# Maternal Health in Assam: Unveiling Broader Challenges

Bimal K Kar[1], Anchal Purbey[2], Aditi[3], Minakshi Buragohain[4], L David Lal[5], Punit Mishra[6], Subrato Mondal[7]

## *Keywords*

Maternal health, NFHS, SRS, Assam, Northeast, Continuum of Care

## Abstract

The current study focuses on the maternal health of the Northeastern part of India, with special emphasis on Assam; because given the MMR rates at the national level are improving, the state still has the highest MMR among all states of India. Using NFHS 4 and 5 and SRS 2018-20, this study analyses key maternal health indicators, including ANC, institutional deliveries, and PNC utilization, highlighting that despite high ANC coverage, PNC utilization is very low, leading to poor maternal health outcomes. The Continuum of Care (CoC) framework was utilized to analyze differences among regions, which revealed the gaps between institutional delivery and PNC, which exceeds 20%. Compared to the national average MMR of 97, Assam's high MMR of 195 is led by a lack of adequate healthcare access, high rates of teenage pregnancy, anemia, and socioeconomic variation. This study shows a weak correlation between C-section rates and MMR, highlighting the Quality of care over procedural prevalence, addressing systematic gaps by targeted interventions especially in Assam and the whole of the north-east.

[1] Gauhati University, Guwahati. Email: bimalkar@gauhati.ac.in

[2] PopulationCouncil Consulting Pvt. Ltd, Delhi. Email: apurbey@pcconsulting.co.in

[3] PopulationCouncil Consulting Pvt. Ltd, Delhi. Email: aditi@pcconsulting.co.in

[4] Tata Institute of Social Sciences, Guwahati, Assam. Email: minakshi.buragohain@tiss.edu

[5] Indian Institute of Information Technology Guwahati, Guwahati, Assam. Email: david@iiitg.ac.in

[6] PopulationCouncil Consulting Pvt. Ltd, Delhi. Email: punitrd@gmail.com

[7] USAID, India. Email- smondal@usaid.gov

# Introduction

Maternal health is influenced by a variety of factors, including complications that may arise during and after pregnancy. Globally, direct obstetric factors account for about 82% of maternal deaths, and indirect factors account for the remaining 18 percent. In the case of India, direct obstetric causes account for 87% of total maternal deaths.

Direct causes leading to maternal deaths in India include hemorrhage (13%), hypertensive disorders (12%), maternal abortion and miscarriage (11%), sepsis and other maternal infections (11%), ectopic pregnancy (11%) and other maternal disorders (29%). Other maternal disorders include congenital malformation of uterus, abnormal biochemical finding during pregnancy, prolonged pregnancy, preterm labor, prolonged labor, perineal laceration during delivery, twin pregnancy, breech, obstructed labor and uterine rupture, cesarean delivery wound, late maternal deaths and deaths aggravated by HIV/AIDS. The indirect causes include anemia, malaria, tuberculosis or chronic conditions like cardiac diseases or diabetes (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators, 2018).

Maternal health in Northeast India remains a significant concern due to various challenges and unique contextual factors that affect the well-being of pregnant women in the region. Northeast India is characterized by its diverse ethnicities, hilly terrains, high tribal population, international borders, areas with frequent disasters and limited access to healthcare facilities (Mukherjee, Rizu, & Parashar, 2022). These contextual factors and socio-cultural beliefs and economic disparities contribute to the complexities surrounding maternal health and the need for a comprehensive Continuum of Care (CoC) approach to maternal health. Maternal mortality rates have decreased globally, but they are still high in several low- and middle-income countries (LMICs), including India, where maternal health is still a significant public health concern (World Health Organization [WHO], 2015). In 2015, India alone accounted for roughly one-fifth of all maternal deaths worldwide with significant intra- and inter-state differences (World Health Organization [WHO], 2015).

CoC from the onset of pregnancy to childbirth plays a significant role in averting maternal deaths. CoC refers to the continuity of individual care throughout the lifecycle (adolescence, pregnancy, childbirth, the postnatal period and childhood) and also between places of caregiving—households and communities, outpatient and outreach services and clinical-care settings (Kerber et al., 2007). Previous studies utilizing the dataset from the 4th round of the National Family Health Survey (NFHS 2015–16)

have reported that women residing in northeast states have lower odds of utilizing complete maternal care (Kothavale & Meher, 2021). Further, barriers to affordability and availability were also found to reduce the likelihood of seeking complete maternal care. Another study on CoC, utilizing the same dataset revealed that only 17% of pregnant women availed the utilization of complete maternal care and 83% either did not seek any care or dropped out after seeking one or two services. Further, the study found that 79% of women who registered for antenatal care services (ANC) did not avail the same adequately (Gandhi et al., 2022). Northeast India has the lowest (83%) ANC utilization in India, with the highest in the southern region (98%) (Nagdev et al., 2023). The District Level Household and Facility Survey (DLHS) study indicates that women from the southern and western regions exhibit higher completion rates of the CoC including prenatal care, institutional delivery and postnatal care (PNC) compared to those from the northern region. Whereas women from the eastern and northeast regions have lower CoC completion rates compared to other regions (Ramanand et al., 2020).

Against this backdrop, this research paper aims to examine the current status of maternal health in the northeast states of India, utilizing the most recent data from the NFHS conducted in 2019–2021. The paper also sheds light on the concerning issue of high maternal mortality ratios specifically within the state of Assam.

# Data and Methodology

## Data Source

The study used data from the NFHS survey conducted in 2015–16 and 2019–21. The sampling procedure for the surveys is explained in detail elsewhere (International Institute for Population Sciences [IIPS] & ICF, 2021). Information was analyzed from all eligible women aged 15–49 from the Woman's Questionnaire of the surveys who were asked questions, among others, on ANC, delivery care and PNC. Maternal Mortality Ratio (MMR) data was pooled from the Sample Registration System (SRS 2018–20).

# Methodology

The analysis of this study was limited to 104 districts from the eight northeast states— Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The outcome variables taken to demonstrate the CoC include important maternal health indicators such as 1) mothers who had an antenatal check-up in the first trimester, 2) mothers who had at least 4 antenatal care visits, 3) mothers who delivered their last child in any health

facility and 4) mothers who received PNC from a skilled health professional within 2 days of delivery for last birth.

The prevalence in each of the 4 indicators was further categorized into 1) higher than national average, 2) higher than regional average but lower than national average 3) higher than state average but lower than regional average and 4) lower than state average. Only 4 categories were considered for ease of classification. The CoC framework for maternal health was adopted from the framework developed by Kerber et al., (2007), though this study focused on the utilization of care assuming two stages as shown in **Figure 1**. The CoC gap between both the stages presented are absolute differences.

**Figure 1. Hypothesized structural relationships for the continuum of care for maternal health.**
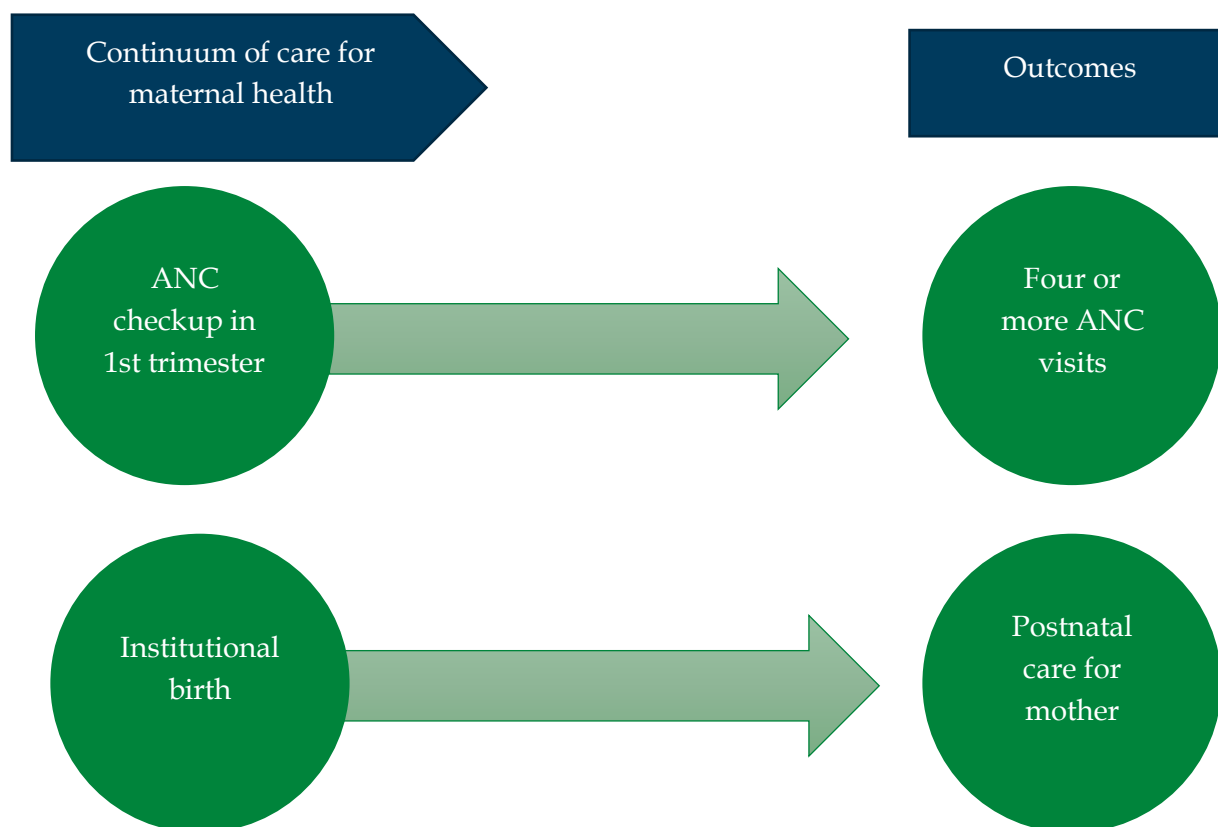


## Results

The results of this study have been divided into two segments. The first segment focuses on the level of maternal health indicators and CoC in northeast states. The second takes a deep dive in the health situation of Assam, which has the

highest maternal mortality amongst all the northeast states.

## Level of maternal health indicators and continuum of care in northeast states

In the northeastern region, states such as Sikkim, the eastern part of Assam, northern and eastern part of Mizoram and the central part of Manipur generally performed well in terms of all 4 maternal health indicators. On the other hand, the southern part of Mizoram, all districts of Manipur excluding the central region closer to the state capital and eastern part of Nagaland overall performed poorly in all maternal health indicators. In terms of the difference in ANC visits in the first trimester and 4 or more ANC visits, Nagaland overall had a gap of more than 20 percent. This is quite prominent as all the gaps may not be explained by having 4 or more ANC visits while skipping the ANC visit in the first trimester. The gap between institutional delivery and PNC for the last birth was higher than 20% in most of the regions especially Arunachal Pradesh, Assam and Sikkim [Figure 2,3].

ANC services need greater focus in southern, western and northern districts of Assam; eastern districts in Nagaland; East district in Sikkim and most of the districts in Tripura. A few districts in the eastern part of Arunachal Pradesh and all districts in Nagaland had a gap of more

than 20% between ANC visits in first trimester and 4 or more ANC visits. Many districts in Mizoram had a gap of 10% or more between ANC visit in 1st trimester and 4 or more ANC. Particularly in case of Meghalaya, the 4 districts where the numbers for 4 or more ANC visits were higher than the national average had in fact lower prevalence of ANC visit in first trimester. Alternately, Tawang district in Arunachal Pradesh and some eastern districts fared well in ANC visits in first trimester but performed poorly in 4 or more ANC visits [Figure 2].

Delivery care services such as institutional delivery and PNC in central districts of Assam, eastern districts in Meghalaya, most districts in Nagaland, East district in Sikkim were generally lower than the national average. The gap between institutional delivery and PNC for mothers was larger in most of the districts of Arunachal Pradesh, central part of Assam, all districts of Sikkim excluding South district with a difference of 20% or more. Four northern districts in Mizoram and 3 districts in Tripura with higher institutional delivery than the national average fared poorly in context of PNC for mother, with a gap of 10–20% or more between institutional delivery and PNC [Figure 3].
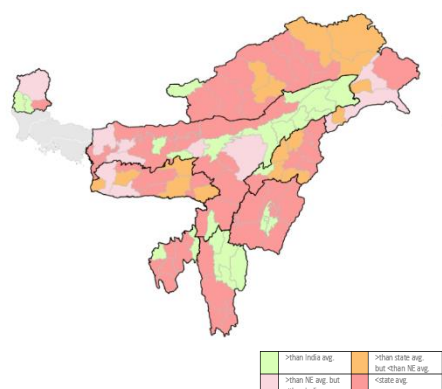
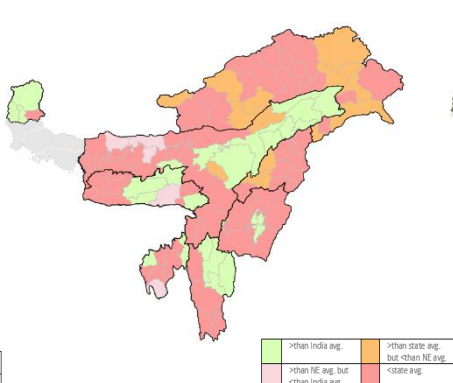Figure 2 (a). Prevalence of ANC checkups in first trimester in northeast states



Figure 2 (b). Prevalence of 4 or more ANC visits in northeast states
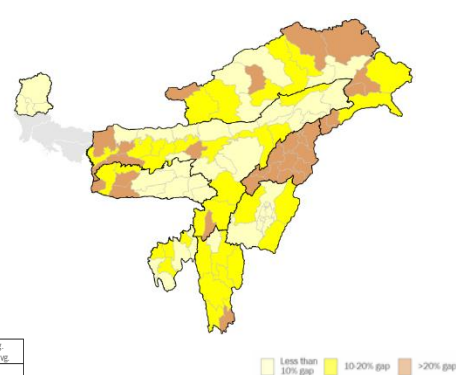


Figure 2 (c). Continuum gap: Gap between ANC visit in 1st trimester and 4 or more ANC visits
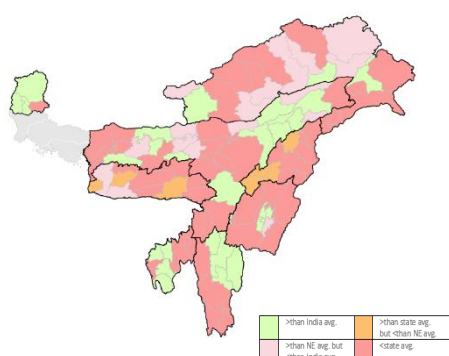
*3*



Figure 3 (a). Prevalence of institutional births in northeast states
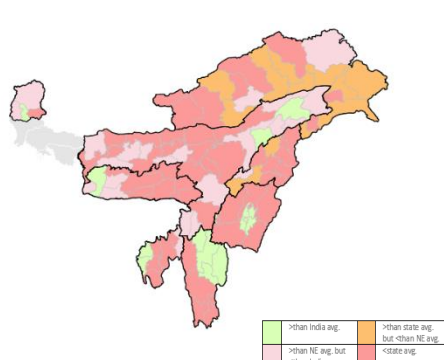


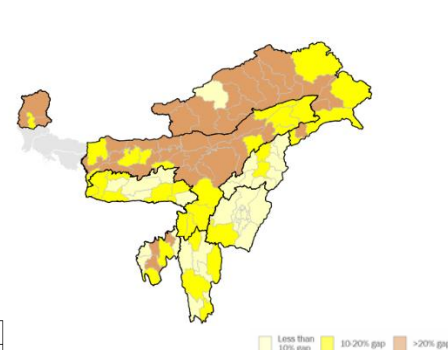Figure 3 (b). Prevalence of postnatal care for mother in northeast states



Figure 3 (c). Continuum gap: Gap between institutional delivery and PNC for mother

## Maternal mortality: Situation of Assam

Maternal mortality refers to the death of a woman during pregnancy, childbirth or within 42 days postpartum. Despite global efforts to reduce maternal mortality, it remains a persistent challenge, particularly in low-resource settings. Northeast India faces unique socioeconomic, cultural and geographic factors contributing to high maternal mortality ratios. According to SRS 2018–20, India's MMR was 97 and among all larger states and UTs, Assam had the highest MMR at 195. This section explains maternal mortality in the northeast with a focus on Assam.

Table 1 presents direct obstetric causes of maternal mortality in Assam based on data from NFHS-4 and NFHS-5. The table highlights that during pregnancy, a number of women in Assam experienced indicators associated with direct obstetric causes of maternal mortality. However, there was no change in these indicators between NFHS-4 and NFHS-5. Approximately 8–12% of pregnant women reported experiencing difficulties with daylight vision and convulsions unrelated to fever. Additionally, around 24–25% of pregnant women reported swelling in their legs, body or face. A significant percentage of women experienced complications from abortions, with the proportion increasing from 12% in NFHS-4 to 17% in NFHS-5. Private health facilities were predominantly sought by women for the treatment of complications caused by abortions.

**Table 1 Direct obstetric causes: the situation in Assam**

| Indicators (%) | NFHS-4 | NFHS-5 |
| --- | --- | --- |
| During pregnancy: | | |
| Had difficulty with daylight vision | 10 | 8 |
| Had convulsions not from fever | 10 | 12 |
| Had swelling of the legs, body or face | 24 | 25 |
| Non-live births | 11 | 10 |
| Women who had complications from abortion | 12 | 17 |
| Private source for treatment of abortion complications | 42 | 42 |

## Trends in maternal mortality in Assam and India

The MMR trends in Assam and India are compared for the period 1997–98 to 2018–20 in Figure 4. Overall, there was a significant decrease over time in the national maternal mortality as well as in Assam, though the MMR in Assam was much higher than at the national level. However, even though there was a gradual decrease in the gap in maternal mortality between India and Assam, the MMR was very high in the state.

**Figure 4. Trends in maternal mortality in Assam and India**
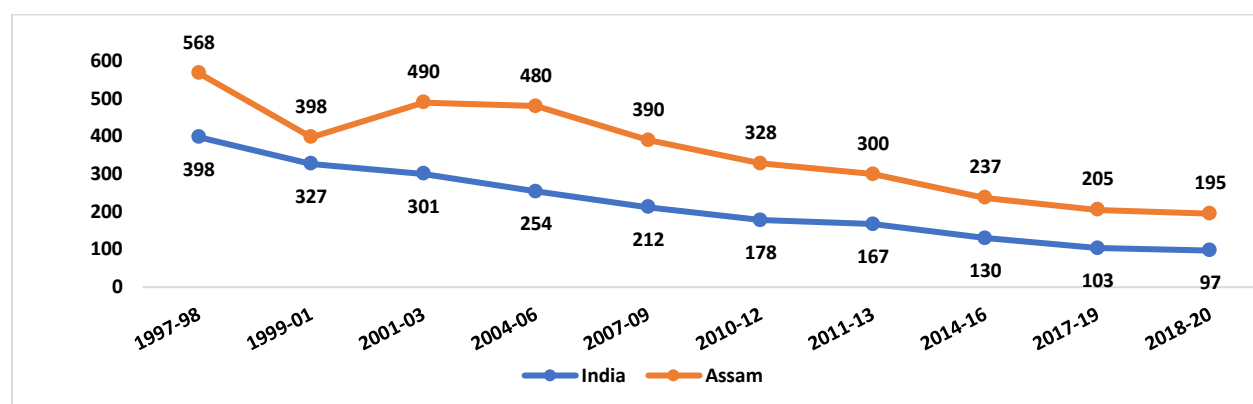


## Relationship between C-section and MMR

The increasing trend in C-sections in India was analyzed in context of MMR. Figure 5 explains the relationship between the two. Data suggested a moderate to weak correlation (correlation coefficient 0.37) between C-Section and MMR in the Indian context. However, global evidence suggests no added reduction in MMR if C-section rates go beyond 10 percent. Data from India suggests that southern states with high rates of C-sections had low MMR and states like Jharkhand and Haryana with low C-section rates had low MMR. In the case of Assam, there was a low C-section rate of 18% and a high MMR.

These observations lead to a pressing question of whether the 10% C-sections are applicable at the national-level as well. Further, in context of the localized observations, there is also the question of what levels would be more accurate to understand the situation across India. As the evidence in this aspect is still evolving, these are pertinent questions that call for further deliberations.

**Figure 5. Relationship between C-sections and MMR in major states in India**
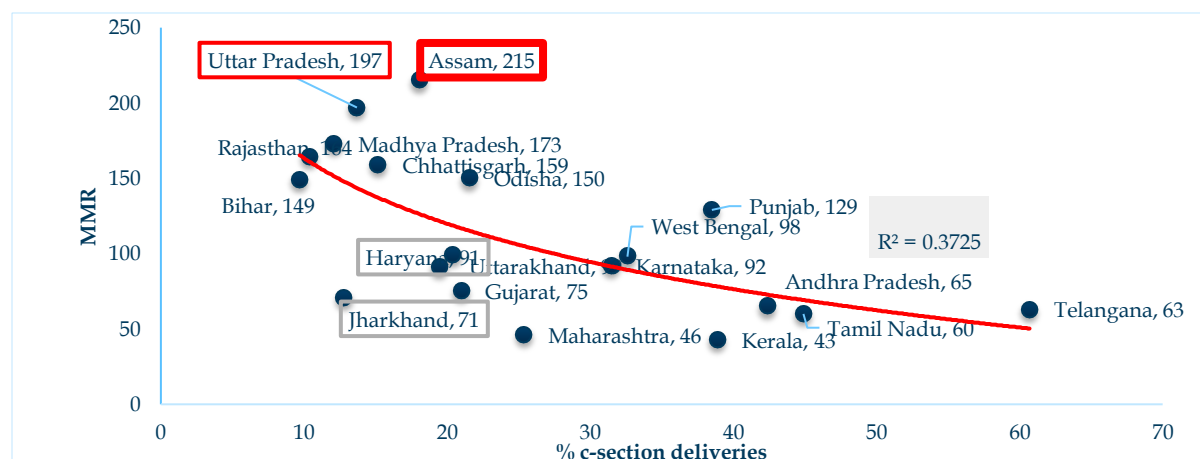
The C-section rates in public and private health systems with MMR in Assam and Odisha between 2016 and 2020 can be seen in **Figure 6**. It can be observed that the MMR decreased as the C-sections in private facilities increased. A similar decreasing trend was seen in MMR between the two states.

**Figure 6. Rise in C-section v/s drop in MMR in Assam and Odisha, 2016 to 2020**
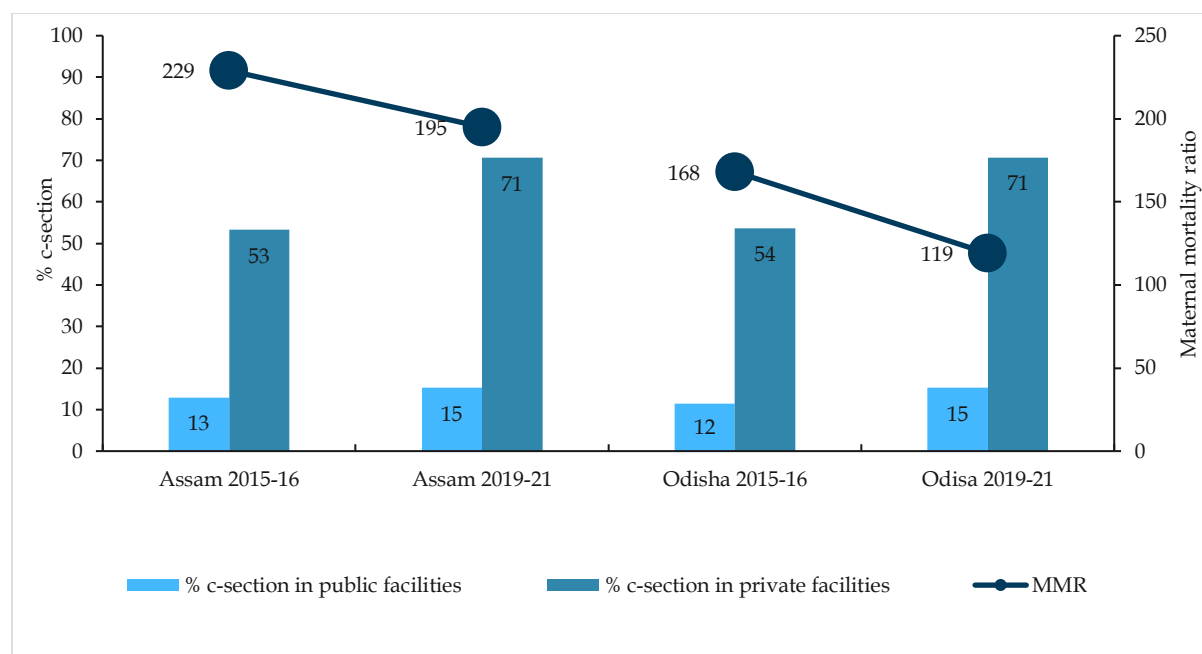


## Other contributing factors to maternal mortality

Several contextual and high-risk practices can pose as barriers to reducing maternal mortality in Assam. Table 2 provides insights into the social vulnerability and maternal health coverage in the state. Notably, teenage pregnancy rates remained high and there was a persistent prevalence of anemia. Furthermore, efforts to reduce avoidable high-risk situations such as short birth intervals, mothers below the age of 18 or above 34, and birth order exceeding 3 did not show significant progress.

Scholarly literature also sheds light on delays in seeking care among women, which can be attributed to long distances to health facilities (Hamal et al., 2020). Considering that most deliveries occurred in public facilities in Assam, this burden contributed to delays in receiving necessary care. These delays, coupled with the existing high burden, further complicate the situation and hinder effective care delivery.

**Table 2. Social vulnerability and maternal health coverage, Assam**

| Social Vulnerability and Maternal Health Coverage | NFHS-4 | NFHS-5 |
|---|---|---|
| Early marriage | 31 | 32 |
| Teenage pregnancy | 14 | 12 |
| Birth order 3 or more | 28 | 22 |
| Anemia | 46 | 66 |
| Took intestinal parasite drug | 9 | 15 |
| Consumed IFA for 100 days | 32 | 48 |
| In avoidable high-risk category | 57 | 55 |
| Prevalence of diabetes | ---- | 5 |
| Index of quality of care (out of 17 score) * | 12 | 13 |

*Refer Appendix I

## Continuum of care in Assam

Although institutional delivery rates are high in Assam, there were missed PNC opportunities. The CoC received by pregnant women in Assam is shown in **Figure 7**. Around 86 percent of women had institutional delivery.

**Figure 7. Continuum of care in maternal health in Assam**
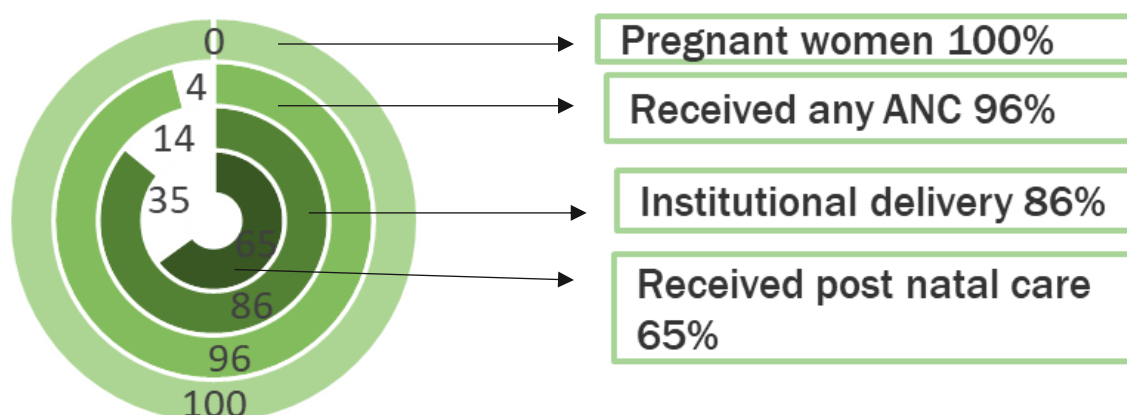
# Discussion

Maternal mortality remains a significant public health challenge in Assam (Ahmed et al., 2016). The national-level MMR trends as well as those in Assam indicate a gradual decrease in the gap between the two, although Assam's MMR remains significantly higher. This research paper has provided insights into the current status of maternal mortality in Assam and identified contributing factors. By addressing suitable interventions to mitigate the challenges, it is possible to make significant progress in reducing maternal mortality and improving the health outcomes of women in Assam.

The case study on Assam reveals that maternal mortality remains a significant public health challenge in the state. The analysis of direct obstetric causes of maternal mortality shows indicators such as difficulties with vision, convulsions, swelling and complications from abortions. A verbal autopsy of maternal deaths in Assam found that hemorrhage (21%), pregnancy induced hypertension (17%) and sepsis (10%) were the major direct causes of death and anemia (29%) was the leading indirect causes of death (Rane et al., 2019). Other contributing factors to maternal mortality in Assam include high rates of teenage pregnancy and the prevalence of anemia. Changing the practice of early marriage and lower rates of teenage pregnancy are important

programmatic focus areas that can help in reducing maternal mortality.

The correlation between C-section rates and MMR is an intriguing subject. In the national setting, the connection between C-sections and MMR implies that other factors such as the quality of care and access to emergency obstetric services also significantly impact maternal outcomes. Further research and debate are required on how these factors can impact maternal mortality. Findings suggest that strengthening the CoC may reduce the burden of maternal mortality in Assam. An epidemiological study of maternal death in Assam found that most maternal deaths occurred during the postnatal period and mostly happened during the hospital emergency hours (Rane et al., 2019).

Challenges exist in the CoC of maternal health in most of the northeastern states, especially between institutional delivery and PNC for mothers. Previous studies utilizing NFHS 2015–16 have found that compliance in one indicator did not necessitate compliance in subsequent indicators (James et al., 2022). NFHS 2015–16 also revealed high ANC coverage and institutional delivery uptake, but lower access to postnatal care for mothers. Improved health behaviors such as cord care, skin to skin care etc. and addressing unique issues faced by women, especially those married as minors, were found to be

associated with improving CoC (McDougal et al., 2017).

In several districts where ANC utilization and institutional deliveries were high, opportunities also exist for further strengthening the CoC. Focused efforts are needed to improve ANC utilization and reduce the gap between PNC and institutional delivery. For instance, a few districts such as Ribhoi, West Khasi hills and South West Khasi hills in Meghalaya which have higher prevalence of 4 or more ANC, fared poorly in ANC visit in first trimester as well as in institutional delivery and PNC. These pockets need attention through an emphasis on the importance of ANC visits very early in the pregnancy period. This also suggests that improvements are needed in the quality of ANC that is provided.

The major strength of the study is that it utilizes large-scale, nationally representative datasets i.e. NFHS 4 and 5. Robust sampling techniques, ensuring that the results reflect wide trends across the northeast region, examining wide range of indicators. Using stratified analysis and district level mapping, which highlights regional trends and highlights the gaps in policy implementation.

This study relies on the NFHS, which is a secondary and self- reported data that could lead to errors due to recall biases. Though the study has used data of 2 rounds of NFHS yet the cross- sectional design of the dataset makes it challenging to establish causal relationship between outcomes.

# Conclusion

This study addresses the gap in explaining why child and maternal health outcomes have not improved, despite the relatively high rates of institutional deliveries in some northeastern states, the lack of PNC is concerning. Adequate PNC is crucial for monitoring and addressing potential complications after childbirth and promoting maternal well-being.

There is a need to strengthen ANC and PNC services, including raising awareness among women and healthcare providers, about the importance of early initiation of antenatal services and providing accessible and high-quality PNC facilities

# Declarations

## Acknowledgements

## Funding

The authors have no support or funding to report.

## Ethical declarations

The present study utilizes a secondary dataset available in the public domain for legitimate research purposes with no identifiable information on the survey participants. Hence, there is no requirement for any additional ethical approval.

## Consent for publication

Not applicable. No details, images or videos related to individual participants were obtained. In addition, data are available in the public domain.

## Competing interests

The authors declare no competing interests.

# References

Ahmed, S. J., Siddique, M. A., & Sultana, N. (2016). Maternal mortality: Scenario, causes, and prevention of the tragedy in the Indian context with special consideration to Assam, India. International Journal of Community Medicine and Public Health, 3(1334–1340).

Gandhi, S., Dash U et al., (2022). Predictors of the utilisation of continuum of maternal health care services in India. BMC Health Services Research, 22(602). https://doi.org/10.1186/s12913-022-07876-9

GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. The Lancet, 392(10159), 1789–1858. https://doi.org/10.1016/S0140-6736(18)32279-7

Hamal, M., Dieleman, M., De Brouwere, V., & others. (2020). Social determinants of maternal health: A scoping review of factors influencing maternal mortality and maternal health service use in India. Public Health Reviews, 41(13). https://doi.org/10.1186/s40985-020-00125-6

International Institute for Population Sciences (IIPS) and ICF. (2021). National Family Health Survey (NFHS-5), 2019-21: India: Volume I. Mumbai: IIPS.

James, K., Mishra, U. R., & Pallikadavath, S. (2022). Sequential impact of components of maternal and child health care services on the continuum of care in India. Journal of Biosocial Science, 54(3), 450–472. https://doi.org/10.1017/S002193202100016X

Kerber, K. J., de Graft-Johnson, J. E., Bhutta, Z. A., Okong, P., Starrs, A., & Lawn, J. E. (2007). Continuum of care for maternal, newborn, and child health: From slogan to service delivery. The Lancet, 370(9595), 1358–1369.

Kothavale, A., & Meher, T. (2021). Level of completion along continuum of care for maternal, newborn, and child health services and factors associated with it among women in India: A population-based cross-sectional study. BMC Pregnancy and Childbirth, 21(731). https://doi.org/10.1186/s12884-021-04198-2

McDougal, L., Atmavilas, Y., Hay, K., Silverman, J. G., Tarigopula, U. K., & Raj, A. (2017). Making the continuum of care work for mothers and infants: Does gender equity matter? Findings

from a quasi-experimental study in Bihar, India. PLoS One, 12(2), e0171002.

Mukherjee, A., Rizu, & Parashar, R. (2022). Longitudinal trends in the health outcomes among children of the North Eastern States of India: A comparative analysis using national DHS data from 2006 to 2020. European Journal of Clinical Nutrition, 76(1528–1535). https://doi.org/10.1038/s41430-022-01147-w

Nagdev, N., Ogbo, F. A., Dhami, M. V., & others. (2023). Factors associated with inadequate receipt of components and non-use of antenatal care services in India: A regional analysis. BMC Public Health, 23(6). https://doi.org/10.1186/s12889-022-14812-3

Ramanand, R., Dixit, P., & Gupta, A. (2020). Continuum of maternal health care in India. International Journal of Biomedicine and Public Health, 3(3), 77–84. https://doi.org/10.22631/ijbmph.2020.201786.1131

Rane, T. M., Mahantab, T. G., Baruahc, M., & Baruahd, S. D. (2019). Epidemiological study of maternal death in Assam. Clinical Epidemiology and Global Health, 7(634–640).

World Health Organization (WHO). (2015). Trends in maternal mortality: 1990 to 2015: Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Retrieved June 19, 2023, from https://www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2015/en/

World Health Organization (WHO). (2016). Standards for improving quality of maternal and newborn care in health facilities. Retrieved June 20, 2023, from https://www.who.int/publications/i/item/9789241511216

# Appendix I

Index of quality of care is calculated from additive score of indicators in four dimensions: I) evidence-based maternal care II) information system III) effective communication and IV) competent human resources. The methodology has been adopted from the WHO framework for the quality of maternal and newborn heathcare.[16] The total additive score is 17 points. The list of indicators in all four dimensions are listed in Appendix I.

**Appendix I: Indicators used in the computation of the index of quality of care**

| | |
|---|---|
| Evidence-based maternal care (Range: 0-7) | • ANC visit in 1st trimester<br>• 4 or more ANC visits<br>• Received TT<br>• Received recommended IFA 100+<br>• Tests and checkups: Weighed, urine test, blood sample, blood pressure measurement, abdominal examination<br>• Institutional delivery<br>• Postnatal checkups for mother |
| Information system (Range:0-3) | • Pregnancy registration<br>• MCP card<br>• Immunization card for child |
| Effective communication (Range:0-4) | • Received advice on cord care, breastfeeding, keeping the baby warm, family planning,<br>• Informed about signs of pregnancy complications,<br>• Informed about where to seek care in case of complications,<br>• Visits by ANM/ASHA/AWW in last 3 months of pregnancy |
| Competent human resources (Range: 0-3) | • ANC provided by skilled provider<br>• Delivery by skilled attendant<br>• Postnatal check up by skilled provider |
| Composite index of maternal care quality (Range: 0-17) | Additive score of all items in four dimensions |