at 5% level of significance); q=1-p=0.50; R = non-response adjustment (assumed to be 20%); and d = margin of error (assumed to be 5%).

$$n = \frac{(1.96)^2 * (0.50) * (0.50) * (1 + 0.2)}{(0.05)^2} = 461$$

To ensure a robust sample, the study aimed to survey 500 respondents per State/UT, comprising 200 currently pregnant women, 200 women with recent regular vaginal deliveries, and 100 women with recent cesarean deliveries from each State/UT. The target was 2,500 respondents across five states/UTs. However, practical issues, such as the unavailability of cesarean-delivered women in some facilities, led to a final sample of 2,362 respondents. The study included women who were recently delivered either vaginally or via cesarean. The final sample included 1,407 recently delivered women, with 871 having had normal deliveries and 536 cesarean deliveries. The study used qualitative research, specifically in-depth interviews (IDIs), to gather data from Obstetricians and Gynecologists (OBGs) in public and private hospitals across Telangana, Sikkim, Maharashtra, and Chhattisgarh. A total of 37 interviews were conducted: 10 in Telangana, 10 in Sikkim, 10 in Maharashtra, and 7 in Chhattisgarh. Data collection occurred from January to March 2023.

Definition of variables
The primary outcome variable of the study was cesarean delivery. Based on an extensive literature review, potentially related covariates such as sociodemographic characteristics, lifestyle factors, health conditions, and household factors were included in the study. Sociodemographic characteristics were age groups (less than 30 years, more than 30), educational status (never went to school, 1-7, 8-10, 11-12, 13 or more years), occupation (non-salaries, business/salaries, household work). The interviewer assessed the obesity status and physical stature of the women based on their observations. A recent study found that trained observers could distinguish normal weight from overweight/obesity with high sensitivity and specificity[11]. Furthermore, the previous cesarean delivery experience is captured as a binary response: yes, no. Moreover, various household characteristics were also included, such as place of residence (urban, rural), type of family (nuclear, no-nuclear), caste (Scheduled Caste (SC)/Scheduled Tribe (ST), Other Backward Classes (OBC), others), and religion (Hindu, Muslim, others), and type of household cards (BPL, APL, don't know), and state (Chhattisgarh, Jammu & Kashmir, Maharashtra, Sikkim, Telangana).

STATISTICAL ANALYSIS
We used descriptive statistics to understand the nature of the variables. Proportion test was performed to assess the significance of differences across the place of delivery, age groups, physical stature, body mass index, family income, and earlier cesarean delivery experience. Further, multivariable logistic regression analysis was used to evaluate the association between cesarean delivery (coded as 0 "no" and 1 "yes") and selected covariates. Findings were presented as an odds ratio (OR) with a 95% confidence interval (CI). Both unadjusted and adjusted regression models were determined to assess the association between the occurrence of cesarean and selected covariates. Furthermore, we analysed IDI transcripts using the directed content (deductive) analysis approach in the qualitative component, highlighting themes relevant to its objectives. After intensive reading, relevant comments were identified. Findings focused on the differentials and determinants in cesarean deliveries.

Ethical consideration
This Pan-India study, approved by the Ministry of Health and Family Welfare

(MoHFW) under the 2022-23 Annual Work Plan for Population Research Centres, received ethical clearance from the Institutional Ethics Committee of SDM College of Medical Sciences and Hospital, Dharwad. Informed consent was obtained from all participants before the interviews.

RESULT

Table 1 presents the women's background characteristics according to their mode of delivery. A total of 1,407 women were included in the study, with 62% (n=871) had vaginal deliveries and the remaining 38% (n=536) had cesarean deliveries. Among the mothers who had vaginal deliveries, nearly 21% were 30 years or older, around 44% had 11 or more years of education, almost 73% were household workers, around 50% of women had a non-salaried source of household income, and nearly 71%

belonged to the Hindu religion. Additionally, 51% of these women were from BPL households, the majority were from rural areas, and almost 39% lived in nuclear families. Regarding physical characteristics, 6% appear obese, and 8% appear short from the interviewer's perspective. Among the mothers who had Cesarean deliveries, nearly 25% were 35 years or older, about 51% had more than 11 years of education, almost 76% were household workers, 41% were involved in non-salaried occupations (both agricultural and non-agricultural), and nearly 74% were Hindu. Furthermore, 45% of these women were from BPL households, most lived in rural areas, and almost 41% were from nuclear families. Regarding physical characteristics, 12% appear obese, and 8% appear short from the interviewer's perspective.

Table 1. Background characteristics of the women delivered by normal vaginal delivery (NVD) and cesarean methods

Background characteristics	Total		NVD		Cesarean	
	N	%	N	%	N	%
Age groups						
Less than 30 years	1,095	77.8	692	79.4	403	75.2
More than 30	312	22.2	179	20.6	133	24.8
Education status						
Never went to school	113	8	79	9.1	34	6.3
1-7	149	10.6	103	11.8	46	8.6
8-10	485	34.5	305	35	180	33.6
11-12	318	22.6	195	22.4	123	22.9
13 or more years	342	24.3	189	21.7	153	28.5
Occupation						
Non-salaried	183	13	122	14	61	11.4
Business/Salaried	177	12.6	109	12.5	68	12.7
Household work	1,047	74.4	640	73.5	407	75.9
Place of delivery						
Public	1,178	83.7	802	92.1	376	70.1
Private	229	16.3	69	7.9	160	29.9
Family income source						
Non-salaried	626	44.5	406	46.6	220	41
Business/Salary	733	52.1	434	49.8	299	55.8
Others/DK	48	3.4	31	3.6	17	3.2
BMI (Observed)						
Normal	1,145	81.4	728	83.6	417	77.8
Underweight	147	10.4	92	10.6	55	10.3
Obese	115	8.2	51	5.9	64	11.9
Stature of women (Observed)						
Normal	1,205	85.6	752	86.3	453	84.5
Short	111	7.9	68	7.8	43	8
Tall	91	6.5	51	5.9	40	7.5

Had CS delivery earlier						
Yes	301	28	34	5.2	267	64.2
No	775	72	626	94.8	149	35.8
Religion						
Hindu	1,018	72.4	622	71.4	396	73.9
Muslim	261	18.6	175	20.1	86	16
Others	128	9.1	74	8.5	54	10.1
Caste						
SC/ST	497	35.3	314	36.1	183	34.1
Other Backward Class	489	34.8	294	33.8	195	36.4
Others	421	29.9	263	30.2	158	29.5
Households cards						
BPL	692	49.2	448	51.4	244	45.5
APL	576	40.9	332	38.1	244	45.5
DK	139	9.9	91	10.4	48	9
Residence						
Rural	887	63	578	66.4	309	57.6
Urban	520	37	293	33.6	227	42.4
Type of family						
Nuclear	558	39.7	337	38.7	221	41.2
Non-nuclear	849	60.3	534	61.3	315	58.8
State						
Chhattisgarh	215	15.3	125	14.4	90	16.8
Jammu & Kashmir	299	21.3	200	23	99	18.5
Maharashtra	287	20.4	187	21.5	100	18.7
Sikkim	320	22.7	200	23	120	22.4
Telangana	286	20.3	159	18.3	127	23.7
Total	1,407	100	871	100	536	100

Note: DK – Don't Know; BMI – Body Mass Index; SC – Scheduled Castes. ST – Scheduled Tribes; APL (Above Poverty Line) ration card; BPL (Below Poverty Line) ration card.

Table 2 presents the proportion test results for the differences in the prevalence of cesarean deliveries across selected covariates. The prevalence of cesarean deliveries is significantly higher in private health facilities than in public facilities (69.9% vs 31.9%). Moreover, this prevalence was significantly higher among obese women, those with previous cesarean delivery, and those women living in households that have business or salary-based income sources. However, we did not find any significant difference in the prevalence of cesarean delivery across age groups and physical stature.

Table 3 presents unadjusted and adjusted logistic regression findings for cesarean deliveries. Initially, findings indicate higher cesarean odds among women in private health facilities, obese individuals, and those in salary-based households. Conversely, women without prior cesareans are significantly less likely to undergo cesarean delivery (UOR: 0.03; 95% CI: 0.02, 0.05). No significant association was found between cesarean delivery and women's age groups or physical stature. However, after adjusting for covariates, women delivered in private health facilities had higher odds of cesarean delivery than those in public facilities (AOR: 7.77; 95% CI: 4.10, 14.70). Additionally, obese women were significantly more likely to undergo cesarean delivery than those with normal BMI (AOR: 2.23; 95% CI: 1.02, 4.85). Other predictors, such as household income source, age group, and stature, were not significantly associated with cesarean delivery after adjusting for covariates.

Table 2. Significance of differences in the prevalence of cesarean across various characteristics

Variables		Categories	Difference
Place of delivery	Public	*Private*	
	31.9	69.9	-38.0***
Age groups	<30 years	*>30 years*	
	36.8	42.6	-5.8
Stature of women (Observed)	Normal	*Short*	
	38.7	37.6	-1.1
BMI (Observed)	Normal	*Obese*	
	36.4	55.7	-19.3***
Family income source	Non-salaried	*Business/Salary*	
	35.1	40.8	-5.7*
Had CS delivery earlier	Yes	*No*	
	88.7	19.2	69.5***

* p<0.05, ** p<0.01, *** p<0.001; p-values are based on the proportion t-test.

Table 3. Unadjusted and adjusted logistic regression results for the cesarean according to various characteristics

	uOR	95% CI	aOR	95% CI
Place of delivery				
Public	*Ref.*		*Ref.*	
Private	4.95***	[3.64,6.73]	7.77***	[4.10,14.70]
Age groups				
Less than 30 years	*Ref.*		*Ref.*	
More than 30	1.28	[0.99,1.65]	0.86	[0.53,1.40]
Stature of women (Observed)				
Normal	*Ref.*		*Ref.*	
Short	1.05	[0.70,1.56]	1.48	[0.66,3.29]
BMI (Observed)				
Normal	*Ref.*		*Ref.*	
Obese	2.19***	[1.49,3.23]	2.23*	[1.02,4.85]
Family income source				
Non-salaried	*Ref.*		*Ref.*	
Business/Salary	1.27*	[1.02,1.59]	0.83	[0.52,1.33]
Had CS delivery earlier				
Yes	*Ref.*		*Ref.*	
No	0.03***	[0.02,0.05]	0.02***	[0.01,0.03]

* p<0.05, ** p<0.01, *** p<0.001; uOR- unadjusted odds ratio; aOR- unadjusted odds ratio; the aOR is estimated after controlling various background characteristics including education status, occupation, religion, caste, households cards, residence, type of family, and state/UT.

Results from the qualitative study

The demographic and professional characteristics of 37 medical practitioners selected for in-depth interviews are presented in Table 4. Most medical practitioners were female (64.9%) and married (94.6%). The age distribution indicates that 43.2% were between 40 and 49, 32.4% were between 30 and 39, and 24.3% were 50 or above. Regarding hospital affiliation, 70.3% worked in public hospitals, and 29.7% worked in private hospitals. Regarding experience, 45.9% had 11-19 years, 24.3% less than ten years, and 29.7% had 20 or more years.

Table 4. Demographic and professional characteristics of medical practitioners selected for the in-depth interviews

	N	%
Age categories (years)		
30-39	12	32.4
40-49	16	43.2

50+	9	24.3
Sex		
Male	13	35.1
Female	**24**	**64.9**
Health facility		
Public	26	70.3
Private	11	29.7
Marital Status		
Married	35	94.6
Unmarried	2	5.4
Years of experience (years)		
Less than 10	9	24.3
19-Nov	17	45.9
20 or more	11	29.7
Total	37	100.0

Differentials and determinants of cesarean deliveries

From a qualitative perspective, we examined the factors influencing cesarean deliveries in states with high cesarean rates in India. Many doctors noted that cesarean deliveries are more common in private health facilities than in public ones. One ObGy working in the hospital stated that, "*It is easier to note that more and more deliveries are being done through cesarean sections in private health facilities compared to the public ones. This trend has drawn the concern of health practitioners, as it indicates that something apart from medical reasons could be promoting C-sections in such facilities*".

Furthermore, many of the doctors interviewed did not rule out the role of a comparatively higher amount of money involved in cesarean delivery than in normal delivery. This phenomenon is particularly true in private hospitals, as the pressure to increase profits can be high. One of the doctors stated, "*When you compare a private hospital to a government hospital, everything is completely different. Government hospitals charge less for a normal delivery and also remuneration is lower. However, in a private hospital, a C-section will cost 3 or 4 times the amount of a normal delivery.*"

While discussing major risk factors of cesarean deliveries among women, most of the doctors reported that diabetic, hypertensive, short-stature and obese women are more likely to experience a cesarean delivery. One of the doctors stated, "*As per my experience, cesarean delivery is more common among women whose height is short, among obese, who have diabetes and hypertension*". Another doctor stated "The prevalence of Cesarean is also higher if the baby- size is big, the mother is anaemic *and below age 20 years and above age 35 years*". Furthermore, while highlighting various other factors, including higher education levels and higher income households as the critical risk factors for the increasing cesarean delivery, one doctor stated, "*The chance of cesarean delivery is higher among women who have a good income, short stature, high BMI (Body Mass Index), those who are more educated, who are the loved ones in their family [pampered]*".

The majority of doctors in both public and private health facilities reported that they do not perform cesarean delivery without a medical indication. One of the doctors stated, "*A cesarean delivery is a medical procedure performed for specific medical indications. It should not be undertaken for commercial purposes.*" Furthermore, they stated, "*Patients demand [for cesarean section] has increased a lot, that's why, percentage of Cesareans increased. Also, once a woman undergoes cesarean section, likely, the next delivery will also be the cesarean section.*" On the other hand, many doctors have reported that numerous families bring auspicious dates and times

suggested by astrologers according to the astrological calendar. These families then pressure obstetricians to deliver baby at the predicted auspicious time. One doctor stated, "*Some people believe in auspicious times [Muhurtham] for childbirth. They might request to have their baby delivered at a specific auspicious time, but we don't accept such requests*".

DISCUSSION

This study assessed the differentials and determinants of cesarean deliveries by utilising data from the five most prevalent cesarean states/UTs in five regions in India with the highest cesarean delivery prevalence. Cesarean delivery is significantly higher in private health facilities than in public health facilities. Existing studies based on Indian data had consistently shown a greater prevalence of cesarean deliveries in private health facilities compared to public facilities[12,13]. Moreover, In the 2019-20 National Family Health Survey (NFHS), cesarean delivery rates were significantly higher in private health facilities (48%) than in the public sector (14%)[3]. In the private healthcare sector, higher cesarean delivery rates can be attributed to financial incentives responding to patient demand and the overuse of intensive treatments[14]. Additionally, studies indicate that many women choose cesarean delivery out of fear of pain or due to perceived safety over vaginal delivery[15].

This study finds that the prevalence of cesarean delivery did not significantly differ between women under 30 and those over 30. However, multiple studies indicate that the risk of cesarean delivery increases with age[16]. For example, a Danish study found women over 30 were significantly more likely to have cesarean deliveries than those under 30[16]. Many women over 35 believe that maintaining good physical health can reduce pregnancy risks and do not consider themselves at high risk for complications[17]. This study found no relationship between women's short stature and cesarean delivery, contradicting previous research that

identified shorter maternal height as a significant risk factor[18–20]. A recent study of 34 sub-Saharan African countries confirmed that shorter women are more likely to have cesarean deliveries, mainly due to obstructed labour from cephalopelvic disproportion (CPD)[21]. However, some researchers question the effectiveness of using height as a screening tool for CPD due to its low sensitivity and specificity[18].

This study finds that women who appear to be obese had nearly two times greater odds of having cesarean delivery than those who seem to have normal BMI. In line with our results, various studies indicated obesity as a potential risk factor for cesarean delivery[22,23]. A recent systematic review based on Sub-Saharan African countries has found that overweight and obese women can have up to four-fold increased risk of cesarean delivery compared to their normal weight counterparts[22]. CPD and fetal macrosomia were significant indications for primary cesarean delivery that increased with increasing obesity[23].

In this study, unadjusted logistic results indicate that women in households with business or salary-based income had higher odds of cesarean delivery compared to those in families with non-salaried income. After adjusting for other covariates, the results become insignificant. Assuming business or salary-based households are socioeconomically better off, we observed higher cesarean delivery rates in these groups. Other studies also report significant socioeconomic differences in cesarean delivery rates, with higher rates among women from high-income families[24,25]. A study based on Indian women found that cesarean deliveries were significantly higher among mothers from high-income families[25]. Factors influencing this trend include education, prenatal care, access to resources, and private health facilities[26]. In addition, the present study found that women who had a history of cesarean delivery earlier were more likely to have repeated cesarean delivery. Similar to our findings, a recent study in India also found

that 88 per cent of repeated cesarean deliveries occur in India[27].

This study has both strengths and limitations. It targets key areas by selecting states/UTs with the highest cesarean delivery rates based on NFHS-5 data. Qualitative insights from ObGyns complement quantitative data, which is a potential strength. Temporal consistency is ensured by collecting data from January to March 2023, and the mixed-method approach enhances validity and reliability. However, the selection of states may not reflect broader variability in cesarean delivery rates across India, potentially skewing results due to different healthcare practices and socio-economic conditions. Practical challenges, like the unavailability of cesarean-delivered women in some facilities, may impact data consistency and representativeness. Therefore, caution is needed when generalising these results to other regions.

CONCLUSION

This study examines key factors influencing cesarean deliveries in India's five high-rate states/UTs. Significant variations in cesarean rates were observed based on place of delivery, obesity status, household income, and previous cesarean experience. Cesarean deliveries were more common in private health facilities, likely due to financial incentives, patient demand, and concerns about vaginal delivery pain. No association was found between maternal height and cesarean delivery, but obesity was confirmed as a significant risk factor. Socioeconomic disparities were noted, with private healthcare access influencing outcomes. A history of cesarean delivery strongly predicted repeat procedures. Findings highlight complex factors affecting cesarean rates in India and suggest targeted interventions to improve maternal and child health outcomes. Future research should explore these determinants in more diverse populations to develop strategies for optimising cesarean rates.

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