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Research Article

Increasing Trends of Caesarean Deliveries in India: Does the Private Sector Contribute to it?

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Abstract

Background: Caesarean deliveries are increasing worldwide at a faster rate. Although Caesarean deliveries can save the lives of mothers and babies, the caesarean section is often performed without medical need, putting women and their babies at-risk of short and long-term health problems. Why are caesarean section deliveries increasing? Does the private health sector have a role to play in it? This paper tries to answer all these questions by examining the patterns and determinants of caesarean deliveries and seeks to understand the reasons for opting for caesarean deliveries in India.

Methods: National Family Health Survey-4 (NFHS-4) data collected from 29 states and six Union Territories (UTs) of India in 2015-16 was used to achieve this. Binary logistic regression models were used to understand the determinants of caesarean delivery and emergency caesarean deliveries in India.

Results: Caesarean section deliveries in India were found to have increased rapidly by more than five-fold, from 3 percent in NFHS-1 (1992-93), to 17 percent in NFHS-4 (2015-16). Mother's age, mother's schooling, religion, wealth quintile, Body Mass Index (BMI), size of the child at birth, pregnancy complications and place of delivery were statistically associated with caesarean section deliveries in India.

Conclusion: Undeniably, a majority of the caesarean section deliveries were performed in the private sector and have increased over the past ten years. This indicates that the private health sector played a significant role in the increasing number of caesarean deliveries in India. Undoubtedly, caesarean sections were effective means of saving the lives of mothers and infants at a very critical stage but should be undertaken only on sound advice for medical reasons.

Keywords: *Caesarean Delivery; Emergency Caesarean Delivery; Private-Public Sector; NFHS; India*

Abbreviations

ANC: Antenatal Care; BMI: Body Mass Index; CEB: Census Enumeration Block; C-Section Delivery: Caesarean Section Delivery; JSY: Janani Suraksha Yojana; NFHS: National Family Health Survey; PSU: Primary Sampling Units

Introduction

The number of caesarean deliveries is increasing worldwide. Although caesarean sections (C-sections) can save the lives of mothers and babies, they are often performed without any medical need, thereby, placing women and their babies at risk of short and long-term health problems. A C-section may be necessary when vaginal delivery might be risky to the mother or the baby. C-section can cause significant complications, disability or death, particularly in settings that lack facilities to conduct safe surgeries or treat potential complications. The international healthcare community considered the "ideal rate" for C-section delivery to be between 10 percent and 15 percent in 1985 [1]. Since then, C-sections have become increasingly common in both developed and developing countries. WHO released a Statement on Caesarean Section rates and monitoring of caesarean section at health care facilities in April 2015. Based on the current WHO recommendation the optimal rate is unknown and that "every effort should be made to provide caesarean section to women in need, rather than striving to achieve a specific rate [2]. When medically justified, a C-section can efficiently prevent maternal and perinatal mortality and morbidity. As with any surgery, the short and long-term risks associated with C-section deliveries, can extend up to many years and affect the health of the woman, her child, and pregnancies in future. These risks are higher in women with limited access to comprehensive obstetric care [1].

In the United States of America, the proportion of caesarean births to total births increased from 21 percent in 1996 to 31 percent in 2006 [3]. Many of the developing countries (e.g. China, Nigeria, Bangladesh etc.) have witnessed a rapid increase in C-section births in the past two decades [4,5]. The number of C-sections was high and continued to rise in developed countries from 15 percent in 1990 to 27 percent in 2014. The less developed countries showed the largest absolute increase, 14.6 percentage points (from 6.3 percent in 1990 to 20.9 percent in 2014) [6]. The increasing trend of C-sections has also generated much controversy regarding the reasons for such a pattern. In many developing nations like China and India, the main reason for the increasing rate of C-sections has been attributed to the increase in institutional births [4]. In India, a scheme like the Janani Suraksha Yojana (JSY)[1] [7] may have a significant impact on the acceptance of institutional deliveries by poor women. That increasing institutional deliveries may be a reason for the increase in the number of C-sections, has generated much controversy in India. Among all factors the place of birth (private or public medical institution) emerged as the strongest factor influencing C-section deliveries [8]. The exact cause of the increasing rate of C-section births in many states in India, especially in the urban areas however, remains unknown. While the primary purpose of medical intervention has been to save the lives of the mother and child, there were other societal forces which played vital roles [9]. It is often argued that, besides medical factors, the physicians' interests determined the choice for C-section [10]. A study by Padmadas., *et al*. (2000) in Kerala also revealed that higher maternal age, 1st order births, current age of mother and births in private hospitals were significantly associated with caesarean section delivery [11]. Though determinants for such increasing trends of C-section deliveries in India were not precise, the possible causes for this phenomenon could be increased access to health care technologies, increased education of women and their decision-making powers and the preference for this method not only by doctors but also, sometimes, by patients [12].

As observed from literature C-section deliveries have increased in the past two decades, more in private health facilities than in public health ones. Hence, in order to understand its reality and the covariates associated with it, the present investigation was undertaken to study public versus private healthcare facilities, considering the quality of health care facility as an important deciding factor for choosing the type of place of delivery for Caesarian delivery in India. There are unanswered questions like, why are caesarean section deliveries in-

[1]Janani Suraksha Yojana (JSY) is a safe motherhood intervention under the National Rural Health Mission (NRHM), being implemented with the objective of reducing maternal and neo-natal mortality by promoting institutional delivery among the poor women through cash assistance, which was started in 2005.

creasing? Does the private health sector have a role to play in it? Is there a gap in the rates of C-section in public vs private facilities? What are the motives in decision making and how do they vary in public vs private facilities? This paper attempts to answer all these questions by examining the trends, patterns and determinants of caesarean deliveries and seeks to understand the reasons for opting for caesarean deliveries in India. The specific objectives were to know the levels and patterns of caesarean deliveries in India and its states to assess the covariates of caesarean and emergency caesarean deliveries in India and also to assess the role of place of delivery in the increasing trends of C-section delivery in India.

Data and Methods

Data for this study was based on all the four rounds of the National Family Health Survey (NFHS) conducted in India, i.e. NFHS-1 (1992-93), NFHS-2 (1998-99), NFHS-3 (2005-06) and NFHS-4 (2015-16) in order to examine the levels and trends of C-sections delivery. The analysis was carried out to evaluate the determinants and covariates of C-sections and emergency C-section deliveries in India using the NFHS-4 data.

For the first time, the National Family Health Survey-4 (NFHS-4) provided district-level estimates for many important indicators, which necessitated expanding the sample size by nearly six-fold as compared to NFHS-3. NFHS-4 data will be useful in setting a benchmark and examining the progress the country has made in the health sector over time. A two-stage stratified sampling design was adopted in rural and urban areas of each district in India so as to provide district-level estimates. NFHS is a nationally representative sample survey, and has data collected from every state/province of the country by trained male and female interviewers. The interviewers collected information from the selected household respondents and eligible females (age 15 - 49) and males (15 - 59) through Computer-Assisted Personal Interviews (CAPI) using a mini-laptop (face-to-face survey). Use of CAPI enabled data transfer to a nodal center, and also monitoring of the fieldwork on a daily basis.

In NFHS-4, a total of 601,509 households, 699,686 women and 112,122 men were interviewed from 28,583 primary sampling units (PSU) comprising villages in rural areas and census enumeration blocks (CEBs) in urban areas, spread across 640 districts of India [13]. The sample size in the present study was 249,949 live births to women in the age group 15 - 49 years who had undergone a C-section in five years preceding the survey. Information on the woman's characteristics, marriage, fertility, children's immunizations and childcare, nutrition, contraception, reproductive health, sexual behaviour and other health issues were also collected in NFHS-4. However, for the present study only maternal variables like Caesarean delivery (C-section) and emergency C-section delivery along with other socio-economic and demographic variables were considered. Details of the variables used in the study are given below. Bivariate and multivariate techniques were applied to analyze the data using IBM SPSS Statistics version 20 and STATA 15.1. Chi square test was also used to assess the association between dependent and independent variables.

Dependent variable: Caesarean delivery (C-section) and emergency C-section delivery were the dependent variables used in this study.

The woman was asked when the decision was taken to conduct a C-section delivery. The options were 'before the onset of labour pain' and 'after the onset of labour pain'. From this information, one could estimate the number of intentional and emergency C-section deliveries in India.

Independent variables: Mainly, three types of variables/factors were used in the analysis, i.e. socio-economic variables, risk factors, and institutional factors.

Socio-economic variables: Mother's place of residence, schooling, caste/tribe, religion, and wealth quintile.

Risk factors: Performing a C-section delivery depended on different medical emergencies such as, advanced maternal age, obesity of mother, mothers' height, breech presentation of the foetus, foetal distress, and failure to progress during labour. These factors were considered risk factors, wherein the doctor could advise the mothers to opt for caesarean delivery. From the risk factors documented in the

recent National Family Health Survey, mother's age during delivery, size of child at birth, ANC visits, whether ultrasound was conducted, BMI (body mass index) and complications during pregnancy were taken into consideration as risk factors for the present analysis.

Institutional factor: Type of place of delivery (Public/Private).

Terms used in the paper

Scheduled Castes (SC) and Scheduled Tribes (ST) are the constitutional categories of people belonging to formerly 'untouchable' castes and tribes in India. They have been historically denied rights to equal opportunity in accessing education, basic amenities and employment. The constitution has provided them reservation in employment, education and legislation.

Other Backward Classes (OBC) is a collective term used by the Government of India to classify certain castes which are educationally or socially disadvantaged.

Size of child at birth: The NFHS collected information about the size of the baby by asking the mother for her estimate of her infant's size at birth (i.e. very small, small, average or larger).

Blinder-Oaxaca decomposition

Oaxaca (1973) developed a regression-based decomposition method to measure the inequality among groups. The Oaxaca decomposition partitions the variation in an outcome into two parts. The Blinder-Oaxaca decomposition technique is a useful method to explain the inter group differentials in outcome variable using a set of predictors. Originally, this technique was used to decompose the labour market outcomes between different groups such as sex and race. However, the same method could also be used to study inter-group differences in any outcome variable and also the differences between two time periods [14,15].

The Government (Public) and Private Hospital differences in caesarean delivery across various characteristics, which affects the caesarean section delivery between two time periods, are presented separately.

The conventional Blinder-Oaxaca decomposition is based on two linear regression models that are fitted separately for the groups 1 and 2: (1=Period NFHS 4, 2=Period NFHS 3)

and

$Y_k = X_k \beta_k + e_k$……..(1)

$Y_k = X_k \beta_k + e_k$……..(2)

Logistic regression model is also employed for testing the statistical significance of selected variables on the dependent variables, women who had emergency caesarean deliveries the dependent variable was dichotomous, coded as 1 for ('emergency C-section') the timing of the decision for C-section taken after the onset of labour pain and 0 for ('otherwise') deliveries where decision was made before the onset of labour pain.

The basic form of the logistic function is:

$$P = \frac{1}{P + e^{-z}}$$

Where, Z is the predictor variable and e is the base of the natural logarithm, equal to 2.71828…. P is an estimated probability.

The parameters in the logit models were estimated using the maximum likelihood method. Further, the problems of multi-collinearity associated with independent variables were taken into consideration before introducing them into the regression equations [16].

Results and Findings

Levels and trends of C-section deliveries in India

A substantial increase in the number of C-section deliveries in India was observed; more than five-folds increase from 3 percent in NFHS-1 (1992-93) to 17 percent in NFHS-4 (2015-16) (Figure 1). The difference between NFHS-1 and NFHS-4 was 14 percentage points and the increase in C-section deliveries during the past decade was 9 percentage points at the national level. Among different states substantial variations in C-section deliveries were noticed, ranging from 6 percent in Bihar to 40 percent in Andhra Pradesh. About half of the states were above the national average in C-section deliveries, crossing 20 percent as against the national average of 17 percent in India. States like Jammu and Kashmir (19 percent), Andhra Pradesh (13 percent), Delhi (12 percent), Tamil Nadu (11 percent), Punjab (10 percent), and Gujarat (10 percent) showed a drastic increase in C-section deliveries in the past decade. Overall, the percentage of all births by C-section increased substantially in NFHS-4 in all the states as compared to NFHS-3 (Table 1 and figure 2).

Table 1: *Levels and trends of C-section deliveries in India and its states from NFHS-1 to NFHS-4, 1992-93 to 2015-16.*

States	NFHS-1 (1992-93)	NFHS-2 (1998-99)	NFHS-3 (2005-06)	NFHS -4 (2015-16)	Diff. NFHS-4 to NFHS-3	Diff. NFHS-4 to NFHS-1
Andhra Pradesh	4.4	14.7	27.5	40.1	12.6	35.7
Assam	2.3	5.0.	6.5	13.4	6.9	11.1
Bihar	1.1	3.0	4.1	6.2	2.1	5.1
Delhi	4.6	13.4	12.0	23.7	11.7	19.1
Goa	13.7	20.0	25.5	31.4	5.9	17.7
Gujarat	2.7	8.6	8.8	18.4	9.6	15.7
Haryana	2.3	4.2	5.0	11.7	6.7	9.4
Himachal Pradesh	1.6	6.8	13.1	16.7	3.6	15.1
J & K	5.7	10.6	14.1	33.1	19.0	27.4
Karnataka	3.7	11.0	15.3	23.6	8.3	19.9
Kerala	13.2	29.8	30.1	35.8	5.7	22.6
Madhya Pradesh	0.7	3.0	6.8	8.6	1.8	7.9
Maha-rashtra	3.4	9.9	15.6	20.1	4.5	16.7
Odisha	1.5	5.2	6.1	13.8	7.7	12.3
Punjab	4.2	8.3	14.4	24.6	10.2	20.4
Rajasthan	0.7	3.0	4.2	8.6	4.4	7.9
Tamil Nadu	7.1	17.5	23.0	34.1	11.1	27.0
Uttar Pradesh	0.6	2.7	5.9	9.4	3.5	8.8
West Bengal	3.3	13.5	15.0	23.8	8.8	20.5
India	2.9	7.1	8.5	17.2	8.7	14.3

** Percentages given for major states only.*

Note*: Author has calculated the state variation of C-section delivery from each round of NFHS separately.*

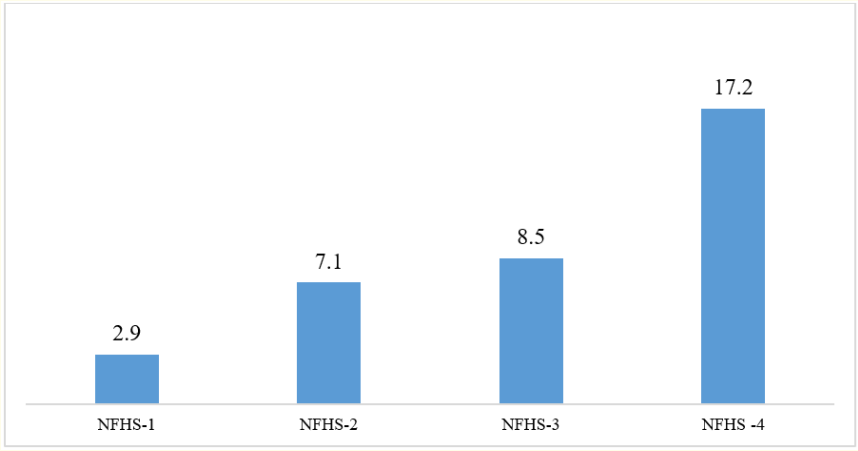


Figure 1: *Caesarean delivery in India from NFHS-1 to NFHS-4.*

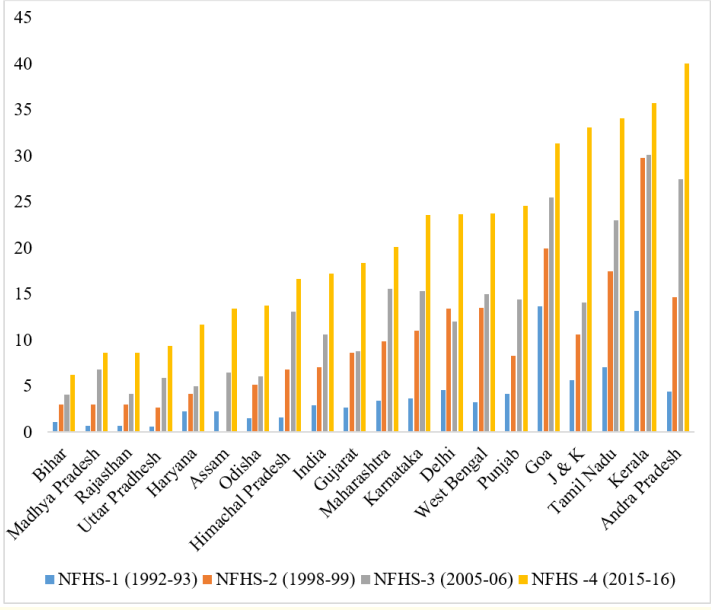


Figure 2: *Trends and levels of C-section deliveries in India and its states.*

Prevalence of C-section deliveries by types of health facilities

Information was gathered to understand the institutional effect on C-section deliveries, in different types of health facilities and the same is presented in table 2. The result reveals that overall 17 percent of births were caesarean deliveries in India. There was a great variation by types of health facilities (public vs private) regarding C-section deliveries. More than two-fifths (41 percent) C-section deliveries

were conducted in private health facilities as against only 12 percent in public health facilities (Figure 3). As high as 58 percent women in Telangana delivered by C-section, followed by Andhra Pradesh (40 percent), Kerala (36 percent) and Tamil Nadu (34 percent) (Map 1). In contrast, delivery by C-section was the lowest (< 10 percent) in Bihar (6 percent), Meghalaya (8 percent) and Madhya Pradesh (9 percent).

Table 2: *Percentage of births delivered in public and private health facilities through C-section delivery by state and UTs, NFHS-3 (2005-06) and NFHS-4 (2015-16).*

State and UTs	NFHS-4				NFHS-3				Difference In Public facilities from NFHS-3 to NFHS-4	Difference In Private facilities from NFHS-3 to NFHS-4
	C Section	Public	Private	Total Births	C section	Public	Private	Total Births		
Andaman and Nicobar Islands	19.3	(16.9)	*	50	NA	NA	NA	NA	NA	NA
Andhra Pradesh	40.1	25.5	57.4	8948	22.2	24.0	40.8	463	1.5	16.6
Arunachal Pradesh	8.9	12.5	*	213	3.0	19.5	10.7	249	-7.0	NA
Assam	13.4	12.9	54.2	6193	5.3	13.0	9.5	1115	0.0	44.7
Bihar	6.2	2.6	31.0	31394	3.1	3.5	16.9	418	-0.9	14.2
Chandigarh	22.6	19.5	(44.0)	147	NA	NA	NA	NA	NA	NA
Chhattisgarh	9.9	5.7	47.9	6142	4.1	6.9	7.4	1031	-1.2	40.5
Dadra and Nagar Havel	16.2	(12.0)	*	70	NA	NA	NA	NA	NA	NA
Daman and Diu	15.8	*	*	28	NA	NA	NA	NA	NA	NA
Goa	31.4	19.9	51.3	211	25.8	43.2	49.3	11719	-23.3	2.0
Gujarat	18.4	10.8	26.6	10709	8.9	13.9	39.0	3516	-3.2	-12.4
Haryana	11.7	8.6	25.2	5687	5.3	13.9	21.8	25	-5.3	3.4
Himachal Pradesh	16.7	16.4	44.7	1114	12.6	37.0	6.4	6256	-20.6	38.3
Jammu and Kashmir	33.1	35.1	75.5	2203	13.5	41.1	9.4	96	-6.0	66.1
Jharkhand	9.9	4.6	39.9	7445	3.9	3.4	15.6	66	1.3	24.3
Karnataka	23.6	16.9	40.3	10336	15.5	34.8	30.4	118	-17.9	10.0
Kerala	35.8	31.4	38.6	4285	30.1	35.6	63.8	51	-4.2	-25.2
Lakshadweep	38.4	*	*	12	NA	NA	NA	NA	NA	NA
Madhya Pradesh	8.6	5.8	41.5	17040	3.5	18.4	8.1	4150	-12.6	33.4
Maharashtra	20.1	13.1	32.8	20794	11.6	26.5	38.4	182	-13.4	-5.6
Manipur	21.1	22.6	46.3	486	9.0	36.1	9.8	1440	-13.5	36.5
Meghalaya	7.6	9.8	31.3	752	4.1	19.7	9.4	161	-9.9	21.9
Mizoram	12.7	12.3	*	212	6.2	51.6	8.3	1877	-39.3	NA

Nagaland	5.8	13.4	(31.5)	336	2.0	7.3	4.4	1955	6.1	27.1
Delhi	26.7	26.5	41.5	3005	13.8	30.2	28.8	521	-3.6	12.7
Odisha	13.8	11.5	53.7	8180	5.1	28.8	7.4	1195	-17.3	46.3
Puducherry	33.6	30.4	(47.5)	208	NA	NA	NA	NA	NA	NA
Punjab	24.6	17.8	39.6	4106	16.6	12.3	39.1	3845	5.5	0.5
Rajasthan	8.6	6.1	23.1	14640	3.8	19.0	10.7	2606	-13.0	12.5
Sikkim	20.9	18.1	*	60	12.3	44.5	3.1	4404	-26.4	NA
Tamil Nadu	34.1	26.3	51.4	14065	20.3	48.1	39.9	3142	-21.8	11.5
Tripura	20.5	18.1	74.0	583	12.9	43.0	4.3	2693	-24.9	69.6
Uttar Pradesh	9.4	4.7	31.3	44573	4.4	6.6	14.2	1019	-1.9	17.2
Uttarakhand	13.1	9.3	35.5	2007	8.1	15.7	17.5	55	-6.4	18.0
West Bengal	23.8	18.8	70.7	16572	10.2	31.8	10.6	2067	-13.0	60.2
Telangana	57.7	40.3	74.5	7146	NA	NA	NA	NA	NA	NA
Total	17.2	11.9	41.0	249949	8.5	15.2	27.9	56438	-6.1	20.1

Note: *NA: Not available, ( ) Based on 25-49 cases, *: Percentage not shown; based on less than 25 cases.*

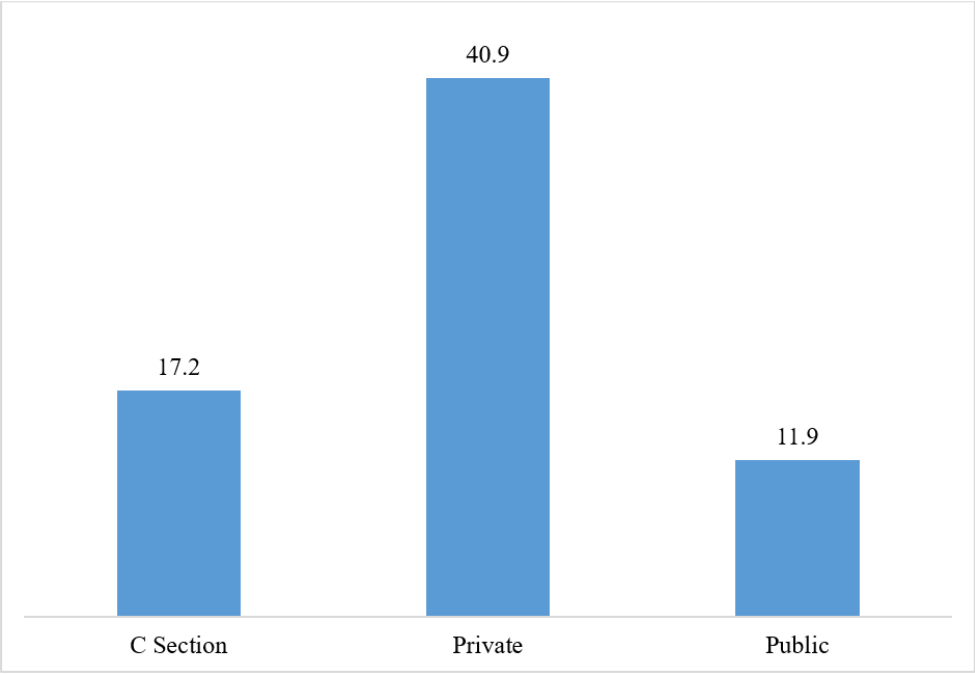
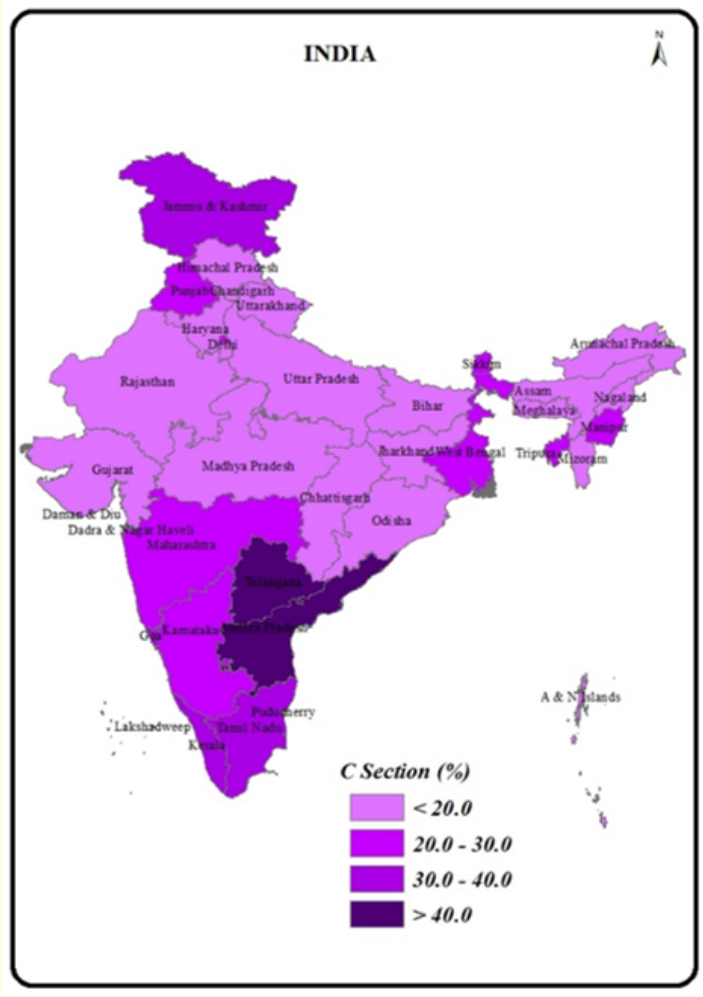
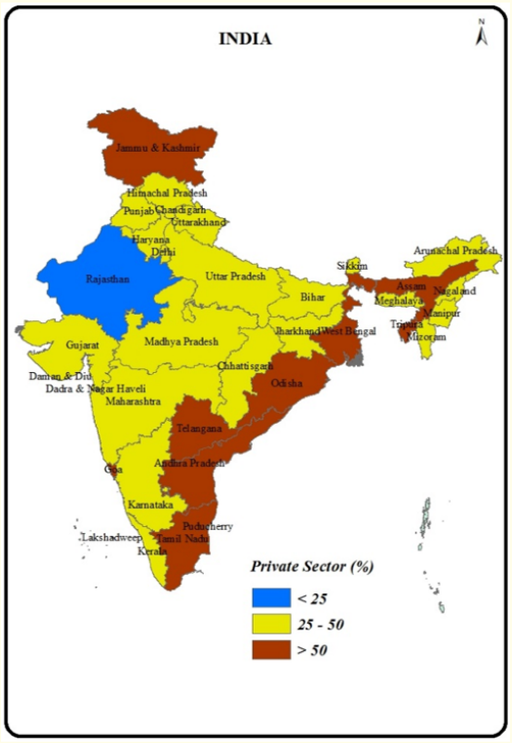


Figure 3: *Prevalence of C-section deliveries by health facility in India.*



Map 1: *C-section delivery in India and its State, 2015-16.*

C-section deliveries were more common in private health facilities, varying from 25 percent in Haryana to 75 percent in Telangana (Map 2). The percentage of C-section births conducted in private facilities was also quite high in Tripura (74 percent) and West Bengal (71 percent). Furthermore, the rate of C-section births in private health facilities was higher in urban areas than in rural areas in all States/ Union Territories (UTs) except Tamil Nadu, Telangana and Sikkim. Overall, according to NHFS-4, the percentage of all births in private facilities conducted by C-section, increased substantially in all the states/UTs, except in Kerala and Gujarat as compared to NFHS-3. At the national level the percentage of all births in private facilities conducted by C-section increased by 20 percent in the past one decade from NFHS-3 (2005-06) to NFHS-4 (2015-16). Similarly, at the state level also a huge variation was observed, ranging from 70 percent increase in C-section deliveries in Tripura to just 2.0 percent increase in Punjab from NFHS-3 to NFHS-4 (Table 2).



Map 2: *C-section delivery by private health facility in India and Its States, 2015-16.*

The decision for caesarean section delivery

Table 3 shows the proportion of births delivered by C-section and the time when the decision was made to conduct a C-section based on background characteristics. For emergency C-sections, the need to conduct C-sections were decided after the onset of labour pains. Eight percent of the decisions to go for C-section births were taken after the onset of labour pain, while the decision for nine percent of the C-section births were taken before the onset of labour pain.

Table 3: *Percentage of births delivered by caesarean section and the time of the decision to conduct a C-section by background characteristics in India, 2015-16.*

Background characteristic	Percentage delivered by C-section	Timing of decision to conduct a C-section		
		Before onset of labour pains	After onset of labour pains	Number of births
Mother's age at birth* **				
Less than 20	15.3	7.8	7.3	33929
20-30	17.5	9.7	7.8	181707
More than 30	17.3	10.0	7.2	34313
Residence* **				
Urban	28.2	16.0	12.1	70144
Rural	12.9	6.9	5.9	179805
Mother's schooling* **				
No schooling	6.0	2.9	3.0	75513
<5 years complete	10.6	5.7	4.7	15076
5-7 years complete	14.7	8.1	6.5	40769
8-9 years complete	17.4	9.6	7.7	41188

10-11 years complete	25.7	14.4	11.1	29883
12 or more years complete	33.7	18.9	14.6	47520
Caste/tribe* **				
Scheduled Caste	14.5	8.1	6.3	53789
Scheduled tribe	8.3	4.3	3.9	26318
Other backward class	17.2	9.4	7.8	110318
Other	23.8	13.3	10.3	48393
Religion* **				
Hindu	17.3	9.6	7.6	196622
Muslim	15.1	8.2	6.8	41372
Others	22.3	12.1	10.1	11955
Wealth index* **				
Lowest	4.4	1.9	2.5	63359
Second	9.7	4.9	4.8	54927
Middle	19.0	10.6	8.3	49582
Fourth	26.8	15.1	11.5	45320
Highest	35.9	20.7	15.0	36760
Place of delivery* **				
Public sector health facility	11.9	6.5	5.3	130156
NGO or trust hospital/clinic	35.8	20.6	15.0	1295
Private sector health facility	41.0	22.6	18.2	65741
Size of a child at birth* **				
Smaller than average	15.3	8.3	6.9	30257
Average	16.4	9.0	7.4	167602
Large than average	22.1	12.6	9.4	47890
Mother's height				
Less than 145 cm	16.1	8.6	7.5	22665
More than 145 cm	17.2	9.5	7.6	225560
BMI* **				
Below normal (BMI <18.5 kg/m^2)	9.9	5.0	4.8	61340
Normal (BMI 18.5-24.9 kg/m^2)	15.3	8.2	6.9	147961
Overweight or obese (BMI ≥ 25.0 kg/m^2)	35.8	20.9	14.8	36104
ANC visits* **				
No ANC	6.4	3.5	2.7	30449
1-2 visits	10.4	5.5	4.9	33303
3-4 visits	16.1	8.3	7.7	43842
5 + visits	30.1	17.1	12.9	75496
Ever terminated pregnancy* **				
No	16.6	9.2	7.4	211844
Yes	20.2	11.2	9.0	38104
Ultrasound sonography* **				
No	14.8	50.9	48.7	16324
Yes	32.0	57.9	41.2	8726
Pregnancy complication* **				
No®	16.4	9.7	6.5	57412
Yes	19.5	10.5	8.9	121803
Total (No.)	17.2	9.4	7.6	249949

*Chi square *** p < 0.01, **p < 0.05, *p < 0.10.*

The mother's age was important at the time of giving birth and a deciding factor for C-section delivery. Results show that women aged 30 years or more at the time of giving birth were more likely to deliver babies through C-section, compared to mothers aged less than 20 years. In India, 17 percent of the mothers aged 30 years and above delivered babies through C-section. There was a similar proportion (17 percent) of mothers in the age group 20 - 30 years who also delivered through C–section. However, in these cases the decision of getting a C-section was taken before the onset of labour pain. More women in urban areas as compared with those in rural areas delivered through C-section. In both the areas, the decision to undergo C-section was taken before the onset of labour pain rather than after the start of labour pain. As far as mother's education was concerned, only six percent of the illiterate women delivered by C-section as compared to mothers who had had 12 or more years of education, i.e. more than one-third (34 percent). Thus, as the level of education of the mother increased the number of C-section deliveries also increased. Among the educated, a higher proportion of mothers with 12 or more years of schooling delivered through C-section and made the decision before the onset of labour pain (19 percent) rather than after the start of labour pain (15 percent) this association was also found to be statistically significant.

A higher proportion of mothers who belong to other than SC/ST or Other Backword Classes (OBC) were found to have delivered by C-section. More than one-third (36 percent) of the mothers belonging to the richest wealth quintile delivered by C-section compared to mothers belonging to the poorest wealth quintile (4 percent). There was a significant difference between the richest and poorest mothers who delivered their babies through C-section and found to be statistically significant. In India, place of birth was one of the deciding factors to opt for C-section or normal delivery. About 41 percent of the C-section births occurred at private facilities as against just 12 percent at public facilities. Among C-sections in public facilities, seven percent were decided before the onset of labour pain whereas, five percent agreed to C-section after the beginning of labour pain. On the other hand, of the C-sections performed at private facilities, 23 percent were decided before the onset of labour pain as against 18 percent after the start of labour pain.

Size of the baby at the time of birth was a crucial factor in deciding whether to opt for a C-section or normal delivery. In India, 22 percent of the mothers with babies larger than average size delivered by C-section, whereas, about one-third (32 percent) of the mothers with babies of average or smaller than average size did the same. The decision to deliver their babies through C-section were mostly made before the onset of labour pain.

Mother's height was also included in the analysis to determine whether it had any effect on C-section and emergency C-section delivery. Literature suggested that mothers of short stature might have had difficulty in normal delivery and hence mostly delivered through C-section. However, in reality, C-section deliveries occurred irrespective of the mothers' height. Mothers who were taller than 145 cm were slightly more likely (17 percent) to deliver their babies through C-section without a medical emergency as the decision was taken before the onset of labour pain, compared to the mothers with height less than 145 cm (16 percent).

Overweight or obese mothers with a BMI ≥ 25.0 kg/m^2 were more likely to face complications during pregnancy than mothers with normal and below normal BMI. More than one-third of the mothers (36 percent) were overweight or obese and delivered by C-section, compared to mothers with normal, and below normal BMI (10 and 15 percent, respectively). Mothers who went for more ANC visits, i.e. five or more ANC visits, were (30 percent) more likely to have a C-section delivery than the mothers with no ANC visits (6 percent) or 1 - 2 ANC visits (10 percent).

Mothers who had prior complications during pregnancy (20 percent) and had had ultrasounds (32 percent) were more likely to have C-section deliveries than mothers with no complications and no ultrasound/sonography (16 and 15 percent respectively). The decision to have a C-section was taken before the onset of labour pain in almost all these cases irrespective of whether the mother had risk factors or not. However, this was not necessarily an emergency C-section.

Decomposition analysis

Private health facility

Table 4A presents the result of Blinder-Oaxaca decomposition analysis of C-section delivery between NFHS-3 and NFHS-4. Results show the contribution of explained factor increasing the caesarean section deliveries in private health facility during period 2005-06 to 2015-16. The average of natural log of caesarean section delivery was 0.40 for NFHS-4 and 0.32 for NFHS-3, thus the NFHS-4 and NFHS-3 gap of 0.074 meant that the C-section delivery in private hospitals increased by seven percent during 2005-06 to 2015-16. The result also indicated that for caesarean section delivery, only 6.90 percent of the total caesarean section delivery gap could be explained with the help of the other characteristics included in the analysis, while the rest remained unexplained. Out of the total explained differences, about 7.11 percent of the difference in caesarean delivery was attributed to the mother's body mass index. In particular, age of the mother contributed 1.79 percent, religion contributed 1.17 percent and most importantly a complication during pregnancy contributed 5.51 percent to the difference in caesarean section delivery in private health facility during period 2005-06 to 2015-16.

Table 4A: *Decomposition of the caesarean delivery in Private Health Facility between NFHS-3 and NFHS-4.*

Contributing Factors	Coef.	Level of Significant	95% CI	% Contribution
Cesarean Delivery				
Differential				
Prediction_NFHS_4	0.402		(0.397, 0.406)	
Prediction_NFHS_3	0.328		(0.316, 0.341)	
Difference (NFHS_4 – NFHS_3)	0.074	*	(-0.060, -0.087)	
Explained				
Age of Mother	0.001	***	(-0.000, -0.002)	1.79
Place of Residence	0.000	***	(-0.996, -0.005)	-0.02
Education	0.000	***	(-0.001, -0.001	0.37
Religion	0.001	***	(0.000, 0.002)	1.17
Wealth	-0.007	***	(-0.015, -0.002)	-8.90
Pregnancy complication	0.004	***	(0.001, 0.009)	5.51
Birth size	0.000	***	(-0.001, -0.000)	-0.12
Body Mass Index	0.005	***	(-0.003, -0.007)	7.11
Total	0.005	***	(-0.005, -0.015)	6.90
Unexplained				
Total	0.064			86.38

****P < 0.01, **P < 0.05, *P < 0.10.*

Public health facility

Table 4B presents the result of Blinder-Oaxaca decomposition; it shows the contribution of the explained factor in caesarean section deliveries in public health facility during period 2005-06 to 2015-16. The average of natural log of caesarean section delivery was 0.11 for NFHS-4 and 0.20 for NFHS-3, thus NFHS-4 and NFHS-3 gap of -0.080, indicated that C-section deliveries in public hospitals decreased

by eight percent during 2005-06 to 2015-16. The results indicate that for caesarean section delivery, only 10.92 percent of the total caesarean section delivery gap could be explained with the help of the characteristics included in the analysis while the rest remained unexplained. Out of the total explained differences, about 4.65 percent of the difference in caesarean delivery was attributed to the education of the mother. In particular, household wealth contributed 25.08 percent to the difference in caesarean section delivery in public health facility during the period 2005-06 to 2015-16.

Table 4B: *Decomposition of the caesarean delivery in Public Health Facility between NFHS-3 and NFHS-4.*

Contributing Factors	Coef.	Level of Significant	95% CI	% Contribution
Cesarean Delivery				
Differential				
Prediction_NFHS_4	0.119		(0.117, 0.121)	
Prediction_NFHS_3	0.200		(0.189, 0.210)	
Difference (NFHS_4 - NFHS_3)	-0.080	*	(-0.091, -0.070)	
Explained				
Age of Mother	0.001	***	(-0.000, -0.001)	-0.80
Place of Residence	0.002	***	(-0.005, -0.009)	-2.71
Education	-0.004	***	(-0.006, -0.002	4.65
Religion	0.002	***	(0.001, 0.003)	-2.21
Wealth	-0.020	**	(-0.031, -0.009)	25.08
Pregnancy complication	0.008	***	(0.003, 0.012)	-9.56
Birth size	0.000	***	(-0.001, -0.001)	-0.20
Body Mass Index	0.003	***	(-0.001, -0.001)	-3.33
Total	-0.009	***	(-0.002, -0.004)	10.92
Unexplained				
Total	-0.050			61.70

****P < 0.01, **P < 0.05, *P < 0.10.*

Emergency caesarean delivery in India

Data on emergency caesarean delivery was collected for the first time in NFHS-4 in India. This data gave an idea of how many caesarean deliveries were emergency deliveries out of the total number of caesarean deliveries (Table 5). Mothers' age at the time of delivery, wealth quintile, BMI of mother and pregnancy complications were significantly associated with emergency caesarean delivery in India. Muslim mothers in rural areas and women belonging to Scheduled Tribes were more likely to deliver through emergency C-section. Simi-

larly, mothers belonging to a higher wealth quintile, more than 30 years of age at the time of delivery, and with a higher BMI were less likely to deliver through emergency C-section as their decision were taken before the onset of labour pain as against younger mothers and mothers with lower BMI. Mothers with complications during pregnancy were more likely to deliver through emergency C-section. Results indicate that the place of delivery had no effect on emergency caesarean deliveries in India.

Table 5: *Logistic regression showing the effect of predicted variables on emergency C-section delivery.*

Background characteristic		Model - I	Model – II
Mother's age at birth			
	Less than 20	1.00	1.00
	20-30	0.93 (0.80, 1.08)	0.93 (0.77, 1.11)
	More than 30	0.78** (0.65, 0.94)	0.87 (0.70, 1.09)
Residence			
	Urban	1.00	1.00
	Rural	1.02 (0.92, 1.13)	1.09 (0.97, 1.23)
Mother's schooling			
	No schooling	1.00	1.00
	<5 years complete	0.83 (0.62, 1.12)	0.77 (0.55, 1.08)
	5-9 years complete	0.89 (0.75, 1.06)	0.84 (0.69, 1.02)
	10 or more years complete	0.87 (0.73, 1.04)	0.86 (0.70, 1.05)
Caste/tribe			
	Scheduled caste	1.00	1.00
	Scheduled tribe	0.93 (0.74, 1.18)	0.91 (0.70, 1.18)
	Other backward class	1.13 (0.99, 1.29)	1.04 (0.90, 1.20)
	Other	0.86* (0.74, 1.00)	0.83** (0.70, 0.98)
Religion			
	Hindu	1.00	1.00
	Muslim	1.16* (1.00, 1.34)	1.20** (1.01, 1.42)
	Others	1.08 (0.89, 1.31)	0.89 (0.72, 1.11)
Wealth index			
	Lowest	1.00	1.00
	Second	0.85 (0.67, 1.08)	0.79 (0.60, 1.04)
	Middle	0.72*** (0.57, 0.90)	0.71*** (0.55, 0.93)
	Fourth	0.74*** (0.59, 0.93)	0.79 (0.61, 1.04)
	Highest	0.72*** (0.56, 0.92)	0.76 (0.57, 1.01)
Place of delivery			
	Public sector health facility	1.00	1.00
	Private sector health facility	1.06 (0.96, 1.17)	1.07 (0.96, 1.20)
Size of child at birth			
	Smaller than average		1.00
	Average		1.08 (0.91, 1.29)

	Large than average		1.09 (0.90, 1.32)
BMI			
	Below normal (BMI <18.5 kg/m^2)		1.00
	Normal (BMI 18.5-24.9 kg/m^2)		0.84 (0.72, 0.99)
	Overweight or obese (BMI ≥ 25.0 kg/m^2)		0.77*** (0.65, 0.92)
Pregnancy complication			
	No		1.00
	Yes		1.22*** (1.09, 1.36)

Note: *Values in the parenthesis are 95% C.I., AND ***P < 0.01, **P < 0.05, **P < 0.10.*

Discussion

The NFHS-4 results show that C-section deliveries have increased rapidly in India. There was more than a five-fold increase, from three percent in NFHS-1 (1992-93) to 17 percent in NFHS-4 (2015-16). Of the17 percent C-section deliveries in India, only eight percent of the births were emergency C-section deliveries. The remaining nine percent of C-section deliveries were not emergency cases as the decision for the C-section were taken before the onset of labour. This may be attributed to various reasons/preferences, which could be medical or non-medical. There were substantial variations among states in C-section deliveries, ranging from 6 percent in Bihar to 58 percent in Telangana. C-section deliveries were more common in private health facilities, varying from 25 percent in Haryana to 75 percent in Telangana. Increased C-section in many states gave an idea about the motives behind them. It is possible that this extremely useful surgical procedure was being misused for the purpose of profit in the private sector in several states in India [10].

Overall, according to the data in NHFS-4, the percentage of all births in private facilities conducted by C-section increased substantially in all the States/UTs except in Kerala and Gujarat as compared to NFHS-3. Guilmoto and Dumont, in their recent paper, argued that the caesarean rate in India in 2016 was 17 percent, slightly above the 15 percent limit proposed by the WHO. However, these figures did not correspond to a mere 2 percent excess above the 15 percent threshold. While, one-fifth of the deliveries still took place at home, 27 percent of the deliveries occurred in private hospitals where the caesarean rate increased to 40 percent, well above the WHO threshold [17].

Various demographic and socio-economic factors along with medical risk factors played a vital role in increasing C-section deliveries in India. Mothers' age played a vital role in the performance of C-sections. Due to increasing age at marriage these days, women get pregnant at a higher age, therefore, their chances of undergoing caesarean deliveries were high [18]. To avoid such complications during delivery, doctors, at the initial stage of pregnancy itself, may have advised relatively older mothers to go for C-section delivery. Many studies suggest that women were more prone to complications due to child birth as their ages during delivery increased [18,19]. Similarly, Remez (1991) concluded that although women aged 35 years or more generally had higher rates of complications and caesarean section, older, primiparous women who had no complications were significantly more likely to undergo a caesarean section despite "no apparent indication" for the intervention. The study also pointed out that the extent to which complications were under reported was probably the same in both younger as well as older (35 years or older) age-groups. However, the higher caesarean delivery rates among older women could stem, in part, from their tendency to select physicians and facilities that might be more likely to perform caesareans [20]. Some of the younger mothers also had C–section deliveries though there was no medical emergency as the decision to do so had been taken before the onset of labour. This raised many unanswered questions: was it the mother's choice; was it the doctor's preference or were there some other reasons. More women in urban areas had C-section deliveries and the decision for C-section was taken before the onset of labour pain. This indicated that there were factors other than medical risk factors that played a vital role in influencing the mother's decision to

choose normal or C-section delivery in India. A study by Mishra & Ramanathan (2002) also highlighted that the high rate in urban areas probably indicated a growing privatisation of healthcare there and financial benefits behind this surgical procedure in private healthcare facilities [10].

C-section deliveries were also found associated with education and wealth. Educated mothers and mothers belonging to the highest wealth quintile were more likely to deliver their babies through C-section. Two-fifths of the C-section births took place in private facilities and the decision to do so, in the majority of cases, had been made before the onset of labour pain. This indicated that private health providers were influencing the mother's decision to deliver through C-section rather than waiting to have a normal delivery. Potter *et al.,* (2001) also highlighted similar findings in their study showing rates of C–section in public and private hospitals, suggesting that non-medical factors, such as economic gain and pressures of private practice, might be motivating doctors to perform surgical deliveries rather than waiting for a normal delivery [21]. Similarly, a very high incidence of C-section delivery among affluent groups and in private hospitals point to factors beyond purely economic motive in India [9]. Affluence could also be one of the factors behind the increase in C-section deliveries in India apart from deliveries in private hospitals.

The size of the baby at the time of birth was another important factor in deciding whether to opt for a C-section delivery or normal delivery. If the size of the baby at the time of birth was larger than average, the doctors were more likely to suggest a C-section delivery to avoid any complications. However, about one-third of the mothers with average sized or even smaller than average sized babies had had deliveries through C-section, the decision for which was taken before the onset of labour pain. Mothers' height, Body Mass Index (BMI) and pregnancy complications were also associated with the doctors' decision to opt for a C-section or normal delivery based on the situation at that time. To mothers with shorter height and those with higher BMI, doctors suggest to opt for a C-section delivery so as to avoid any complications. The effect of short stature on obstetric performance was highlighted by Baird and others. A study in Aberdeen showed an unfavourable influence on obstetric outcome in relation to short maternal stature, with a higher incidence of perinatal mortality, pelvic abnormality, difficult labour, caesarean sections, premature labour, low birth-weight, and birth trauma [22-24]. Camilleri (1981) in his study confirmed that the shorter woman continues to carry a higher risk of low birth-weight, caesarean section, low Apgar score, and a bad obstetric history [25].

Mothers with pregnancy complications were more likely to deliver through emergency C-section, often on doctor's recommendation to save the mother as well as her unborn baby. However, no significant difference was observed between public and private health care facilities in terms of emergency C-section delivery. The place of delivery had no effect on emergency caesarean delivery in India.

Further, to understand the factors affecting decision making; a qualitative study involving women who opted for C section including varying economic status, desired family size and education, health care providers would be a good idea.

Limitations of the Study

The present study was based on the last or the most recent births and therefore the information on C-section for all births could not be considered for this study. Certain information on risk factors like breech presentation of the foetus, foetal distress, and failure to progress during labour, was not collected in NFHS-4, and hence, could not be used while considering the risk factors for emergency caesarean delivery in the present study. In this study the emergency C-section deliveries are considered as those in which the decision of caesarean delivery was taken after the onset of labour. There can be many emergency indications for which a decision of C-section may be taken before onset of labour. However, as there was no such data available in NFHS-4, there was the possibility of slightly underestimating emergency C-section deliveries. Moreover, the information on actual birth weight was not collected from all mothers for each child delivered in NFHS-4. Only information related to the perception about size of the baby at birth by the mother (i.e. very small, small, average or larger) was collected, and not many women had health cards on which weights of infants were recorded.

Conclusion

Clearly, C-section deliveries have increased rapidly in India. The results indicated that mothers' height, BMI and pregnancy complications were found associated with the decision to opt for a C-section delivery. Other factors such as mother's age, mother's schooling, wealth quintile, size of the child at birth, and place of delivery were statistically associated with C-section deliveries in India. Among all other factors, the place of birth (private vs. public health care facility) emerged as the strongest factor that influenced C-section deliveries in India. Undoubtedly, caesarean sections were effective means of saving the lives of mothers and infants at a very critical stage but should be undertaken only on sound advice for medical reasons.

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