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Original Research Article

Interstate differences in institutional delivery and Caesarean section rates in India

Prema Ramachandran[1,*], **K Kalaivani**[1]

[1]*Nutrition Foundation of India, New Delhi, India*

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ABSTRACT

Background and Objectives: In the last two decades, India witnessed a steep rise in institutional delivery (ID) rates and some increase in Caesarean section (CS) rates. Analysis of raw data from three major surveys was undertaken with the objective of identifying factors associated with both low and high institutional deliveries and Caesarean rates so that appropriate locale specific corrective interventions can be initiated.
Materials and Methods: The raw data from NFHS4, AHS and DLHS4 were analysed to assess urban-rural and interstate differences in ID and CS rates in government and private institutions and CS rates in relation to sociodemographic and obstetric profile of the woman.
Findings: At national level $3/4^{th}$ of women had ID. There were substantial interstate variations (50·4% to 99·8%). ID rates were higher in urban areas and in DLHS4 states. CS rate in ID at the national level was 18·5%; CS rates in ID were higher in urban areas, in DLHS4 states and in private institutions in all states. Interstate differences in CS rate were high (2·4% in government institutions in Bihar to 69·2% in private institutions in West Bengal. CS rates were higher in urban, educated women from higher SLI group delivering in private institutions.
Interpretation: National surveys help in identifying the states and institutions with lower ID rates and higher CS rates and enable the initiation of appropriate interventions to strengthen institutions. Awareness generation about adverse consequences of home deliveries and CS without obstetric indications will hasten the progress towards universal institutional delivery and optimal CS rates.

1. Introduction

Safe institutional deliveries (ID) and timely caesarean sections (CS) for women with well-defined obstetric problems, save infant lives and reduce maternal morbidity.[1] However suboptimal delivery care in institutions and CS performed without obstetric indication are associated with higher maternal and perinatal morbidity and may have adverse implications for future pregnancies.[2–8] In India, both ID and CS rates were relatively low in the 1990s.[9,10] By 2015 there was a steep increase in institutional deliveries and a relatively small rise in CS rates in institutional deliveries.[11–14] Surveys,[9–14] and research studies,[15,16] have reported substantial differences in CS rate in all deliveries and institutional deliveries between urban and rural areas, different states, government (govt) and private (pvt) institutions and in women from different socio-demographic groups. High CS rates in some states and institutions especially pvt institutions, have been attributed partly to a preference for CS by institutions and providers, and partly due to the preference of women and their families for CS.[17–19] There is a need to identify factors associated with low ID rates, and low and high CS rates in IDs so that these can be addressed through appropriate interventions.

* *Corresponding author*.
E-mail address: premaramachandran@gmail.com (P. Ramachandran).

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Three major surveys District Level Health Survey 4 (DLHS4), second updation of Annual Health Survey (AHS) and National Family Health Survey 4 (NFHS4) conducted in India between 2012 and 2015 collected information on ID and CS. All three surveys were designed to provide state and district level estimates of reproductive and child health indicators, so that programme officers can identify the problem in their districts and initiate district-specific interventions. Comparison of the state-level data from these three surveys showed that there was good concordance between state-level estimates of CS rates between AHS and NFHS4 but there were substantial differences in the CS rates between NFHS4 and DLHS4 in some states. The factors responsible for the reported differences between DLHS4 and NFHS4 in some states have to be identified and corrected.

Analysis of raw data from NFHS4, DLHS4, AHS second up-dation round were undertaken with the objective of identifying factors associated with low IDs, low and high CS rates, IDs in urban and rural areas, in different states, in Pvt and Government institutions, and in relation to the sociodemographic, and obstetric profile of the women. Findings from the study will help in evolving and implementing appropriate interventions to strengthen institutions to provide safer IDs and CS and hasten the progress towards universal affordable institutional delivery and optimal CS rates.

2. Materials and Methods

DLHS4, second updation of AHS and NFHS4 were conducted between 2012 and 2015. NFHS4 covered all states and UTs. AHS covered nine states [Assam (AS), Bihar (BH), Chhattisgarh (CHH), Jharkhand (JH), Madhya Pradesh (MP), Odisha (OD), Rajasthan (RJ), Uttar Pradesh (UP), and Uttarakhand (UTT)] (AHS states) where 60% of India's population reside. DLHS4 covered most of the other states & UTs of India (DLHS4 states).

The unit-level data of NFHS4 were obtained from the Demographic and Health Survey (DHS) Programme. The unit-level data of DLHS4 was obtained from the International Institute for Population Sciences, Ministry of Health & Family Welfare (MoHFW) and data for AHS was obtained from the MoHFW. The Institutional Ethics Committee granted an exemption for secondary data analysis of these large-scale surveys.

The schedules used for data collections in NFHS4, DLHS4 and AHS second updation round were compared. All the surveys collected information on place and mode of delivery. For the present study, deliveries in institutions with inpatient beds where women were admitted and a doctor and nursing staff were available to provide care during delivery were defined as institutional delivery; therefore, sub-centre deliveries were not included as government institutional deliveries. None of the surveys collected information on whether CS was undertaken in institutions where deliveries occurred. Therefore, for computing CS rates in institutional deliveries, all institutions where delivery occurred had been used as the denominator.

NFHS4, AHS and DLHS4 were designed to provide the district level estimates on health and family welfare indices. The reports of these surveys indicate that they were designed for self-weighing at the domain level (urban and rural areas of each state). The household sampling weight was further adjusted for individual non-response to obtain the individual sampling weight. Both adjustments for non-response were done at the domain level in order to preserve the self-weighting nature of the sample within domains. The national and state standard weights were normalized so that the total number of weighted cases equals the total number of unweighted cases at the national and state level.[11–14] In view of this, the data from all three surveys were analysed without using any weights.

Data analysis were done using IBM SPSS Statistics 27. Data at the state level from all the three surveys were analysed for all AHS states and the following DLHS4 states – Haryana (HR), Himachal Pradesh (HP), Karnataka (KA), Kerala (KL), Maharashtra (MH), Punjab (PB), Tamil Nadu (TN) and West Bengal (WB). Institutional delivery rates as % of total deliveries, overall CS rate as % of total deliveries, CS rate as % of institutional deliveries were computed separately in government and pvt institutions.

Computed data on institutional delivery (as defined for the purpose of the study) and CS rates in institutional deliveries were compared with the data on these indicators from Reports/Fact Sheets of NFHS 4, DLHS4 and AHS (second updation round) to assess whether there were any differences between the computed rates and the rates reported in the Reports/Fact Sheets. CS rates in relation to sociodemographic and obstetric profiles were computed in AHS and DLHS4.

3. Results

At the national level 75% of women had ID. ID rates were lower in AHS states as compared to DLHS4 states. At the national level CS rates in IDs was 18·5%. CS rates in all deliveries and CS rates in IDs were higher in DLHS4 states as compared to AHS states (Table 1).

ID rates and CS rates in institutions (especially pvt institutions) were higher in urban as compared to rural areas. Both in urban and rural areas CS rates in pvt institutions were higher as compared to government institutions. CS could not be performed at subcentre or home; these are likely to be data entry errors (Figure 1 a,b).

ID rates computed from NFHS 4 were similar to the ID rates for the respective state compiled from AHS and DLHS4. Compared to AHS states ID rates were higher in DLHS4 states. There were substantial interstate differences (50·4% to 99·8%) in institutional deliveries. In all states

Table 1: Institutional deliveries (ID) and Caesarean sections (CS) in India

Survey	Year	Total Deliveries	Institutional deliveries		Caesarean Section		
			Number	Rate	Number	% in total deliveries	% in ID
NFHS 4	2015-16	255584	189401	74·1	35184	13·8	18·5
AHS	2012-13	442840	271611	61·3	39681	9·0	13·0
DLHS 4	2012-13	114160	90794	79·5	21510	18·8	23·5

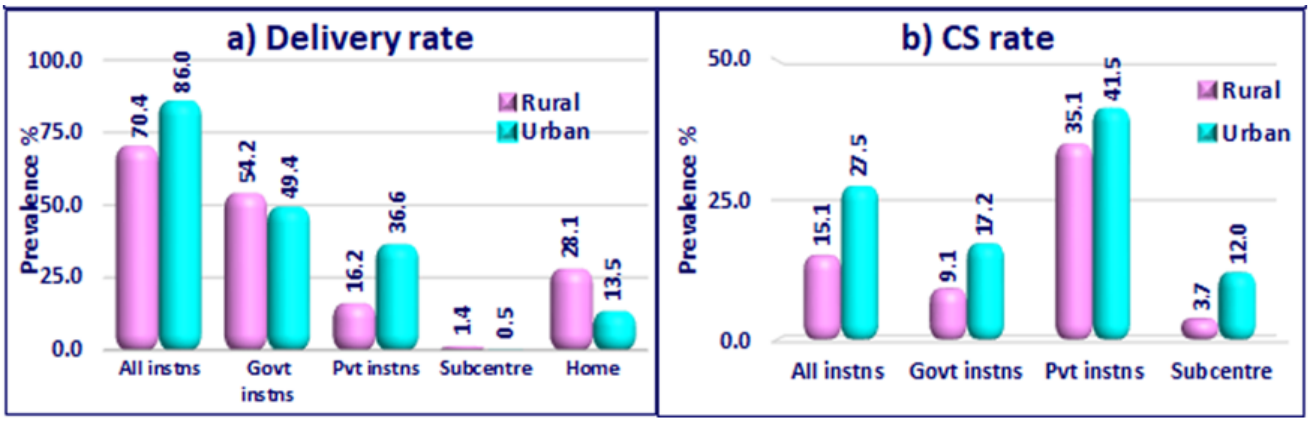


Fig. 1: Urban rural differences in place of delivery & Caesarean section (NFHS 4)

except in Kerala, a higher proportion of women delivered in government hospitals as compared to pvt hospitals. Sub centre deliveries were uncommon. Home delivery rates ranged between 0·2% in Kerala to 49·6% in Jharkhand (Figure 2 a,b).

Computed data on CS rates in IDs from NFHS4 were comparable to the CS rates in respective states in AHS and DLHS4. In all states, CS rates were higher in pvt as compared to government institutions. Compared to AHS states CS rates were higher in DLHS4 states both in govt and pvt institutions. There were substantial interstate differences in CS rates in govt institutions (2·4% in BH and 17·2% in WB) and in pvt institutions (BH 20·0% and WB 69·2%) (Figure 3a,b).

Data on CS rates in IDs computed from NFHS4 were compared to the CS rates reported in the fact sheets/reports for respective states in AHS and DLHS4. There was good concordance between the NFHS4 and AHS; but CS rates in govt and pvt institutions reported for some states in DLHS4 fact sheets were substantially lower when compared to the CS rates for the state computed from NFHS4 (Figure 4a, b).

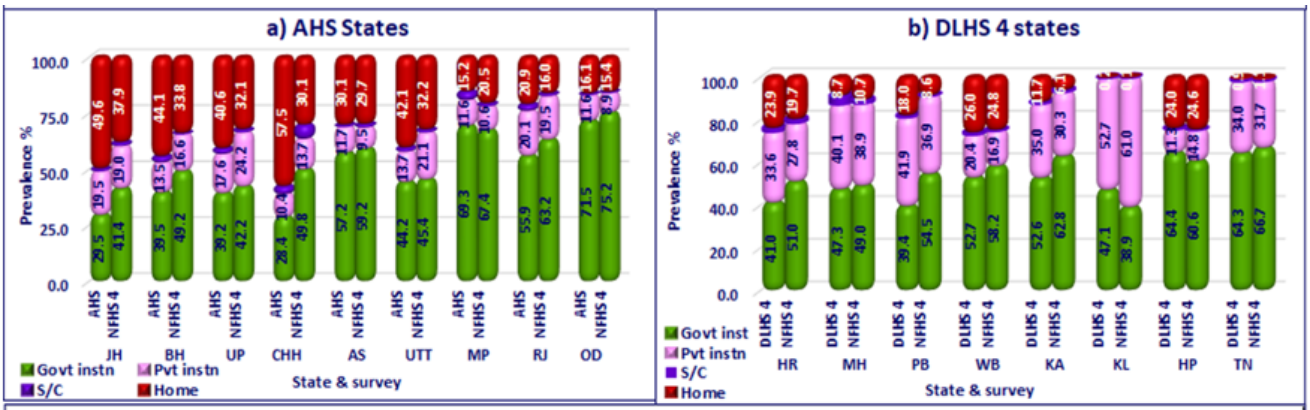
Data from AHS and DLHS4 showed that there were no substantial differences in CS rates in relation to age and parity; irrespective of the age and parity CS rates were higher in DLHS4 as compared to AHS; CS rates in pvt institutions were higher as compared to Govt institutions both in AHS and DLHS4 (Figure 5 a,b).

There was a gradient in CS rates both in govt and pvt institutions in relation to the education and standard of living index (SLI) of the family. CS rates both in AHS and DLHS4 were highest in college-educated women from high SLI groups (Figure 6 a,b).

4. Discussion

4.1. Trends in institutional deliveries

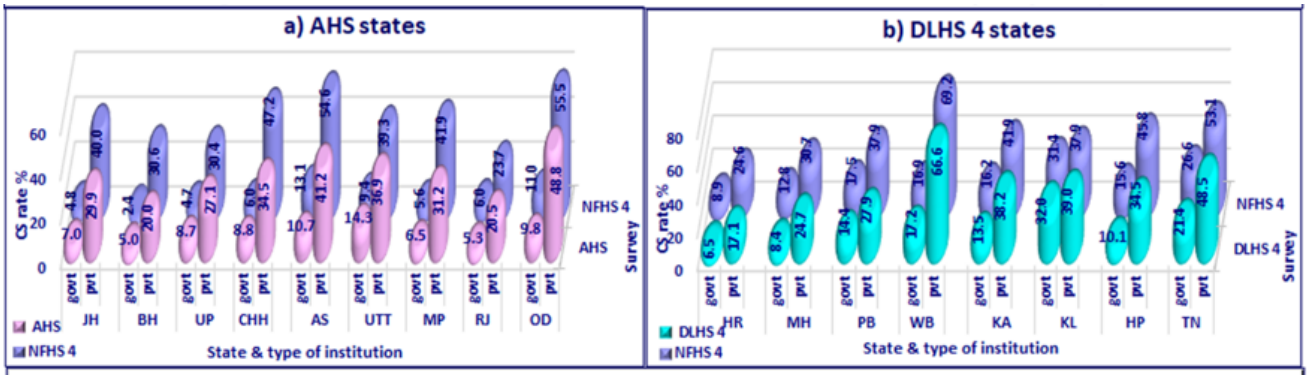
India recognised the importance of antenatal and delivery care for reducing the high maternal and perinatal morbidity and mortality and built up the needed urban and rural primary health care infrastructure and manpower by 1990. But the improvement in institutional delivery rate and reduction in perinatal mortality was tardy.[9,10] The dawn of the new millennium gave a fillip to the country's efforts to improve antenatal and delivery care and achieve the MDG targets for maternal and infant mortality rates.[20] The Village Health and Nutrition Days provided a platform for antenatal care and health education by Accredited Social Health Activist (ASHA), Anganwadi Worker (AWW) and Auxiliary Nurse Midwife (ANM). ASHA facilitated the mothers accessing institutional care during pregnancy and labour. The Janani Suraksha Yojana (JSY), reduced the financial barriers to delivery care in institutions.[21] Between 2000 and 2021 all the states showed improvement in institutional delivery rates both in urban and rural areas. NFHS5 (2019-2021) reported ID rate of 93·8% in the urban and of 86·7% in the rural areas.[22] Clearly as and when affordable access was provided, women and their families did seek institutional delivery. Experience in the last decade suggests that the country will soon achieve universal institutional deliveries both in urban and rural



CI for Prevalence of institutional deliveries in states in surveys

95% CI	UTT	RJ	UP	BH	AS	JH	OD	CHH	MP	HP	PB	HR	WB	MH	KA	KL	TN
AHS/DLHS4	57.3-58.5	75.6-76.5	56.6-57.2	52.7-53.4	68.5-69.4	48.6-49.6	82.7-83.5	38.3-39.4	80.5-81.2	73.6-77.6	80.5-82.1	73.8-75.4	72.2-74.1	86.9-87.9	87.2-88.2	99.6-99.9	98.0-98.5
NFHS 4	66.4-66.5	82.2-83.3	66.0-66.9	65.1-66.3	68.7-68.6	59.5-61.3	83.5-84.9	62.6-64.5	77.5-78.6	73.8-76.9	90.6-92.1	77.9-79.7	73.8-76.2	87.2-88.6	92.6-93.7	99.7-100.0	98.1-98.7

Fig. 2: Inter-state differences in place of delivery AHS, DLHS4 & NFHS4 (Computed)



CI for CS rates in institutional deliveries in states in surveys

95% CI	UTT	RJ	UP	BH	AS	JH	OD	CHH	MP	HP	PB	HR	WB	MH	KA	KL	TN
AHS/DLHS4	19.0-20.3	8.9-9.6	14.1-14.7	8.6-9.1	15.5-16.3	15.6-16.7	14.8-15.7	15.0-16.3	9.7-10.3	11.9-15.6	20.5-22.3	10.6-11.9	29.8-32.2	15.3-16.5	22.7-24.0	33.9-37.5	29.9-31.6
NFHS 4	17.7-20.2	9.7-10.7	13.7-14.5	9.1-9.9	17.9-19.8	15.0-16.7	15.0-16.4	14.0-15.8	10.1-11.0	19.8-23.2	24.5-27.0	13.6-15.3	27.2-30.0	19.8-21.6	23.5-25.5	33.5-37.3	34.1-36.2

Fig. 3: Interstate differences in CS rates in institutional deliveries (computed)

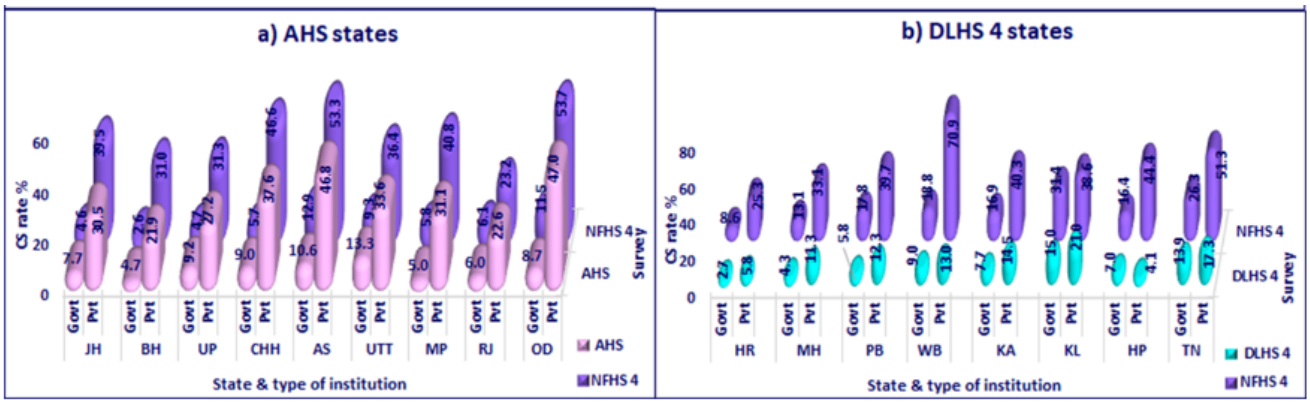


Fig. 4: Interstate differences in CS rates in institutional deliveries (from fact sheets)

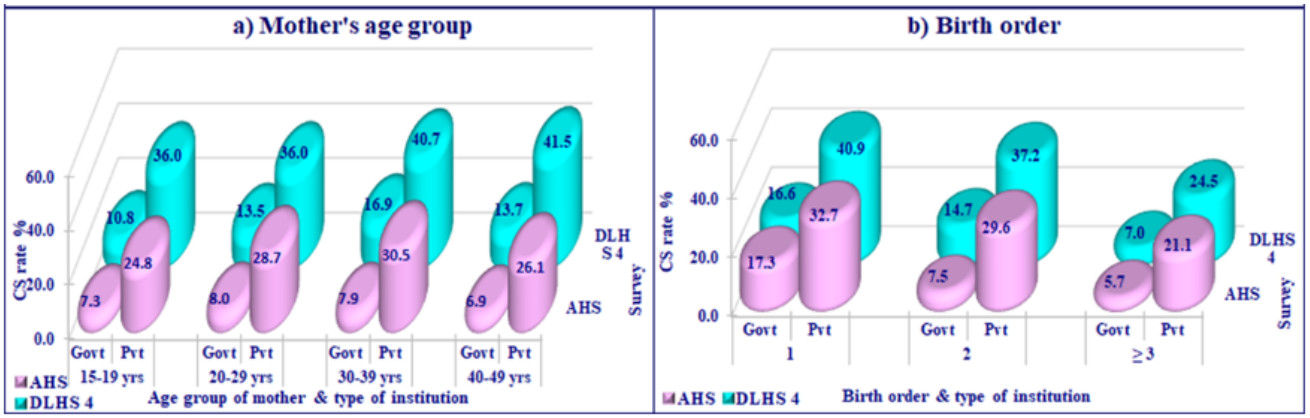


Fig. 5: CS rates in institutional deliveries in relation to obstetric profile (AHS and DLHS4)

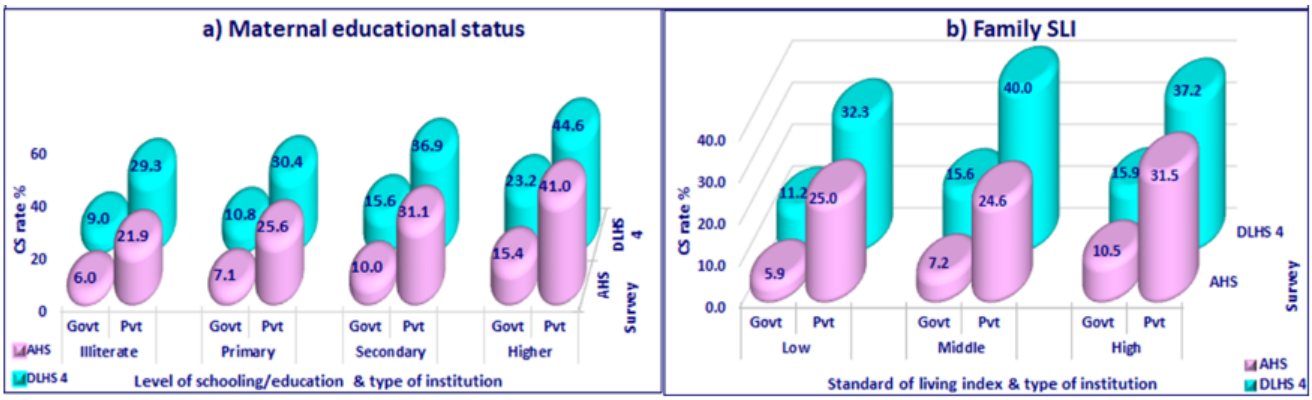


Fig. 6: CS rates in instituional deliveries in relation to socio-demographic profile (AHS and DLHS4)

areas in all states.

It is well documented that there are inadequacies in infrastructure and deficiencies in manpower in govt health care institutions especially in AHS states where 60% of India's deliveries occur. Despite these inadequacies the steepest increase in institutional delivery rates occurred in govt institutions in AHS states (Figure 2). It is important to improve health infrastructure and manpower in these states, so that women do get optimal delivery care and there is substantial improvement in maternal and perinatal morbidity and mortality.

Infrastructure and manpower in govt institutions in DLHS4 states were better as compared to AHS states; despite this, delivery in pvt institutions was common in DLHS4 states (Figure 2) Kerala ranked high in terms of adequacy of the govt primary health care infrastructure but over 60% of deliveries were in pvt institutions. Improving people friendliness in govt institutions, addressing convenience of women, generating awareness that the cost of care is lower and CS without clear cut obstetric indications are unlikely in the govt institutions may improve institutional deliveries in govt hospitals.

4.2. Trends in caesarean section rates

India is witnessing a steep increase in institutional deliveries and a relatively lower rise in CS rates. CS rates among all deliveries were lower in AHS states as compared to DLHS4 states. This was partly due to lower percentage of institutional deliveries and partly due to lower CS rates in IDs. Rise in institutional delivery leading to increase in CS for obstetric problems is essential for improvement in perinatal outcome and has to be supported by appropriate institution strengthening.

All the surveys have reported CS being performed in sub-centre and/or at home. (Figure 2). This might be due to errors in data collection or data entry either of the place of delivery or type of delivery. These errors do not make any significant difference in computed CS rates in govt institutions. But such errors do raise worries about the technical quality of the data collection. Data collection errors might be because survey was not done by health para-professionals. Qualified para-professionals are available in India; if they were recruited and trained in the survey methodology, it might be possible to prevent such errors and improve the technical quality of data collected.

As the country and the states are witnessing rapid but variable changes in ID rates, CS rates in institutional deliveries are the appropriate indicators to track changes in CS rates. Not all institutions which are equipped for conducting delivery are equipped to perform CS e.g PHC is equipped for deliveries but not for CS. None of the surveys collected information on whether the institution conducting delivery was also performing CS. In the absence of this information, CS rates have been computed using all institutional deliveries as the denominator. If at the time of the survey, information on whether CS is being done in the institution where the woman has delivered is recorded, it will be possible to compute CS rates in institutions equipped to perform CS.

4.3. Differences between computed and reported CS rates

In the present study CS rates in govt and pvt institutions computed from the raw data of NFHS4, AHS and DLHS4, were compared with the reported CS rates from Fact Sheets/Reports of these surveys. The CS rates were comparable in NFHS4 and AHS after taking into account the differences in the definition of institutional delivery used in the study. But, reported CS rates in pvt and govt institutions in DLHS4 Fact Sheets were lower as compared to the computed rates (Figure 4). This has not been reported in the published study on CS rates in DLHS4.[19] This difference was due to the fact that in DLHS4, CS rates appear to have been computed as:

1. CS rates in govt institutions=Number of CS in govt institutions/number of deliveries in govt+pvt institutions.
2. CS rates in pvt institutions=Number of CS in pvt institutions/number of deliveries in govt +pvt institutions.

The error of using combined (both govt & pvt) institutional deliveries as denominator while calculating CS rate separately for govt or pvt institutions resulted in CS rates in DLHS 4 being the lowest among all the surveys. Programme officers often use the reported data on CS rates from Fact sheets of surveys for initiating district-specific interventions and monitoring impact of the ongoing interventions. Because of the error in computing CS rates in DLHS4, data on CS rates in NFHS4 were interpreted by some programme officers as a rise in CS rates across both pvt and govt institutions in DLHS4 states. It is essential to ensure that uniform criteria are used for computing and reporting CS rates across all surveys.

4.4. Interstate differences in CS rates

There were substantial urban, rural, and inter-state differences in CS rates in IDs. CS rates in govt institutions, pvt institutions and all institutions were lower in AHS states as compared to DLHS4 states. This could be partly because of:

1. Lower CS rates in govt hospitals in AHS states perhaps due to the inadequacies in institutional facilities in these states; and
2. A relatively lower proportion of women delivered in pvt institutions with high CS rates.

To improve perinatal and maternal outcomes, it is essential to invest in health infrastructure and manpower in states with low CS rates and ensure that all women with obstetric problems do benefit from timely CS.

Among the DLHS 4 states CS rates were lowest in HR; KL and TN had higher CS rates because:

1. CS rates even in govt institutions were high,
2. High proportion of deliveries were in pvt institutions, and
3. CS rates in pvt institutions were higher than those in govt institutions.

Awareness generation on the adverse health consequences of CS without obstetric indications may play an important role in halting the rise in CS rates in IDs.

4.5. CS rates in Govt and pvt institutions

All three surveys showed that CS rates in govt institutions were significantly lower as compared to CS rates in pvt institutions in all states, in urban or rural areas. The lower CS rates in Govt hospitals might be because trained health education staff in these institutions were able to convince the women and their families that CS should be done only for obstetric indications. These efforts should be supported to achieve optimal CS rates in govt institutions in all states.

CS rates in pvt institutions were higher as compared to Govt institutions in all surveys, in all states in urban and rural areas. WB has reported the highest CS rates in pvt hospitals. Such high CS rates are unlikely to be due to obstetric indications. Factors responsible for high CS rates in pvt institutions may include the women and/or their families opting for CS (because of the misconception that CS is a pain-free and safe mode of delivery), preference of doctors or institutions for CS (for financial and logistic reasons).[19–21]

4.6. CS rates in relation to socio-demographic and obstetric profile

All the survey reports, as well as publications from in-depth analysis of raw data from surveys on the impact of sociod emographic parametersand obstetric factors (available in the survey proforma) on CS rates have shown that CS rates were higher in DLHS 4 states, women residing in urban areas,

and literate women from upper socioeconomic strata and those accessing pvt institutions for delivery.[19–21] Data from the present study has also shown that categories of women with higher CS rates are from higher socio-economic and educational groups. Such women are likely to be better nourished, and access antenatal care, benefit from early detection and effective management of obstetric problems. Therefore, CS rates for obstetric indications are expected to be lower in these women. CS audits done by obstetricians and epidemiologists can assess whether the reported higher CS rates were due to CS being done without obstetric indications in some women.

In the coming years the country will have to strive to provide near-universal access to institutional delivery and keep the CS rates at optimal levels. Prevention of CS without obstetric reasons should be included as an important topic for continuing education programme for medical officers and obstetricians. The WHO has developed guidelines for technical audit of CS in institutions regarding the indications for CS and these have been used in several countries.[23–27] Institutionalising universal CS audits may go a long way in identifying institutions where women who needed CS did not get it and where CS was being done without obstetric indications. In addition to governmental oversight, professional associations can help in institutional audit of CS rates.

5. Conclusion

Analysis of data from large surveys provided useful information on trends in institutional delivery and CS rates. All states require intuitional strengthening and improvement in people friendliness in all institutions so that the objective of near-universal institutional safe delivery and optimal CS rates is achieved soon. AHS states with a higher number of deliveries and suboptimal infrastructure need substantial additional inputs for institutional strengthening. CME programmes for health professionals and health education programmes to pregnant women and their families on adverse consequences of CS done without obstetric indications may halt rise in CS rates. These interventions may enable the country to achieve the twin objectives of universal institutional delivery and optimal CS rates within a decade.

6. Strengths of the Study

Raw data from large scale representative national surveys have been analysed using uniform definitions.

7. Limitations

The data collection was predominantly done by trained personnel who were not qualified health para-professionals. Assessment of changes in institutional deliveries and CS rates in institutional deliveries were not objectives of these surveys.

8. Data Availability

Data pertaining to all the three surveys are available in public domain.

9. Author Contributions

PR Conceptualisation, study design.

KK Data cleaning, data analysis, preparation of the graphics for the manuscript.

Both authors: review of literature, methodology, tabulation plan and drafting of the manuscript.

10. Funding Source

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11. Conflict of Interest

The authors declare no conflict of interest.

References

1. World Health Organization. WHO Statement on Caesarean Section Rates: Geneva, Switzerland; 2015. Available from: http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/cs-statement/en/.
2. Betran AP, Ye J, Moller AB, Zhang J, Gulmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates. *PLoS One*. 2016;11(2):e0148343. doi:10.1371/journal.pone.0148343.
3. Althabe F, Sosa C, Belizán JM, Gibbons L, Jacquerioz F, Bergel E. Cesarean section rates and maternal and neonatal mortality in low, medium, and high-income countries: an ecological study. *Birth*. 2006;33(4):270–4.
4. Molina G, Weiser TG, Lipsitz SR, Esquivel MM, Urib-Leitz T, Azad T, et al. Relationship between cesarean delivery rate and maternal and neonatal mortality. *JAMA*. 2015;314(21):2263–70.
5. Festin MR, Laopaiboon M, Pattanittum P, Ewens MR, Henderson-Smart DJ, Crowther CA, et al. Caesarean section in four South East Asian countries: reasons for, rates, associated care practices and health outcomes. *BMC Pregnancy Childbirth*. 2009;9:17. doi:10.1186/1471-2393-9-17.
6. Shah A, Fawole B, M'imunya JM, Amokrane F, Nafiou I, Wolomby JJ, et al. Cesarean delivery outcomes from the WHO global survey on maternal and perinatal health in Africa. *Int J Gynaecol Obstet*. 2009;107(3):191–7.
7. Lumbiganon P, Laopaiboon M, Gülmezoglu AM, Souza JP, Taneepanichskul S, Ruyan P. Method of delivery and pregnancy outcomes in Asia: the WHO global survey on maternal and perinatal health 2007-08. *Lancet*. 2010;375(9713):490–9.
8. Sandall J, Tribe RM, Avery L, Mola G, Visser GH, Homer CS, et al. Short-term and long-term effects of caesarean section on the health of women and children. *Lancet*. 2018;392(10155):1349–57.
9. IIPS. National Family Health Survey-1. Available from: http://rchiips.org/nfhs/pub_nfhs-1.shtml.
10. IIPS. National Family Health Survey-2; 2021. Available from: http://rchiips.org/nfhs/pub_nfhs-2.shtml.

11. IIPS. National Family Health Survey- 3; 2021. Available from: https://dhsprogram.com/pubs/pdf/frind3/frind3-vol1andvol2.pdf.
12. IIPS National Family Health Survey-4 Fact sheet; 2021. Available from: http://rchiips.org/nfhs/pub_nfhs-4.shtml.
13. IIPS District Level Household and Facility Survey (DLHS-4); 2021. Available from: http://rchiips.org/DLHS-4.html.
14. RGI Clinical anthropometric and biochemical component of Annual health survey Fact sheets; 2021. Available from: http://www.censusindia.gov.in/2011census/hh-series/cab.html.
15. Ghosh S, James KS. Levels and Trends in Caesarean Births: Cause for Concern? *Eco Pol Wkly*. 2010;30:19–22.
16. Lee HW, Kim R, Juhwan O, Subramanian SV. Association between the type of provider and Cesarean section delivery in India: A socioeconomic analysis of the National Family Health Surveys 1999, 2006, 2016. *PLOS ONE*. 2021;doi:10.1371/journal.pone.0248283.
17. Desai G, Anand A, Modi D, Shah S, Shah K, Shah A, et al. Rates, indications, and outcomes of caesarean section deliveries: A comparison of tribal and non-tribal women in Gujarat, India. *PLoS One*. 2017;12(12):e0189260.
18. Sreevidya S, Sathiyasekaran BW. High caesarean rates in Madras (India): a population-based cross sectional study. *Int J Obstet Gynaecol*. 2003;110(2):106–11.
19. Singh P, Hashmi G, Swain PK. High prevalence of cesarean section births in private sector health facilities-analysis of district level household survey-4 (DLHS-4) of India. *BMC Public Health*. 2018;18(1):1–0.
20. Millennium Development Goals India Country Report; 2015. Available from: https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.
21. National Health Mission : Janani Suraksha Yojana (JSY) ; 2005. Available from: https://www.nhp.gov.in/janani-suraksha-yojana-jsy-_pg.
22. IIPS: NFHS5 India fact sheet. Available from: http://rchiips.org/nfhs/factsheet_nfhs-5.shtml.
23. Robson MS, Scudamore IW, Walsh SM. Using the medical audit cycle to reduce cesarean section rates. *Am J Obstet Gynecol*. 1996;174(1):199–205.
24. Robson M, Hartigan L, Murphy M. Methods of achieving and maintaining an appropriate caesarean section rate. *Best Pract Res Clin Obstet Gynaecol*. 2013;27(2):297–308.
25. WHO Robson Classification: Implementation Manual (2017). Available from: https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/robson-classification/en/.
26. Boatin AA, Cullinane F, Torloni MR, Betrán AP. Audit and feedback using the Robson classification to reduce caesarean section rates: a systematic review. *Int J Obstet Gynaecol*. 2018;125(1):36–42.
27. Betran AP, Torloni MR, Zhang J, Ye J, Mikolajczyk R, Deneux-Tharaux C, et al. What is the optimal rate of caesarean section at population level? A systematic review of ecologic studies. *Reprod Health*. 2015;12:57.

Author biography

Prema Ramachandran, Director https://orcid.org/0000-0003-1974-8281

K Kalaivani, Deputy Director

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