

Assessing Socio-Demographic Factors of Cesarean Delivery in India: Insights From National Family Health Survey-4

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Abstract

Background: The rate of cesarean delivery has considerably increased in the world during the last few decades. This paper aims to investigate the prevalence and socio-demographic correlates of cesarean delivery in India with a focus on Bihar and Tamil Nadu, accounting for the lower and higher proportion of cesarean birth.

Methods: The study is based on secondary data, collected from the latest National Family Health Survey in 2015-16 (NFHS-4). The present study is based on 190,898 most recent births during the five years preceding the survey. Bivariate and multivariate analyses were carried out to identify the factors associated with cesarean delivery.

Results: The highest rate of cesarean delivery was observed in Telengana (60%) and followed by Andhra Pradesh (42%), Tamil Nadu (36%). C-section found to be negligible in low-income states, namely Bihar (7%), Madhya Pradesh (10%) and Jharkhand (11%). Multivariate analysis revealed that the prevalence of cesarean delivery was substantially higher among women who married at higher age, with first birth-order, women in the 'obese' category with higher education, those from upper quintile of household wealth. Similarly the incidence of cesarean birth was remarkably higher in private hospitals both in the Indian sample (OR 3.9, 95% CI: 3.77-4.03) and in the selected states, Bihar (12.86, 95% CI: 10.92-15.15) and Tamil Nadu (OR 2.74, 95% CI: 2.40-3.13), compared to the public hospitals.

Conclusion: Our study revealed that there are a high proportion of women delivering babies through cesarean section in South India. Thus, medical justifications need to be taken to deal with this concern. On the other hand, Women should also be driven towards regular ANC check-ups for the well-being of maternal and newborn health that can also help to increase the cesarean delivery for women who need C-section delivery especially in low-income states.

Background

Cesarean delivery is a life-saving obstetric surgical intervention for mothers and babies.^{1,2} This vital clinical procedure is often needed to avoid maternal and neonatal deaths. Certain obstetric risks such as dystocia, macrosomia, fetal distress, breech births, post-term pregnancy, multiple pregnancy, maternal weight, and pregnancy-induced hypertension are considered to be justifiable medical reasons for cesarean deliveries.²

The rate of cesarean delivery has considerably increased in the world during the last few decades. Globally, approximately 18.5 million cesarean births are recorded each year, accounting for 19.1% of total births.³ The World Health Organization has recommended 10–15% as a standard cut-off of C-section birth.⁴ Among high-income countries, the caesarean delivery rate is 30.3% in the United States, 30% in Australia, 28% in Germany, 26% in Canada, and 22% in the United Kingdom⁵. In low-income countries, the caesarean delivery rate is 23% in Bangladesh⁶, 5% in Nepal³, 20% in Pakistan⁷ and 11.4% in Ghana⁸.

However, during the last decade, the increase in cesarean section deliveries has become a matter of serious concern for public health experts globally.⁸ India is not an exception. The rate of cesarean delivery is dramatically increasing from 10% in 2005-06 to 17% in 2015–16. The Southern Indian states have recorded substantially higher levels of cesarean deliveries in comparison to the other parts of the country.^{9,10}

Studies have indicated that socio-demographic, economic, cultural and psychological factors determine cesarean delivery in India.⁸ It is evidenced that education, wealth status, occupation, place of delivery and nutritional status of the mother are significant predictors of cesarean delivery.^{6,11} Previous studies revealed that educational attainment and household wealth status are positively associated with a cesarean birth. A study conducted in Bangladesh investigated higher educated women almost 4 times more likely to have cesarean birth.⁶ In Brazil, on the contrary, women with higher education are less likely to have a cesarean birth compared to uneducated women.¹² In regard to cultural factors, the health-seeking behavior of women during pregnancy has a key role in cesarean delivery.^{7,13} Additionally, various psychological causes, such as fear related to prolonged labor and vaginal delivery pain reinforce women's preferences for cesarean delivery.⁷

The Indian government has initiated several important safe motherhood programs to reduce the incidence of maternal mortality and to improve the overall well-being of mothers and babies. India has made remarkable achievements in institutional delivery over recent decades. The Indian government has started *Janani Suraksha Yojana* (JSY) to improve institutional delivery in the country, particularly among the vulnerable section of society by providing economic incentives to poor mothers. Despite several maternal healthcare initiatives, the incidence of maternal mortality for some of the states is still alarming. For instance, maternal mortality is substantially higher in Bihar compared to the national average. The United Nations (UN) set Sustainable Development Goal (SDG) to reduce the incidence of maternal mortality as low as below 70 per 100,000 live births by 2030. A study on maternal mortality in India observed the highest maternal mortality rate in rural areas of poorer states (397 per one million live births), in which 82% maternal deaths were attributed to direct obstetric causes.¹⁴ It is noteworthy to mention that maternal mortality could be averted by cesarean delivery. Women who had obstetric complications should undergo cesarean delivery.

Studies also indicated that the geographical region also has a significant influence on cesarean delivery.^{11,15} According to the NFHS-4, the Southern states, namely Telangana (58%), Andhra Pradesh (40%) and Tamil Nadu (34%) constitute higher cesarean delivery rate, whilst central and eastern states like Bihar (6%), Jharkhand (10%) and Orissa (13%) have a lower proportion of cesarean delivery.

In this present study, we assess the socio-demographic factors of cesarean delivery among Indian women using the most recent nationally representative database. Furthermore, our study focuses on two socio-culturally distinct states such as Bihar and Tamil Nadu to understand the differential influence of various factors in cesarean delivery.

Methods

We used the data from the fourth round of the National Family Health Survey (NFHS-4), conducted in 2015-2016. Data were collected from 601,509 households and 699,686 women in the age group of 15-49 years, with a response rate of 97%. The samples were collected using a stratified two-stage sampling technique covering 28586 clusters, where 20,059 clusters are from rural areas, 8,397 clusters are from urban areas, and 130 clusters selected from the slum list provided by Municipal Corporation Office (MCOs). In the first stage, clusters have been chosen using probability proportional to cluster size. In the second stage, 22 households were selected from each cluster with an equal opportunity systematic selection from the household listing. A detailed description of the sampling design and survey procedure has been provided in the national report of NFHS-4. Our study participant restricted to most recent birth during the five years preceding the survey (N=190,898).

Outcome variable:

The outcome variable of this study is cesarean birth. In NFHS-4, women were asked, “was the baby delivered by cesarean section, that is, did they cut your belly open to take the baby out?” Women who reported having cesarean delivery for most recent birth were classified as yes (coded as 1) or no (coded as 0).

Explanatory variables:

In this study, the socio-demographic characteristics of women were included as explanatory variables. Demographic characteristics include women’s age (15-24, 25-34 and 35+ years), age at first marriage (<18, 18-24 and ≥ 24 years), birth order (first, second, third and fourth or more). Body mass index (BMI) of mothers was also included as an independent variable. Women’s BMI was classified as thin (BMI < 18.5kg/m²), normal (BMI of 18.5–24.9 kg/m²) and obese (BMI ≥ 25 kg/m²) as per the WHO standards. The selected socio-economic variables are women’s education (no education, primary, secondary and higher), religion (Hindu, Muslim, Christian and others), social group (Scheduled Caste [SC], Scheduled Tribe [ST], Other Backward Classes [OBC] and others) and wealth index (poorest, poorer, middle, richer, and richest). It is noteworthy to mention that the household wealth index has been used as a proxy indicator of economic status. Wealth index was computed by the ownership of household assets including consumer items and housing characteristics using principal component analysis (PCA).

Place of delivery was categorized as public facility and private facility. Public facilities include government/municipality hospitals, government dispensaries, urban health clinics/urban health posts (UHP)/urban family welfare centers (UFWC), community health centers (CHC)/rural hospitals/block primary health centers (BPHC), PHC/additional PHC, sub-centers and other public sector health facilities, while private facilities include hospital/maternity home/clinics, other private sector health facilities and NGOs or trust hospital/clinics.

Antenatal care (ANC) is an important predictor of cesarean delivery. ANC visits variable was classified as no visit, 1–3 visits and four or more visits. Pregnancy loss was dichotomized as yes (includes abortion, miscarriage and stillbirth) and no. Similarly, delivery complications were grouped as binary responses, such as yes (includes prolonged labor, breech presentation and excessive bleeding) and no.

Women's exposure to mass media was measured from the frequency of listening radio, reading newspapers/magazines and watching television. All these three variables on mass media have been dichotomized (yes/no). Place of residence was classified as rural and urban. Indian states and union territories grouped into six regions based on geographical contiguousness and cultural similarities. These regions are North, Central, East, Northeast, West and South.

Statistical analysis:

Descriptive statistics were carried out to understand the distribution of study participants. Bivariate analysis was conducted to examine the nature of the association between cesarean delivery and socio-demographic characteristics of women. The sample weight was used to estimate the percentages. Furthermore, Pearson's chi-square was performed to test the level of significance in the association. Finally, binary logistic regression was applied to examine the factors associated with cesarean delivery. The regression results are presented by an estimated odds ratio (OR) with 95% confidence interval (CI). STATA version 12.1 has been used for all statistical analyses.

Results

Trends in cesarean delivery (1992-93 to 2015-16):

Figure 1 depicts the trends of C-section delivery from 1992-93(NFHS-1) to 2015-16 (NFHS-4). The prevalence of CS delivery substantially increased from 2.9% in 1992-93 to 17.2% in 2015-16 at the national level. In case of Tamil Nadu, the rate of CS delivery rapidly increased (from 7.1% in 1992-93 to 34.1% in 2015-16), while comparatively slower progress in C-section delivery had been observed in Bihar (from 1.1% in 1992-93 to 6.2% in 2015-16). We found a large gap in cesarean delivery between Tamil Nadu and Bihar in all four survey years.

Cesarean delivery according to the states and union territories of India:

Table 1 displays the prevalence of CS deliveries in all the states and union territories of India. On average, the rate of cesarean birth was 19.2% in India, ranging from 7.1% in Nagaland to 59.7% in Telangana. It was observed that Kerala, Tamil Nadu, Andhra Pradesh, and Telangana together comprised 24.5% of all C-section delivery in India. In nine states, the rate of CS delivery was lower than 10% namely, Rajasthan (9.9%), Meghalaya (9%), Bihar (7.4%), and Nagaland (7.1%). Among union territories, the prevalence of CS delivery was ranging from 39.9% in Lakshadweep to 17.1% in Daman and Diu.

Respondent characteristics:

Table 2 presents socio-demographic characteristics of the women. A substantial proportion of women were in the age group of 20-24 years (56%), married between 18-24 years of age (54%). Nearly 60% of women belong to average BMI. Almost a quarter of the respondents had no formal education and about 46% of them had a secondary level of education. Majority of the women were living in rural areas, affiliated to Hindu religion, and belonged to OBC social group. The distribution of study participants decreased from bottom to upper quintile of household wealth. Around 71% of the women in India were depends on public hospitals to conduct the delivery. A substantial proportion (47%) of participants has received 4 or more than 4 times ANC visits during their pregnancy. Only 15% and 11% of respondents had ever experienced pregnancy loss and delivery complications respectively. Most of the women were watching television compared to reading newspapers or magazines and listening to radio in their daily life. The study participants from central India were comparatively higher than any region in India.

Prevalence of cesarean delivery by socio-demographic characteristics:

Table 3 presents the proportion of cesarean delivery by socio-demographic characteristics of women. The results show that the prevalence of cesarean delivery was substantially lower among the older women (aged 35-49 years) than the younger women (aged 15-24 years and 25-35 years) at the national level. Similarly, in Bihar, the rate of CS delivery decreased with the increasing age of women. Contrastingly, in Tamil Nadu, the incidence of C-section delivery increased among the older age group of women. For instance, in Tamil Nadu, about 44% of women aged 35–49 years had given birth to the C-section as compared to 31% of younger women (aged 15-24 years). The prevalence of CS delivery also increased with increasing age at marriage. A greater percentage of women who married at 25 years or above had their most recent birth at C-section. Birth order had a negative association with C-section delivery where the incidence of CS delivery was found to be decreased with higher-order children in Bihar and Tamil Nadu and as well as at the national level. The occurrence of C-section delivery was significantly higher among overweight/obese women as compared to thin and normal women. It is noticed that CS delivery had a rising trend with an increasing level of education in which respondents with higher education had a higher proportion of CS delivery. The prevalence of CS delivery was lower among Muslim women compared to Hindus, Christians, and others at the national level and Bihar. On the other hand, in Tamil Nadu, the rate of CS delivery was lower among Hindu women than the Muslims, Christians, and others. The prevalence of C-section delivery was lowest among Scheduled Tribe women, followed by Scheduled Caste women, whilst the General caste women had the highest rate of CS delivery in both the states and India. Furthermore, the rate of C-section delivery increased among women from bottom to upper quintile of household wealth at the national level as well as two other selected states.

In regard to public-private distribution, the incidence of CS birth was remarkably higher in private hospitals than the public hospitals at the national level (43 vs. 13%). In Bihar, the proportion of C-section delivery was 34.1% in private hospitals, while it was only 2.9% in public hospitals. In Tamil Nadu, over half (52.8%) of the deliveries in private hospital shad occurred in C-section.

There was a positive relationship between the number of ANC visits and the prevalence of CS deliveries where mothers who received four or more ANC visits had higher CS delivery compared with women who did not have sufficient ANC. A significantly higher percentage of women who had experienced pregnancy loss undergo C-section delivery as compared with those who did not experience pregnancy loss. Similarly, mothers who had faced delivery complications at the time of childbirth were more likely to experience CS deliveries in India and Bihar. In Tamil Nadu, contrasting results were found where women who experienced delivery complications considerably were less likely to deliver in C-section than those who did not experience delivery complications.

Exposure to mass media had a positive impact on CS delivery. Women who had access to any mass media reported higher experience of C-section delivery in India and Bihar. In Tamil Nadu, women's exposure to newspaper/magazine only made significant difference CS birth. Our study found that the prevalence of CS delivery significantly differed across the rural-urban residence and geographical regions. Women residing in rural areas were less frequent in CS birth compared with women living in urban areas. Regarding geographical region, the highest rate of C-section delivery was observed in South region (38.2%), followed by West region (21.5%), while the lowest the prevalence of CS birth was found in Central region (10.6%), followed by East region (14.6%).

Multivariate analysis:

Table 4 presents the results of the multivariate logistic regression models showing the socio-demographic factors associated with cesarean delivery for India, Bihar, and Tamil Nadu.

India:

The results show that the likelihood of C-section delivery increased with increasing age of women where women aged 25-34 years (OR= 1.20; 95% CI: 1.16-1.25) and 35-49 years (OR=1.57; 95% CI: 1.46-1.68) were less likely to have cesarean birth compared with women aged 15-24 years. Similarly, the odds of cesarean birth increased with rising age at first marriage. Women who married at 18-24 years and above 24 years were 8% (OR=1.08; 95% CI: 1.04-1.12) and 48% (OR=1.48; 95% CI: 1.39-1.57) more likely to have C-section delivery respectively than those who married under 18 years of age. Birth order was negatively associated with cesarean birth where women with two (OR=0.75; 95% CI: 0.72-0.78), three (OR=0.46; 95% CI: 0.43-0.49), and four or more birth order (OR=0.30; 95% CI: 0.28-0.32) had a lower likelihood of CS delivery. Regarding maternal BMI, it was found that the likelihood of cesarean delivery for overweight women was more than two-fold (OR=2.23; 95% CI: 2.12-2.24).

Educational attainment of women was found to be positively associated with C-section delivery in which women with higher education were 42% (OR=1.42; 95% CI: 1.04-1.20) more likely to have cesarean delivery compared with uneducated women. Compared to Hindu women, the probability of CS delivery was significantly higher among Muslims (OR=1.05; 95% CI: 1.00-1.11), whilst the odds of CS delivery were 14% (OR= 0.76; 95% CI: 0.70-0.82) lower for Christian women. Social group also had a significant influence on C-section delivery. Women belonged Scheduled Tribe (OR= 0.79; 95% CI: 0.74-0.84) and Other

Backward Classes (OR= 0.86; 95% CI: 0.82-0.90) were less likely and women belonged to General caste (OR=1.07; 95% CI: 1.01-1.12) were more likely to have cesarean birth compared to Scheduled Caste women. Wealth quintile of the household also had a strong positive correlation with C-section delivery. Compared to the poorest women, the likelihood of cesarean birth was 57% higher among the richest quintile of household wealth (OR= 1.57; 95% CI: 1.35-1.59).

Place of delivery had a strong association with CS delivery. It was found that women delivered in private hospitals were associated with almost four-fold increased odds of C-section delivery (OR=3.90; 95% CI: 3.77-4.03). Antenatal care visits acted as enabling factors of C-section delivery. Women received four or more ANC visits were 1.6 times (OR=1.6; 95% CI: 1.50-1.70) more likely to have cesarean birth compared to those who did not receive ANC service. Women who had ever pregnancy loss (OR=1.22; 95% CI: 1.17-1.27) were more likely to undergo cesarean delivery than those who did not experience pregnancy loss. Women who had delivery complications were less likely to experience C-section delivery (OR= 0.18; 95% CI: 0.16-0.20). Furthermore, it is observed that exposure to mass media had a positive association with cesarean births. For instance, women who had exposure to radio and television were 15% (OR=1.15; 95% CI: 1.10-1.20) and 13% (OR=1.13; 95% CI: 1.07-1.19) more likely to have cesarean birth.

In regard to place of residence, rural women were significantly less likely to have cesarean delivery (OR= 0.89; 95% CI: 0.86-0.93) compared to their urban counterparts. Compared to women from North region, women residing in East (OR= 1.32; 95% CI: 1.25-1.40), Northeast (OR= 1.46; 95% CI: 1.37-1.55) and South region (OR= 2.14; 95% CI: 2.03-2.26) were more likely and women from Central (OR= 0.94; 95% CI: 0.90-0.99) and West region (OR= 0.89; 95% CI: 0.84-0.95) were less likely to have cesarean birth.

Bihar and Tamil Nadu:

The odds of cesarean delivery increased with the increasing age of women in both Bihar and Tamil Nadu. However, the association of age on cesarean delivery appears to be stronger in Tamil Nadu as compared to Bihar. The impact of age at marriage on cesarean delivery was found to be significant in Tamil Nadu only. The results show that women who married at 25 years or later were 35% more likely to have C-section delivery (OR= 1.35; 95% CI: 1.07-1.72) compared to those who married before 18 years. Birth order had a negative relationship with cesarean delivery in both states. The odds of cesarean delivery decreased with the increasing birth order. For instance, mothers with four or more order-child were 68% and 78% lower likelihood of having cesarean delivery in Bihar and Tamil Nadu, respectively. Regarding mothers' BMI, overweight condition of women increased the odds of cesarean delivery in both states. However, the likelihood of cesarean birth was slightly higher in Tamil Nadu (OR=2.26; 95% CI: 1.86-2.75) as compared to Bihar (OR=1.92; 95% CI: 1.51-2.43). Although we found a strong association between educational attainment of women and cesarean delivery at the national level, a marginal association was found in Bihar and the association became insignificant in case of Tamil Nadu. In Bihar, women who belonged to forward caste were significantly more likely to have a cesarean birth (OR= 1.28; 95% CI: 1.00-1.63) as compared to SC women. We found a decreasing trend in cesarean delivery from bottom to upper quintile of household wealth in Tamil Nadu. However, wealth index was found to be less important in

Bihar. Place of delivery was found to be a strong predictor of cesarean delivery. In Bihar, women delivered in private hospitals were associated with almost 13 fold increased odds of cesarean delivery (OR=12.86; 95% CI: 10.92-15.15) as compared to public hospitals. In Tamil Nadu, the likelihood of cesarean birth in private hospitals increased by nearly three-fold (OR=2.74; 95% CI: 2.40-3.13). The number of ANC visits was positively correlated with cesarean delivery in Bihar. Women who received four or more ANC visits were 1.8 times more likely to have a cesarean birth (OR= 1.82; 95% CI: 1.49-2.13) compared with women who did not receive ANC service. In Tamil Nadu, women who had pregnancy loss were at 24% increased likelihood of having cesarean birth (OR= 1.24; 95% CI: 1.06-1.46) compared with women who had no pregnancy loss. Likewise, women having delivery complications were associated with 63% higher odds of cesarean delivery (OR= 1.63; 95% CI: 1.41-1.88) in Bihar, whereas women having delivery complications were associated with 67% decreased odds of cesarean delivery (OR= 0.33; 95% CI: 0.28-0.38) in Tamil Nadu. We found no significant association between women's exposure to mass media (newspaper/magazine, radio, and television) and cesarean delivery in both states. Place of residence had a significant relationship with cesarean birth in Bihar where women living in rural areas were 20% less likely to have a cesarean birth (OR= 0.20; 95% CI: 0.65-0.99) as compared to urban women.

Discussion

Our study made a comprehensive assessment of factors influencing cesarean delivery in India, with a particular focus on two states, namely Bihar and Tamil Nadu. In India, the rate of cesarean delivery is 17% in 2015-16. There is a large variation in the rate of C-section delivery across Indian states. The prevalence of cesarean delivery is considerably higher in Tamil Nadu (34%) than the national average, while a very low proportion of women have undergone cesarean delivery in Bihar (6%).

Multivariate analysis revealed that cesarean delivery increased with the increasing age of women where older women were more likely to have cesarean birth compared to younger women. This could be explained by the fact that older mothers are highly susceptible to pregnancy and delivery-related complications.^{8,16,17} Therefore, older women may incline towards the cesarean section as a safe delivery option to protect their fetus after a long period of conception difficulty.^{8,18} The higher prevalence of cesarean birth was also found among women who married at a higher age. The possible reason could be adult married women may have higher decision-making autonomy in terms of their health-seeking behavior compared to child married women. In case of Bihar, we did not find any significant association between age at marriage and cesarean delivery. Birth order was found to be significantly associated with a lower likelihood of cesarean delivery. The results show that the odds of cesarean birth decreased with higher older-birth. Mothers in first birth are more likely to prefer cesarean delivery probably due to fear of labor pain.^{7,19} On the other hand, mothers with a vaginal delivery experience at first birth might reject cesarean delivery for the next children due to overcoming fear related to childbirth. Moreover, the nutritional status of mothers has a significant influence on cesarean delivery.²⁰ Several studies have found that excessive weight gain and obesity increase relevance in obstetrics for cesarean delivery.²¹

Vinturache et al.,²² in a study of the Canadian population investigated that obesity is associated with increased risk of pregnancy, delivery, and postpartum complications.

Our study found that education is significantly associated with an increased likelihood of cesarean delivery at the national level. This finding is consistent with several previous studies conducted in Bangladesh,^{23,24} Brazil,²⁵ Pakistan,⁷ Nepal³ and China²⁶. Women with higher education may have better decision-making ability to access obstetric care and more aware of the risk of childbirth-related complications.⁸ In the present study, caste had a significant influence on cesarean delivery. Consistent with other studies conducted in India,^{17,27} the current study also found that the likelihood of cesarean delivery was higher among ST women. Moreover, the rate of home delivery is higher among tribal women. Due to impoverishment and marginalization of tribal communities, they do not prefer cesarean delivery. A study conducted in Madhya Pradesh reported that about 41% of maternal death occurred among tribal women.²⁸ Several studies from Bangladesh,⁶ Pakistan,⁷ China,²⁶ Mozambique²⁹ and Ghana³⁰ demonstrated a significant influence of wealth status on cesarean delivery. In this study, the rate of cesarean delivery increased from bottom to upper wealth index groups. Women in wealthier quintiles may have no financial constraints to have a cesarean delivery. Conversely, a negative relationship was found between household wealth index and cesarean delivery in Tamil Nadu. Similarly, Robelo et al.,¹² found that women in higher quintiles are less likely to deliver in the C-section.

Place of delivery is found to be a strong predictor of cesarean delivery. At the national level, women delivered in private hospitals were 3.9 times more likely to have cesarean birth compared to public hospitals. In case of Bihar, private hospitals increased the odds of cesarean birth by almost 13 folds. Similar findings have been reported in other studies.^{11,15,31} The higher rate of cesarean delivery in private hospitals could be due to sufficient modern medical instruments, specialized treatment, sufficient medical staff and caretakers, the demand of couple or mother's request.^{32,33} In our study, women who received four or more ANC visits were more likely to deliver in the cesarean section which is in accordance with other studies.^{8,10} Counseling of mothers during the ANC period could have a positive influence on cesarean birth. Moreover, women having pregnancy complications could increase ANC visits and they are more likely to prefer C-section as a safe delivery option.¹⁷ Likewise, women who had ever experienced pregnancy loss were more likely to have cesarean birth compared to those who had never experienced pregnancy complications. Women who had ever experience fetus loss prefer cesarean delivery to avoid any complications during childbirth, especially mothers who are married and have a pregnancy at a very late age might drive them quickly opt for a cesarean section.^{18,34}

Studies have indicated that women's exposure to mass media has a positive influence on contraceptive use and maternal health-seeking behavior.³⁵⁻³⁷ In our study, exposure to mass media had a significant impact on cesarean delivery. The study found that women who listened to the radio and watched television were more likely to have cesarean delivery at the national level. However, exposure to mass media had no significant influence on cesarean delivery in Bihar and Tamil Nadu.

Furthermore, place of residence had a significant impact on cesarean delivery in case of India and Bihar. Women residing in rural areas were less likely to have cesarean birth compared to urban women. This could be due to limited healthcare facilities, lack of knowledge, and impoverishment of rural women. Our study found that the rate of cesarean delivery considerably varies across the geographical region. For instance, women from the south region were associated with more than two-fold increased odds of having C-section delivery as compared to women from the north region. This finding is in line with previous studies.^{11,17} Southern states are better in the condition in terms of socio-economic status and healthcare facilities compared to northern states. Moreover, women in southern states are highly educated, having a higher level of autonomy and more aware of the risk of reproductive health, which could lead to an increase in cesarean delivery in this region.

Strength and limitations:

The present study is based on a nationally representative sample survey of NFHS-4. Therefore, the results of this study could be generalized for the whole country. Additionally, our study focuses on two selected states, namely Bihar and Tamil Nadu, which account for the lowest and highest rate of cesarean birth in India, respectively. Therefore, the findings of this study could be helpful for policymakers to design effective policies and programs to address the vulnerable section of society where the incidence of maternal mortality is widespread by increasing cesarean delivery among them.

The present study has several limitations. First, the collected information is self-reported; therefore, the data are prone to recall bias. Second, due to the cross-sectional nature of data, a causal relationship could not be established between the independent variables and the dependent variable. Third, cesarean delivery can be influenced by many cultural, physiological and behavioral factors; however, we could not include these factors in the analysis due to the unavailability of information in the dataset. Further, the data does not provide details of medical reasons for cesarean delivery. Further in-depth qualitative research is needed to understand the driving force behind cesarean section delivery.

Conclusion

In India, the rate of cesarean birth is 17%. This study has revealed that education, wealth quintile, ANC visits, pregnancy loss, place of residence and geographical region are found to be significant predictors of cesarean birth at the national level. It is also evident that the rate of cesarean delivery was substantially higher in private facilities compared to public facilities. Awareness regarding the importance of ANC visits can also help to reduce pregnancy complications and that can also help to increase the cesarean delivery for women who need C-section delivery. Women should also be driven towards regular ANC check-ups for the well-being of maternal and newborn health. The Government should intervene for rural and poor women for easy access to healthcare services.

Abbreviations

NFHS: National Family Health Survey; SC: Scheduled Caste; ST: Scheduled Tribe; OBC: Other Backward Class; PCA: Principal component analysis; ANC: Antenatal care; JSY: Janani Suraksha Yojana; SDG: Sustainable Development Goal; PHC: Public health center; CS: Cesarean Section.

Declarations

Ethics approval and consent to participate: This study is based on secondary data which is available in public domain. Therefore, ethical approval is not required for conducting this study.

Consent to publish: Not applicable

Availability of data and materials: The data for this research is available to the public on DHS measures website. Any individual can register and easily obtained data in electronic version from the following website <https://dhsprogram.com/data/new-userregistration.cfm>

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Authors' Contributions: AR and PP conceptualized the study aims and designed the study and assisted with interpretation of the analysis/results and manuscript writing. NK and MR conducted the analysis and lead the preparation of the manuscript. JS, BB assisted with different parts of the manuscript editing/writing. PC prepared final draft of the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1
Distribution of cesarean delivery in India, NFHS-4 (2015–2016)

States/UTs	Vaginal delivery		Cesarean delivery		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>
Andaman And Nicobar	447	79.2	79	20.8	526
Andhra Pradesh	1,339	58.2	931	41.8	2,270
Arunachal Pradesh	3,526	89.9	332	10.1	3,858
Assam	7,289	84.8	1,245	15.2	8,534
Bihar	15,579	92.6	1,243	7.4	16,822
Chandigarh	114	74.9	36	25.1	150
Chhattisgarh	6,072	88.9	733	11.2	6,805
Dadra And Nagar Havel	201	81.8	43	18.2	244
Daman And Diu	257	82.9	74	17.1	331
Goa	233	66.7	114	33.3	347
Gujarat	4,826	79.5	1,001	20.5	5,827
Haryana	4,997	87.0	722	13.0	5,719
Himachal Pradesh	1,892	82.1	400	17.9	2,292
Jammu And Kashmir	4,350	64.5	1,930	35.5	6,280
Jharkhand	7,987	88.9	960	11.1	8,947
Karnataka	4,395	74.2	1,481	25.8	5,876
Kerala	1,380	64.5	748	35.5	2,128
Lakshadweep	161	60.1	101	39.9	262
Madhya Pradesh	15,708	89.9	1,698	10.1	17,406
Maharashtra	5,729	78.1	1,414	21.9	7,143
Manipur	3,520	76.2	909	23.8	4,429
Meghalaya	2,850	91.0	269	9.0	3,119
Mizoram	3,307	86.5	374	13.5	3,681
Nagaland	2,942	92.9	194	7.1	3,136
Delhi	936	71.0	322	29.0	1,258

	Vaginal delivery		Cesarean delivery		Total
Odisha	7,692	84.7	1,323	15.3	9,015
Puducherry	507	66.0	372	34.0	879
Punjab	3,086	73.7	1,046	26.3	4,132
Rajasthan	10,782	90.1	1,168	9.9	11,950
Sikkim	712	78.3	187	21.7	899
Tamil Nadu	3,923	64.2	2,258	35.8	6,181
Tripura	934	77.8	235	22.2	1,169
Uttar Pradesh	25,632	89.2	3,109	10.8	28,741
Uttarakhand	3,683	85.2	615	14.8	4,298
West Bengal	3,403	73.8	1,056	26.2	4,459
Telangana	769	40.3	1,016	59.7	1,785
India	1,61,160	80.8	29,738	19.2	1,90,898

Table 2
Respondent socio-demographic characteristics, NFHS-4 (2015-16)

	India (N = 190,898)		Bihar(N = 16,822)		Tamil Nadu (N = 6,181)	
Women's Characteristics	n	%	n	%	n	%
Women's age						
15–24 years	62,082	32.5	5,707	33.9	1,996	32.3
25–34 years	1,07,500	56.3	8,999	53.5	3,829	62.0
≥ 35 years	21,316	11.2	2,116	12.6	356	5.8
Age at first marriage						
< 18 years	69,751	37.3	9,302	55.6	1,213	19.8
18–24 years	1,01,506	54.3	6,985	41.7	4,094	66.7
≥ 25 years	15,572	8.3	449	2.7	828	13.5
Birth order						
1	61,807	32.4	3,878	23.1	2,497	40.4
2	62,484	32.7	4,442	26.4	2,823	45.7
3	33,064	17.3	3,644	21.7	710	11.5
4+	33,543	17.6	4,858	28.9	151	2.4
Women's BMI						
Thin	43,179	22.9	5,124	30.7	871	14.2
Normal	1,17,040	62.1	10,233	61.3	3,425	56.0
Obese	28,285	15.0	1,338	8.0	1,824	29.8
Women's Education						
Illiterate	55,165	28.9	9,223	54.8	343	5.6
Primary	26,712	14.0	2,036	12.1	430	7.0
Secondary	88,871	46.6	4,764	28.3	3,978	64.4
Higher	20,150	10.6	799	4.8	1,430	23.1
Religion						
Hindu	1,38,343	72.5	14,038	83.5	5,534	89.5
Muslim	29,309	15.4	2,767	16.5	323	5.2

	India (N = 190,898)		Bihar(N = 16,822)		Tamil Nadu (N = 6,181)	
Christian	15,202	8.0	4	0.0	321	5.2
Others	8,044	4.2	13	0.1	3	0.1
Social group						
SC	35,170	19.3	3,747	22.5	1,849	30.0
ST	37,889	20.8	543	3.3	111	1.8
OBC	74,060	40.7	9,980	59.8	4,113	66.8
General	34,705	19.1	2,410	14.5	88	1.4
Wealth quintile						
Poorest	46,782	24.5	9,191	54.6	201	3.3
Poorer	43,739	22.9	4,004	23.8	933	15.1
Middle	38,393	20.1	2,028	12.1	1,914	31.0
Richer	33,212	17.4	1,215	7.2	2,042	33.0
Richest	28,772	15.1	384	2.3	1,091	17.7
Place of delivery						
Public	1,05,615	71.7	8,474	74.2	4,069	66.6
Private	41,643	28.3	2,946	25.8	2,044	33.4
Number of ANC visit						
No visit	33,642	17.8	7,011	41.8	509	8.3
1–3 visits	65,964	34.9	7,299	43.5	621	10.2
≥ 4 visits	89,438	47.3	2,458	14.7	4,991	81.5
Pregnancy loss						
No	1,61,055	84.4	14,572	86.6	5,306	85.8
Yes	29,843	15.6	2,250	13.4	875	14.2
Delivery complication						
No	1,65,076	88.6	8,135	48.4	1,128	18.3
Yes	21,325	11.4	8,687	51.6	5,053	81.8
Mass media exposure						
Reading Newspaper/Magazine						

	India (N = 190,898)		Bihar(N = 16,822)		Tamil Nadu (N = 6,181)	
No	1,27,235	66.7	13,303	79.1	3,093	50.0
Yes	63,663	33.4	3,519	20.9	3,088	50.0
Listening Radio						
No	1,62,596	85.2	13,967	83.0	4,702	76.1
Yes	28,302	14.8	2,855	17.0	1,479	23.9
Watching Television						
No	57,311	30.0	11,305	67.2	190	3.1
Yes	1,33,587	70.0	5,517	32.8	5,991	96.9
Place of residence						
Urban	47,833	25.1	1,780	10.6	2,687	43.5
Rural	1,43,065	74.9	15,042	89.4	3,494	56.5
Region						
North	36,079	18.9				
Central	52,952	27.7				
East	39,243	20.6				
Northeast	28,825	15.1				
West	13,892	7.3				
South	19,907	10.4				

Table 3
Prevalence of cesarean delivery by socio-demographic characteristics, NFHS-4 (2015-16)

Socio-demographic characteristics	India	p-value	Bihar	p-value	Tamil Nadu	p-value
Women's age		< 0.001		< 0.001		< 0.001
15-24 years	18.3		8.5		31.4	
25-34 years	20.2		7.5		38.5	
≥ 35 years	16.8		4.3		44.4	
Age at first marriage		< 0.001		< 0.001		< 0.001
< 18 years	12.1		5.6		27.7	
18-24 years	22.1		9.6		36.0	
≥ 25 years	40.1		12.4		46.7	
Birth order		< 0.001		< 0.001		< 0.001
1	27.4		14.1		39.2	
2	21.9		8.8		36.8	
3	11.0		5.1		23.4	
≥ 4	4.2		2.4		14.9	
Women's BMI		< 0.001		< 0.001		< 0.001
Thin	11.1		4.5		25.9	
Normal	17.1		7.3		31.1	
Obese	37.5		18.4		48.8	
Women's Education		< 0.001		< 0.001		< 0.001
Illiterate	6.9		4.2		26.8	
Primary	12.6		5.6		31.3	
Secondary	23.1		11.2		34.5	
Higher	39.8		28.2		42.5	
Religion		< 0.001		0.249		0.001
Hindu	19.4		7.7		35.0	
Muslim	16.9		6.4		39.3	
Christian	26.1		0.0		45.8	
Others	22.2		2.0		79.3	
Social group		< 0.001		< 0.001		< 0.001
SC	16.4		4.9		31.8	
ST	9.5		2.9		30.8	
OBC	19.2		7.0		37.4	
General	26.0		14.3		46.4	
Wealth quintile		< 0.001		< 0.001		< 0.001
Poorest	5.2		4.0		35.3	
Poorer	10.9		7.0		27.2	
Middle	20.6		11.2		33.5	
Richer	28.7		22.0		37.5	
Richest	37.2		31.9		42.1	
Place of delivery		< 0.001		< 0.001		< 0.001
Public	13.2		2.9		27.6	
Private	43.2		34.1		52.8	
Number of ANC visit		< 0.001		< 0.001		0.055
No visit	6.4		3.6		33.2	
1-3 visits	12.1		6.9		31.7	
≥ 4 visits	27.7		20.6		36.7	
Pregnancy loss		< 0.001		0.01		< 0.001
No	18.7		7.3		34.7	
Yes	22.2		8.6		42.6	
Delivery complication		< 0.001		< 0.001		< 0.001
No	17.9		5.4		58.3	
Yes	22.4		9.2		30.7	
Mass media exposure						

Socio-demographic characteristics	India	<i>p-value</i>	Bihar	<i>p-value</i>	Tamil Nadu	<i>p-value</i>
Reading Newspaper/Magazine		< 0.001		< 0.001		0.015
No	18.6		5.3		34.4	
Yes	23.4		15.7		37.2	
Listening Radio		< 0.001		< 0.001		0.376
No	6.9		7.2		36.3	
Yes	24.2		8.5		34.2	
Watching Television		< 0.001		< 0.001		0.95
No	13.9		4.8		37.3	
Yes	18.5		12.9		35.8	
Place of residence		< 0.001		< 0.001		0.001
Urban	30.4		16.3		37.5	
Rural	14.5		6.4		34.2	
Region						
North	16.9	< 0.001				
Central	10.6					
East	14.6					
Northeast	15.3					
West	21.5					
South	38.2					

Table 4

Logistic regression analysis showing the likelihood of cesarean delivery by socio-demographic characteristics, NFHS-4 (2015-16)

	India (N = 134986)			Bihar (N = 11151)			Tamil Nadu (N = 5391)		
	Odds Ratio	p-value	95% Conf. Interval	Odds Ratio	p-value	95% Conf. Interval	Odds Ratio	p-value	95% Conf. Interval
Current age									
15–24 years (Ref.)									
25–34 years	1.2	0.000	1.16–1.25	1.26	0.010	1.05–1.50	1.29	0.001	1.11–1.49
≥ 35 years	1.57	0.000	1.46–1.68	1.41	0.050	1.01–1.97	1.66	0.001	1.23–2.25
Age at first marriage									
< 18 years (Ref.)									
18–24 years	1.08	0.000	1.04–1.12	1.06	0.426	0.91–1.24	1.17	0.061	0.99–1.38
≥ 25 years	1.48	0.000	1.39–1.57	0.79	0.260	0.53–1.19	1.35	0.013	1.07–1.72
Birth order									
1 (Ref.)									
2	0.75	0.000	0.72–0.78	0.68	0.000	0.57–0.82	0.88	0.049	0.77–1.00
3	0.46	0.000	0.43–0.49	0.48	0.000	0.38–0.60	0.4	0.000	0.32–0.51
≥ 4	0.3	0.000	0.28–0.32	0.32	0	0.24–0.42	0.22	0.000	0.13–0.37
Women's BMI									
Thin (Ref.)									
Normal	1.24	0.000	1.19–1.29	1.11	0.222	0.94–1.32	1.22	0.028	1.02–1.46
Obese	2.23	0.000	2.12–2.24	1.92	0.000	1.51–2.43	2.26	0.000	1.86–2.75
Women's Education									
Illiterate (Ref.)									
Primary	1.12	0.000	1.05–1.19	0.87	0.280	0.68–1.12	0.94	0.705	0.66–1.32
Secondary	1.16	0.000	1.09–1.22	0.78	0.028	0.63–0.97	1.01	0.944	0.76–1.34
Higher	1.42	0.000	1.04–1.20	0.79	0.140	0.57–1.08	0.99	0.944	0.72–1.36
Religion									
Hindu (Ref.)									
Muslim	1.05	0.040	1.00–1.11	1.06	0.610	0.86–1.30	1.05	0.732	0.80–1.37
Christian	0.76	0.000	0.70–0.82	1			1.18	0.204	0.91–1.52
Others	1.03	0.400	0.96–1.11	1.83	0.630	0.16–20.98	1.92	0.606	0.16–22.90
Social group									
SC (Ref.)									
ST	0.79	0.000	0.74–0.84	0.62	0.120	0.34–1.14	0.97	0.901	0.61–1.54
OBC	0.86	0.000	0.82–0.90	0.97	0.784	0.79–1.19	0.98	0.801	0.86–1.13
General	1.07	0.010	1.01–1.12	1.28	0.050	1.00–1.63	1.04	0.865	0.64–1.69
Wealth quintile									
Poorest (Ref.)									
Poorer	1.17	0.000	1.10–1.25	1.01	0.93	0.83–1.23	0.68	0.008	0.43–0.89
Middle	1.42	0.000	1.33–1.52	0.8	0.072	0.62–1.02	0.65	0.013	0.46–0.91
Richer	1.5	0.000	1.40–1.61	0.92	0.59	0.70–1.23	0.56	0.001	0.39–0.79
Richest	1.57	0.000	1.35–1.59	0.82	0.33	0.56–1.21	0.5	0.000	0.35–0.74
Place of delivery									
Public (Ref.)									
Private	3.9	0.000	3.77–4.03	12.86	0.000	10.92–15.15	2.74	0.000	2.40–3.13
Number of ANC visit									
No visit (Ref.)									
1–3 visits	1.19	0.000	1.12–1.27	1.11	0.264	0.92–1.33	0.9	0.476	0.69–1.19
≥ 4 visits	1.6	0.000	1.50–1.70	1.82	0.000	1.49–2.23	1.04	0.713	0.84–1.29
Pregnancy loss									
No (Ref.)									
Yes	1.22	0.000	1.17–1.27	1.01	0.900	0.84–1.23	1.24	0.008	1.06–1.46
Delivery complication									
No (Ref.)									

	India (N = 134986)			Bihar (N = 11151)			Tamil Nadu (N = 5391)		
	Odds Ratio	p-value	95% Conf. Interval	Odds Ratio	p-value	95% Conf. Interval	Odds Ratio	p-value	95% Conf. Interval
Yes	0.18	0.000	0.16–0.20	1.63	0.000	1.41–1.88	0.33	0.000	0.28–0.38
Mass media exposure									
Reading Newspaper/Magazine									
No (Ref.)									
Yes	1	0.920	0.96–1.04	1.1	0.350	0.90–1.34	0.95	0.414	0.83–1.08
Listening Radio									
No (Ref.)									
Yes	1.15	0.000	1.10–1.20	1	0.964	0.83–1.21	0.93	0.331	0.81–1.07
Watching Television									
No (Ref.)									
Yes	1.13	0.000	1.07–1.19	1.1	0.292	0.92–1.33	0.92	0.609	0.65–1.28
Place of residence									
Urban (Ref.)									
Rural	0.89	0.000	0.86–0.93	0.8	0.040	0.65–0.99	1.11	0.115	0.98–1.26
Region									
North (Ref.)									
Central	0.94	0.020	0.90–0.99						
East	1.32	0.000	1.25–1.40						
Northeast	1.46	0.000	1.37–1.55						
West	0.89	0.000	0.84–0.95						
South	2.14	0.000	2.03–2.26						
Constant	0.25	0	0.21–0.29	0.03	0	0.02–0.04	1.01	0.97	0.57–1.81
	LR chi2(36) = 24817.91 Prob > chi2 = 0 Pseudo R2 = 0.1869 Log likelihood=-53978.507			LR chi2(30) = 2095.83 Prob > chi2 = 0 Pseudo R2 = 0.277 Log likelihood=-2734.7			LR chi2(32) = 902.00 Prob > chi2 = 0 Pseudo R2 = 0.1154 Log likelihood=-3457.0165		

Figures

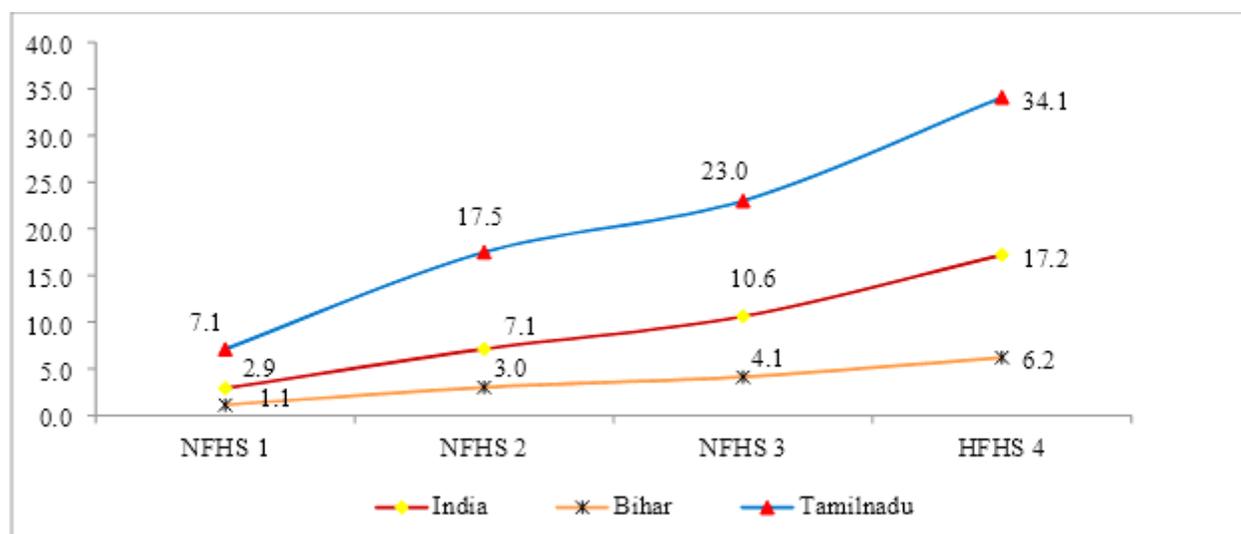


Figure 1

Trend of C-section delivery, NFHS-1 to NFHS-4