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Executive summary

Progress in maternal, newborn and child health care indicators in Bihar are not achieved as expected. Bihar is still having a dismal picture as far as maternal health is concerned. However, millions of lives could be saved through provision of quality care and health system strengthening. For example, improving access to institutional delivery through implementation of conditional cash transfer scheme appeared effective in reducing maternal mortality. Having said so, it is important to assess out of those institutional deliveries, how many are giving births through caesarean section (C-section). C-section being an important maternal health care indicator, it is also important to determine

1. whether the decision to perform a cesarean section is based on medical indications or not
2. whether the women in need are getting access to this life-saving surgical intervention.

Thus, a comprehensive understanding of what groups of women are undergoing C-section will help to design and implement measures that can effectively reduce or increase C-sections where applicable.

To address the relative scarcity of data on C-section in Bihar, the current analysis was conducted. The objectives of the current analysis were to find the distribution and determinants of Caesarean section deliveries, their place of occurrence and probable reasons in rural Bihar. Both descriptive and inferential analysis were performed on household survey data collected by the CARE team through mixed method sampling from 534 blocks of 38 districts. Approximately, 46998 mothers (15687 in 2014, 15644 in 2015 and 15667 in 2016) having babies aged 0-2 months were interviewed.

The total number of babies who were delivered by C-section among all institutional deliveries across three rounds of annual household survey were 1001 (8.74%, N=11456, R-6, 2014), 1043 (9.32%, N=11190, R-7, 2015) and 1048 (9.34%, N=11225, R-8, 2016), respectively. The proportions of C-section were higher in private sector compared to public facilities across all three rounds- 7.13vs 1.61 in 2014, 8.29 vs 1.03 in 2015 and 8.03 vs 1.31 in 2016. Only in few districts, proportion of C-section deliveries increased over time while in most of districts there was no fixed direction of change. Mean age of the

respondents after taking into consideration the weight was 23.66 (95% CI: 23.51-23.81). Majority of the mothers were Hindu by religion (86.56%) and belonged to non-marginalized caste (82.23%). Near about one-third mothers and one-fifth fathers were illiterate. The most common reason reported for undergoing C-section was “baby was not getting delivered” followed by maternal complications.

Likelihood of having C-sections were relatively higher among women having better educational level, educated husband, better socio-economic conditions, history of child loss (abortion, still birth or child death) and who underwent USG during antenatal period and complications during pregnancy compared to their respective reference categories. Even after adjustment for potential confounders including age, religion, mothers' education and socio-economic condition, the direction of association did not change. Odds of having C-sections were relatively lower among women belonging to marginalized caste, having early registration, with more pregnancies and having higher number of living sons. Male child was more often born out of C-section deliveries even for those mothers who did not undergo any antenatal USG.

C-section in a private facility was more likely among women having better socio-economic conditions, prior history of child loss, who had USG done during antenatal period, reporting pregnancy-related complications and being medically advised. C-section in a private facility was less likely among woman who did early registration.

Although the proportion of C-section delivery did not exceed the global recommendation, considering state's maternal and infant mortality rates, future research is needed to answer these two questions- whether women with medical indications are getting access or health facilities are still overdoing it without medical need. Information related to community and institutional factors that influences women's choices and decisions could be instrumental in understanding why women are preferring or readily accepting the advice to give a C-section birth in resource-poor settings.

Introduction

Caesarean section or (C-section) is a surgical intervention carried out when normal delivery is impossible or physician perceived that normal delivery will be too risky for mother and baby¹. Appropriate use of C-section reduces maternal mortality and morbidity¹. On the other hand, improper use imposes huge financial burden and is associated with both maternal and neonatal complications²⁻⁵. Globally, the C-section rate is rising gradually and is becoming a major public health concern⁶. Research found that over the last two decades, the C-section birth rate has increased, especially in the developing countries^{6,7}. C-section as a percent of all live births is considered an important indicator reflecting adequate access to emergency obstetric care⁸. A cut-off value < 5% indicates inadequate availability and/or access to emergency obstetric care, between 5 and 10% levels indicates adequate access and beyond 10% level, it has no impact on maternal/neonatal mortality⁸.

Alike in other developing countries, India is also experiencing rising C-section births. Although the national average is low, disparities in C-section deliveries are huge and worrisome across Indian states. For example, in India, analysis of national survey data showed that C-section increased between 1992-93 and 2005-06, particularly in the southern states^{9,10}. Although the national estimate of women who had undergone C-section delivery remained 10.6% in 2005-06, disparities were huge and worrisome across Indian states¹¹⁻¹⁴. Many rural areas in India are facing an epidemic of unregulated C-section births. Reasons for such dramatic increase are not well-understood Maternal and fetal indications could not fully explain such dramatic rise. Other possible explanations might be change in professional practicing style, malpractices, request from mother or family member^{15, 16}. However, there is no comprehensive data on C-section delivery in Bihar.

Progress in maternal, newborn and child health care indicators in Bihar are not achieved as expected. Bihar is still having a dismal picture as far as the maternal health is concerned. However, millions of lives could be saved through provision of quality care and health system strengthening. For example, improving access to institutional delivery through implementation of conditional cash transfer scheme appeared effective in reducing maternal mortality. Having said so, it is important to assess out of those institutional deliveries, how many are giving births through this procedure. C-section being an important maternal health care indicator, it is also important to determine 1. whether the decision to perform a C-section is based on medical indications or not 2. whether the women in need are getting access to this life-saving surgical intervention. Thus, a comprehensive understanding of what groups of women are undergoing C-section will help to design and implement measures that can effectively reduce or increase C-sections where applicable. As there is no data on C-section in Bihar, the current analysis was

conducted. The objectives of this research were to find the distribution and determinants of C-section deliveries, their place of occurrence and probable reasons among a representative sample of rural women in Bihar.

Methods

Study area

With approximately 104 million people, Bihar is India's third most populous and one of the poorest states¹⁷. An estimated more than 30% of the residents are below the poverty line, particularly in rural areas and people have differential access to health, education and other services¹⁷. There are about 534 administrative units or blocks in total 38 districts of Bihar. In each block there are many health sub-centers (HSC) and Anganwadi centers (AWC) which deliver basic maternal and family planning services.

Like in other states, maternal and child health services in this state are delivered through a network of peripheral outreach health workers (Auxiliary Nurse Midwives, ANM and Anganwadi workers, AWW) and community based health activists (Accredited Social Health Activist, ASHA) cumulatively known as frontline workers or FLWs. Despite many ongoing maternal and child health programs and interventions through antenatal and postnatal home visits by FLWs, Bihar is experiencing much slower decline in maternal and neonatal death than other states. It is, therefore, crucial to identify and address the predictors of the persistent underlying gap between recommended advices and existing practices so that the intended changes in attitudes and behaviors of mothers, families could be successfully adopted.

With the aim of improving the health and survival of women, newborns and children by providing comprehensive family health services through FLWs, improvement of the quality of care in health facilities and by scaling-up community-based innovative solutions, a statewide health system strengthening program of CARE India is ongoing in Bihar, supported by the Bill and Melinda Gates Foundation. Although health status indicators have improved, maternal mortality is among the highest in the country and a stark inequality persists across regions.

Sampling and recruitment

Married women having babies aged 0-2 completed months were included in the study. The sampling methodology has been described elsewhere¹⁸. Briefly, a two-stage proportional cluster random sampling was conducted in a systematic way to select a state-level representative of recently delivered women having babies aged 0-2, 3-5, 6-8, 9-11 and

12-23 completed months from eligible households. The households were sampled from each of Anganwadi Center. The total sample size from all 38 districts was 15687 per age group per round. The data for current analysis were obtained from three annual rounds of statewide household survey conducted between 2014 and 2016.

Data collection

Using a pre-tested, structured interview-administered questionnaire information on potential determinants were collected by trained staffs through household surveys- maternal age in years, religion (Hindu/other religion), caste (marginalized/non-marginalized), education of respondents and fathers (illiterate/up to grade 8th or below/above grade 8th), number of pregnancies, number of living sons, history of child loss, obstetric complications including swelling of feet/face/hand, anemia, visual disturbance, jaundice, high blood pressure, severe headache, vaginal bleeding, convulsions, weak or no movement of fetus, abnormal position of baby, whether USG done during antenatal period, receiving skilled antenatal services including frequency of household visits and advices given.

Data analysis

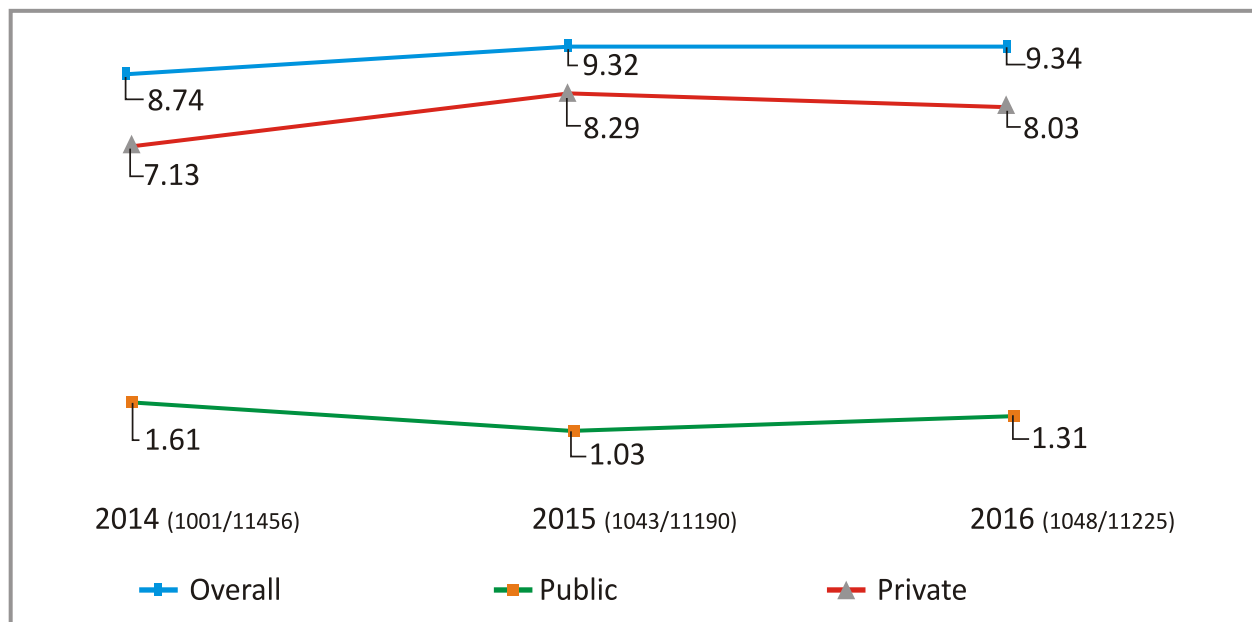
Descriptive analysis was conducted to find the overall distribution of C-section births in the state as well as what proportions of all institutional deliveries taking place in private vs public facilities across 38 districts between 2014 and 2016. The current analysis also determined the frequency distributions of maternal socio-demographic characteristics like age, religion, education of women, education of husbands, caste and religion, pregnancy related information for example number of pregnancies, time of registration, whether USG performed or not, antenatal check-ups, examination of mothers, consumption of iron and folic acid tablets, pregnancy care provided by front line workers, complications during pregnancy. Quality of antenatal care was determined by calculating a composite score by adding all individual scores related to services that mother received at the designated antenatal clinic and categorizing into three based on tertile distribution (good/average/poor)- These components of care included time of registration (early=within first trimester, late= after first trimester), ultrasound scanning, measurement of height/weight/blood pressure, abdominal/breast examination, blood/urine tests and receiving Tetanus injection. Based on standard text books, severity of pregnancy related complications was categorized into three: mild or none- severe headache, anemia, jaundice, moderate- swelling, abnormal position of fetus, vaginal bleeding and severe- convulsions, and visual disturbances, weak or no movement of fetus

and high blood pressure Mean was used for continuous variables while percentages for categorical variables. The survey weight was calculated as inverse of the sampling fraction. The outcomes of interest were whether the last birth was a caesarean or not and whether place of C-section delivery was in public vs private.

Data were weighted by the corresponding weighting factor to represent the actual distribution of respondents in each district. Both bi-variate and multiple logistic regression analyses were performed to assess the socio-demographic determinants and other predictors of C-section and predictors of those underwent C-section births in private facilities. Associations were expressed in unadjusted and adjusted odds ratios (ORs) with corresponding 95% confidence interval (CI) after considering survey design (sampling weights). To control for confounding, all analyses were adjusted for maternal age, education, religion, caste and socio-economic condition. Statistical software SAS version 9.4 was applied for current analysis and level of significance was fixed at 0.05.

Results

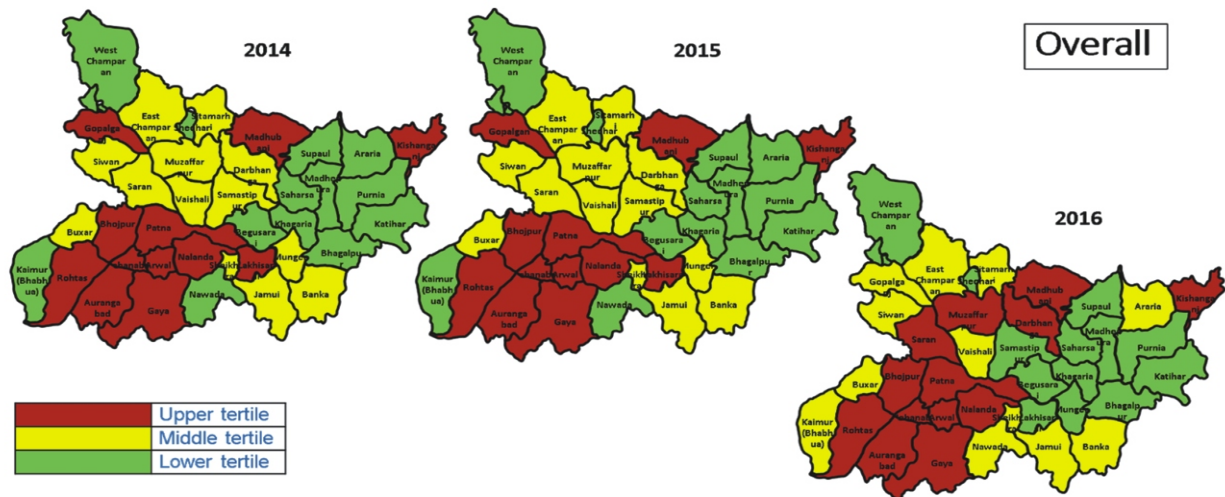
Figure 1 Proportion of C-section among all institutional deliveries in rural Bihar across years



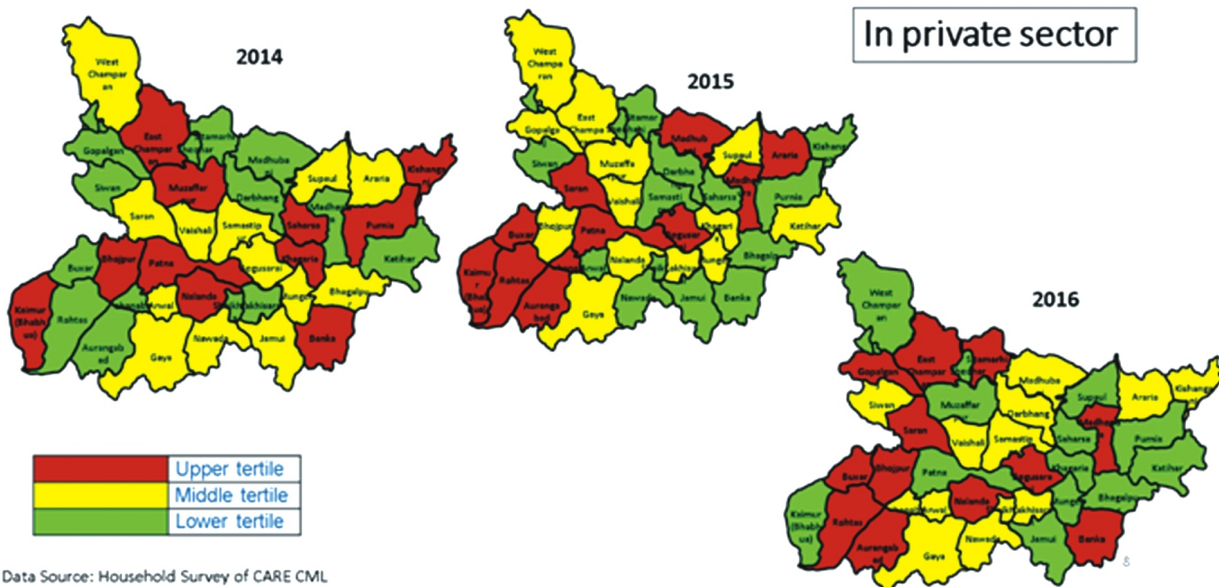
The response rate was more than 99% in all three waves of household survey. The total number of babies who were delivered by C-section among all institutional deliveries across three rounds were 1001 (8.74%, N=11456, R-6, 2014), 1043 (9.32%, N=11190, R-7, 2015) and 1048 (9.34%, N=11225, R-8, 2016), respectively. The proportions of C-section

were higher in private sector compared to public facilities across all three rounds- 7.13vs 1.61 in 2014, 8.29 vs 1.03 in 2015 and 8.03 vs 1.31 in 2016. (Figure 1)

Figure 2. District wise variation of C-section deliveries (2014-16)



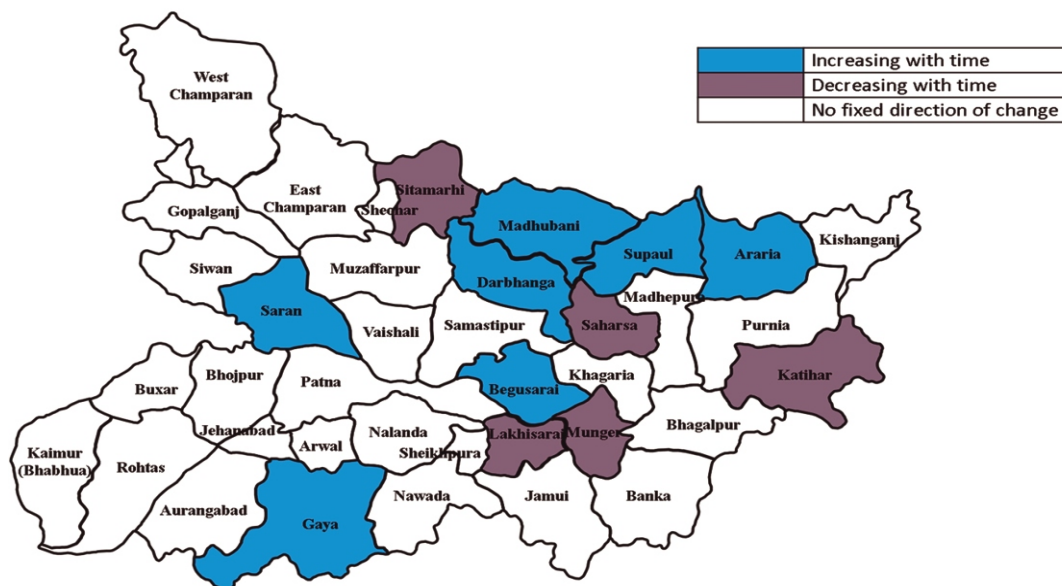
Data Source: Household Survey of CARE CML



Data Source: Household Survey of CARE CML

These figures displayed the tertile distributions of C-section deliveries (overall and in private sector) across all 38 districts during the study period. There is no definite pattern observed apart from few clustering in some of the districts. (Figure 2.)

Figure 3. Changes in district-wise variation of C-section deliveries in Bihar (2014-16)



This figure depicted the rise in percentage distributions of C-section births across all 38 districts from 2014 to 2016. Only in few districts, proportion of C-section deliveries increased over time while in most of districts there was no fixed direction of change. (Figure 3)

Figure 4. Socio-demographic profile of mothers undergoing C-section deliveries [N = 1001 (2014), 1043 (2015), 1048 (2016)]

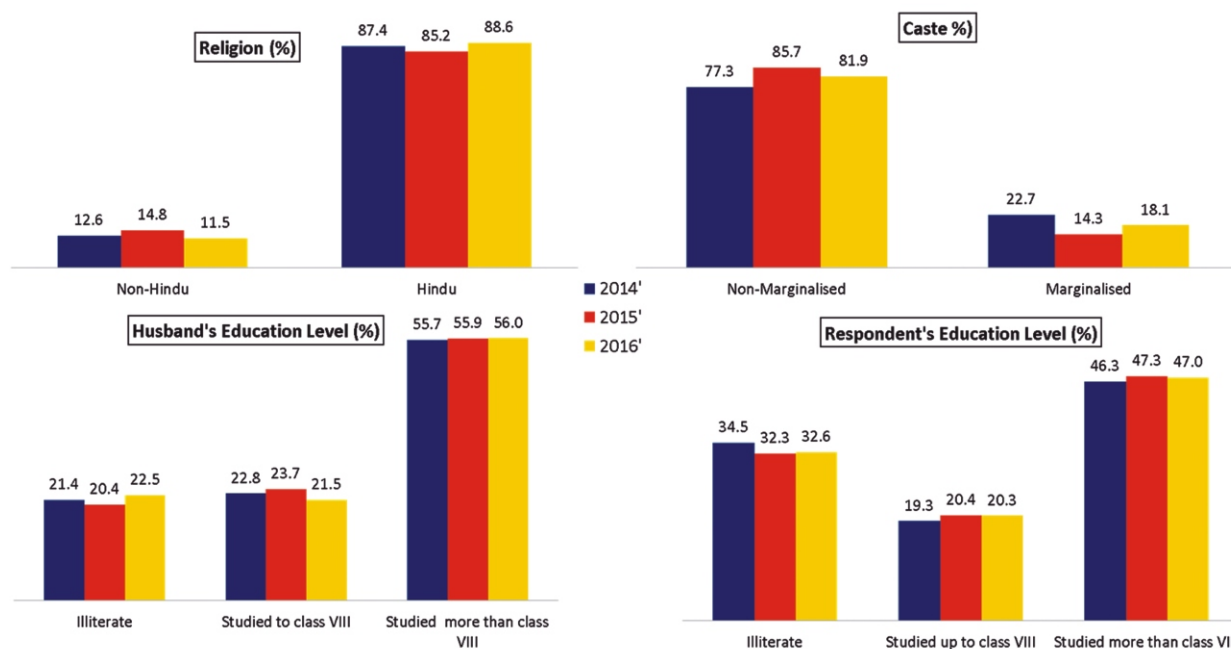
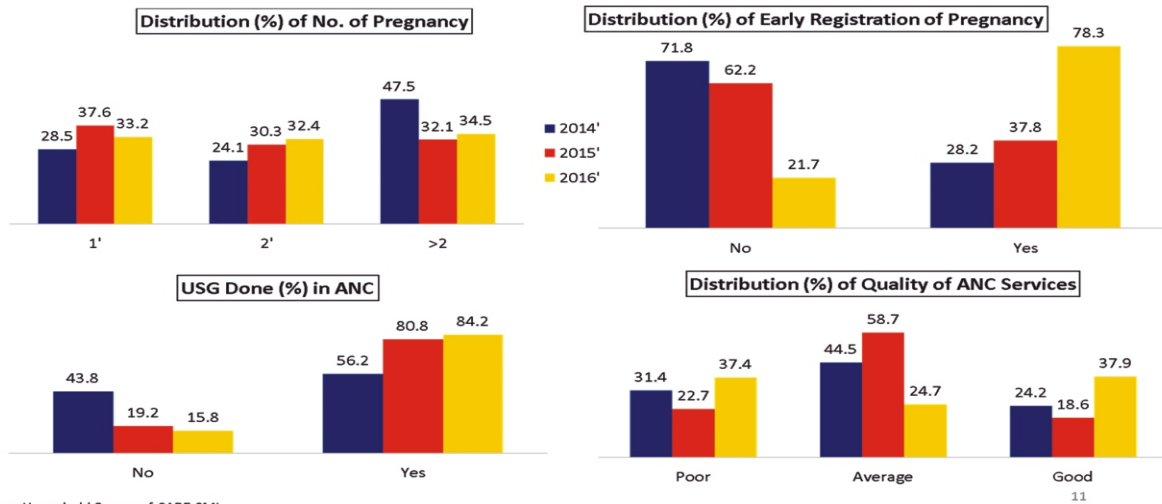


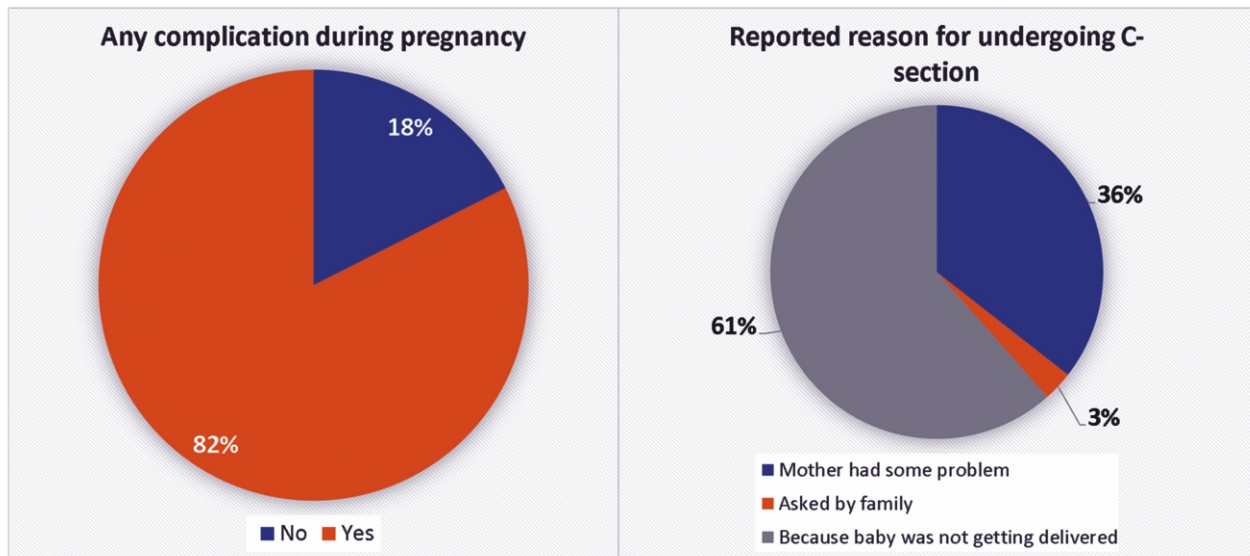
Figure 5. Pregnancy and antenatal care among mothers undergoing C-section deliveries [N = 1001 (2014), 1043 (2015), 1048 (2016)]



Data Source: Household Survey of CARE CML

The bar charts described the socio-demographic characteristics and relevant pregnancy care of mothers who underwent C-section in Bihar between 2014 and 2016. Mean age of the respondents after taking into consideration the weight was 23.66 (95% CI: 23.51-23.81), not shown in the figure. Majority of the mothers were Hindu by religion (86.56%) and belonged to non-marginalized caste (82.23%). Near about one-third mothers and one-fifth fathers were illiterate. The number of women who had early registration and undergo USG increased during 2014 and 2016. (Figure 4 & 5)

Figure 6. Complications/other factors among mothers undergoing C-section deliveries (N=2091, 2015-16)



Data Source: Household Survey of CARE CML

The pie-diagram showed the distribution of reported reasons for undergoing C-section. An estimated 82% mothers reported some complication during the antenatal period or during delivery. The most common reason reported for undergoing C-section was “baby was not getting delivered” followed by maternal complications. (Figure - 6)

Table 1: Determinants of C-section

Characteristics of the respondents	Categories	Type of delivery (ref: normal)	
		AOR	P value
Respondent's educational level (ref : illiterate)	Literate up to class VIII	1.31	< .0001
	Literate more than class VIII	2.31	< .0001
Husband's educational level (ref : illiterate)	Literate up to class VIII	1.20	0.0022
	Literate more than class VIII	1.58	< .0001
Socio-economic status (ref : lowest tertile)	Middle tertile	1.21	0.0007
	Upper tertile	1.51	< .0001
History of child loss	Continuous variable	1.26	< .0001
USG done in ANC (ref : no)	Yes	3.44	< .0001
Any Complication (ref : no)	Yes	1.22	< .0001
Severity of complication (ref : Mild or none)	Moderate	1.24	< .0001
	Severe	1.36	< .0001
Caste (ref : non marginalised)	Marginalised	0.75	< .0001
Early registration of pregnancy (ref:no)	Yes	0.80	< .0001
Birth order (ref : single pregnancy)	2 pregnancies	0.90	0.0475
	> 2 pregnancies	0.71	< .0001
Number of living sons	Continuous variable	0.81	< .0001

AOR = Odds ratio after adjustment for age, religion, caste, mother's education, socio-economic status

Predictors of C-section

Findings from multiple logistic regression analysis showed that likelihood of having C-sections were relatively higher among women having better educational level, educated husband, better socio-economic conditions, history of child loss (abortion, still birth or child death) and who underwent USG during antenatal period and complications (increased with severity also) during pregnancy compared to their respective reference categories. Even after adjustment for potential confounders including age, religion, mothers' education and socio-economic condition, the direction of association did not change. Odds of having C-sections were relatively lower among women belonging to marginalized caste, having early registration, with more pregnancies and having higher number of living sons. Male child was more often born out of C-section deliveries even for those mothers who did not undergo any antenatal USG. (Table 1.)

Table 2: Determinants of place of delivery for C-section

Characteristics of the respondents	Categories	Type of delivery (ref: C-section at a government facility)	
		AOR	P value
Socio-economic status (ref : lowest tertile)	Upper tertile	1.78	< .0001
History of child loss	Continuous variable	1.18	0.0270
USG done in ANC (ref : no)	Yes	1.84	< .0001
Any Complication (ref : no)	Yes	1.29	0.0419
Reason for C-section (ref : mother had some problem)	Advised by doctor	1.70	0.0137
Early registration of pregnancy (ref : no)	Yes	0.66	0.0002
90 or more IFA tablet consumed (ref : no)	Yes	0.46	< .0001

AOR = Odds ratio after adjustment for age, religion, caste, mother's education, socio-economic status

Predictors of place of delivery

C-section in private facilities was more likely among women having better socio-economic conditions, prior history of child loss, had USG done during ANC, reporting pregnancy-related complications and being medically advised. C-section in a private facility was less likely among woman who did early registration. Even after additional adjustment for complications in the regression models, for other factors the directions of associations remained same. Thus, it appeared that the drivers of private sector C-sections were instrumental similarly in both indicated and non-indicated C-sections in rural Bihar. (Table 2.)

Table 3 C-section where no definite antenatal complications were recalled

Characteristics of the respondents	Categories	Asked by family Doctor advised			
		AOR	P value	AOR	P value
USG done in ANC (ref :no)	Yes	0.41	0.0027	0.59	0.0011
Quality of ANC services (ref : poor)	Average	0.38	0.0023	0.71	0.0479
	Good	0.44	0.0178	0.58	0.0086
Respondent's educational level (ref : illiterate)	Literate > class VIII	NA		2.01	< .0001
Socio-economic status (ref : lowest tertile)	Middle tertile			0.31	< .0001
	Upper tertile			0.01	< .0001
Birth order (ref : single pregnancy)	2 pregnancies			0.58	0.0056
	> 2 pregnancies			0.58	0.0023

AOR = Odds ratio after adjustment for age, religion, caste, mother's education, socio-economic status

Having undergone C-section only due to preference by family members was less likely among women who had USG done during ANC as opposed to who did not have USG and who had better quality of antenatal care compared to those receiving poor quality care. Having undergone C-section due to only doctor's advice without having any complication was more likely among better educated and less likely among women having more number of pregnancies and who had USG done during ANC (Table 3.)

Discussion

This is the first study that explored distribution and determinants of C-section in Bihar between 2014 and 2016. The proportions of C-section varied between 8.74% and 9.34% during the study period. C-section deliveries were currently low in Bihar with specific clusters of districts having more such deliveries. The observed proportion of C-section delivery was a bit lower than the conservative WHO recommendation of 10-15%¹⁹. It is also less when compared to Latin America, Caribbean⁶, and other Asian countries including Vietnam, Bangladesh, Peru²⁰ and China²¹. But when compared to Sub-Saharan Africa, the current proportion was much higher^{22,23}. However, given different methods of calculating C-section births, these figures are not comparable across the study base.

The current analysis indicated that majority happening in the private sector compared to public hospitals. All these factors together probably indicate towards an expectation for better infrastructure for C-section in private sector especially among those with higher socio-economic condition. These findings are consistent with results from previous studies^{11,13,24,25}. So, what is prompting the increase in C-sections in private sectors. A further research is needed to explore the indications of C-section delivery in private sector

The current analysis demonstrated a positive association between education of the parents and increased likelihood of C-section delivery. This finding is consistent with prior studies^{26,27}. One of the probable explanations might be better education of respondent and husband might have helped in better identification of complications, might have increased the preference for C-section also.

The study findings also revealed that women who were economically better-off were more likely to undergo C-section delivery. Such associations were also reported from Brazil²⁴, Indonesia²⁵, Bangladesh²⁸ and other developing countries^{20,27}. Women with better socio-economic condition might have increased the inclination for C-section wrongly perceiving it to be safe, effective and less-painful procedure. History of child loss and having antenatal complications probably justifiably increased the C-section likelihood. This analysis also found that mothers having higher number of living sons and having more pregnancies were less likely to opt for the procedure, which corroborated with the Bangladesh study²⁶. This is probably after completion of family and having desired number of children, women might be more confident with normal deliveries.

Another important finding that came out from the current study was that women who were registered early had lower odds of C-section delivery compared to those who did late registration. Early registration of pregnancy probably resulted in better pregnancy care and thus less complications. Other hand, lower C-section among marginalized caste may be due to low affordability and limited access to the intervention.

Better quality antenatal care including having USG done during checkups might have increased the likelihood of only indicated C-sections through proper counselling. The present analysis also emphasized the fact that probably elective ones were not based on preference of family/doctors. Women with more no of pregnancies may be ok with normal delivery (as observed in earlier analyses also), hence they may be less likely to get motivated for C-section only based on doctors' advice in absence of a noticeable complication during pregnancy period.

Conclusion and way forward

Nevertheless, we believe that given limited knowledge in this area and because of large data set and advanced statistical analysis, the study findings provided strong evidence on C-section scenario in rural Bihar. Although the proportion of C-section delivery did not exceed the global recommendation, considering state's maternal and infant mortality rates, good quality future research is needed to explore whether women in need are getting access to this live-saving intervention and whether there is an actual increase in non-indicated C-section births in Bihar.

Reference

1. Obstetric care consensus no. 1: safe prevention of the primary cesarean delivery. *Obstetrics and gynecology*. 2014;123:693-711.
2. Gregory KD, Jackson S, Korst L and Fridman M. Cesarean versus vaginal delivery: whose risks? Whose benefits? *American journal of perinatology*. 2012;29:7-18.
3. Marshall NE, Fu R and Guise JM. Impact of multiple cesarean deliveries on maternal morbidity: a systematic review. *American journal of obstetrics and gynecology*. 2011;205:262.e1-8.
4. Souza JP, Gulmezoglu A, Lumbiganon P, Laopaiboon M, Carroli G, Fawole B and Ruyan P. Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health. *BMC medicine*. 2010;8:71.
5. Timor-Tritsch IE and Monteagudo A. Unforeseen consequences of the increasing rate of cesarean deliveries: early placenta accreta and cesarean scar pregnancy. A review. *American journal of obstetrics and gynecology*. 2012;207:14-29.
6. Betran AP, Ye J, Moller AB, Zhang J, Gulmezoglu AM and Torloni MR. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. *PloS one*. 2016;11:e0148343.
7. Gibbons L, Belizan JM, Lauer JA, Betran AP, Merialdi M and Althabe F. Inequities in the use of cesarean section deliveries in the world. *American journal of obstetrics and gynecology*. 2012;206:331.e1-19.
8. WHO Statement on Caesarean Section Rate: http://apps.who.int/iris/bitstream/10665/161442/1/WHO_RHR_15.02_eng.pdf.
9. Ghosh S and James K. Levels and trends in caesarean births: cause for concern? *Economic and political weekly*. 2010:19-22.
10. Dhodapkar SB, Bhairavi S, Daniel M, Chauhan NS and Chauhan RC. Analysis of caesarean sections according to Robson's ten group classification system at a tertiary care teaching hospital in South India. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. 2017;4:745-749.
11. Mishra US and Ramanathan M. Delivery-related complications and determinants of caesarean section rates in India. *Health policy and planning*. 2002;17:90-8.
12. Biswas AB, Das DK, Misra R, Roy RN, Ghosh D and Mitra K. Availability and use of emergency obstetric care services in four districts of West Bengal, India. *Journal of health, population, and nutrition*. 2005;23:266-74.

13. Sreevidya S and Sathiyasekaran BW. High caesarean rates in Madras (India): a population-based cross sectional study. *BJOG : an international journal of obstetrics and gynaecology*. 2003;110:106-11.
14. Bhasin S, Rajoura O, Sharma A, Metha M, Gupta N, Kumar S and Joshi I. A high prevalence of caesarean section rate in East Delhi. *Indian Journal of Community Medicine*. 2007;32:222.
15. Utz B and Halim A. Improving midwifery care worldwide. *Lancet (London, England)*. 2015;385:26-27.
16. Aminu M, Utz B, Halim A and van den Broek N. Reasons for performing a caesarean section in public hospitals in rural Bangladesh. *BMC pregnancy and childbirth*. 2014;14:130.
17. Bihar. State Information. UNICEF, India. Available at: <http://unicef.in/StateInfo/Bihar/Introduction>.
18. Das A, Mahapatra S, Sai Mala G, Chaudhuri I and Mahapatra T. Association of Frontline Worker-Provided Services with Change in Block-Level Complementary Feeding Indicators: An Ecological Analysis from Bihar, India. *PloS one*. 2016;11:e0166511.
19. Betran AP, Torloni MR, Zhang JJ and Gulmezoglu AM. WHO Statement on Caesarean Section Rates. *BJOG : an international journal of obstetrics and gynaecology*. 2016;123:667-70.
20. Ronsmans C, Holtz S and Stanton C. Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. *Lancet (London, England)*. 2006;368:1516-23.
21. Mi J and Liu F. Rate of caesarean section is alarming in China. *Lancet (London, England)*. 2014;383:1463-1464.
22. Cavallaro FL, Cresswell JA, Franca GV, Victora CG, Barros AJ and Ronsmans C. Trends in caesarean delivery by country and wealth quintile: cross-sectional surveys in southern Asia and sub-Saharan Africa. *Bulletin of the World Health Organization*. 2013;91:914-922d.
23. Chu K, Cortier H, Maldonado F, Mashant T, Ford N and Trelles M. Cesarean section rates and indications in sub-Saharan Africa: a multi-country study from Medecins sans Frontieres. *PloS one*. 2012;7:e44484.
24. Copelli FHdS, Rocha L, Zampieri MdFM, Gregório VRP and Custódio ZAdO.

Determinants of women's preference for cesarean section. *Texto & Contexto-Enfermagem*. 2015;24:336-343.

25. Nababan HY, Hasan M, Marthias T, Dhital R, Rahman A and Anwar I. Trends and inequities in use of maternal health care services in Indonesia, 1986-2012. *International journal of women's health*. 2018;10:11-24.
26. Kamal SM. Preference for institutional delivery and caesarean sections in Bangladesh. *Journal of health, population, and nutrition*. 2013;31:96-109.
27. Leone T, Padmadas SS and Matthews Z. Community factors affecting rising caesarean section rates in developing countries: an analysis of six countries. *Social science & medicine (1982)*. 2008;67:1236-46.
28. Shahabuddin AS, Delvaux T, Utz B, Bardaji A and De Brouwere V. Determinants and trends in health facility-based deliveries and caesarean sections among married adolescent girls in Bangladesh. *BMJ open*. 2016;6:e012424.

The Centre for Health Policy (CHP) at the Asian Development Research Institute (ADRI) has been set up with support from the Bill & Melinda Gates Foundation to strengthen the health sector in Bihar with a multidimensional and multi-disciplinary approach. Its aim is to engage in rigorous analysis of the health system and inform policy makers to fine-tune interventions for even stronger outcomes.

- Research and Analytical Studies

It constitutes the core of CHP's activities. The areas of research include health infrastructure and delivery with emphasis on equity, health outcomes such as IMR, MMR, TFR and its predictors, health financing, private-public partnerships, regulatory framework and its implementation, and other issues which might emerge.

- Informing Policymakers on Strengthening the Existing Health System

CHP aims to be the trusted partner of the state Government in providing evidence-based inputs in making the health system stronger, resilient and equitable.

- Sustainable Health Solutions

CHP recognizes the need for establishing a strong health system which will be self-sustaining. It means immunity to natural disasters/calamities, financial uncertainties and other unanticipated factors. These pillars may be interrelated; CHP will provide a framework of synergy among actors working on these pillars.

- Collaboration

CHP engages in collaboration with an extensive network of academic and policy research institutions both in India and abroad in health and the broader social sciences.