

REVIEW



Maternal health and child malnutrition: A district-level study in Assam, North Eastern India (A secondary data-based research review)

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This paper examines maternal health and child malnutrition in Assam using secondary data from NFHS-2 to NFHS-5, together with evidence from the Global Burden of Disease Study, ISEC working papers, government sources and relevant research literature. The analysis focuses on maternal BMI, anaemia and dietary diversity and considers their relationship with stunting, wasting and underweight among children below five years. The paper also reviews district-level patterns reported in NFHS-based spatial studies. The evidence points to persistent high-burden districts, including Dhubri, Bongaigaon, Barpeta, Goalpara, Kokrajhar, Karimganj and Darrang. Poverty, food insecurity, maternal education, feeding practices, recurrent floods and gaps in programme implementation are discussed as factors associated with poor nutritional outcomes. The paper concludes with policy measures aimed at improving maternal and child nutrition at the district and community levels.

KEYWORDS

Malnutrition; Assam; Maternal health; Child undernutrition; Underweight; NFHS

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Introduction

Malnutrition is an important public health concern because poor nutrition during childhood can affect growth, learning, immunity and health later in life. It includes undernutrition, such as stunting, wasting, underweight and micronutrient deficiencies, as well as overweight and obesity. The coexistence of different forms of malnutrition is often described as the double burden of malnutrition [1]. Children below five years are particularly vulnerable because nutritional problems during this period can have lasting effects on physical and cognitive development [2].

India has made considerable economic progress over the past few decades, but child undernutrition remains widespread. NFHS-5 (2019–21) reported that 35.5% of children below five years were stunted, 19.3% were wasted and 32.1% were underweight [3]. The continued prevalence of these conditions shows that economic growth has not removed nutritional deprivation. Differences across states and regions also remain important, including differences between India and other South Asian countries discussed in the literature [4].

Assam faces a similar problem. According to NFHS-5, 35.3% of children below five years in the state were stunted, 21.7% were wasted and 32.8% were underweight. The wasting rate was higher than the national figure and was among the highest reported in the North Eastern Region. Maternal nutrition is an important part of this situation. Low BMI, anaemia and inadequate dietary intake among women can affect pregnancy and child nutrition, creating risks that may continue from one generation to the next [5].

The problem also varies considerably within Assam. Evidence from different NFHS rounds shows that districts such as Dhubri, Bongaigaon, Barpeta, Goalpara, Kokrajhar, Karimganj and Darrang have repeatedly appeared among the higher-burden areas. Poverty, low female literacy, recurrent floods and limited access to services are among the conditions reported in studies of these areas.

Against this background, the present paper brings together available secondary evidence to examine maternal and child malnutrition at the district level in Assam. It considers changes over time, differences between districts, the relationship between maternal and child nutrition, and the socioeconomic

and environmental factors discussed in the literature

Review of Literature

Existing studies show that malnutrition remains a major concern in India and the North Eastern Region. However, fewer studies bring together maternal nutrition, child outcomes and district-level spatial patterns for Assam. The following review summarises the main evidence relevant to the present study.

Global and national context

Swaminathan et al., using data from the Global Burden of Disease Study for 1990–2017, examined trends in maternal and child malnutrition across Indian states. The study reported substantial differences between states in indicators such as low birthweight and maternal health outcomes, with Assam among the states facing a high burden. These findings are useful for placing Assam's nutritional situation in the wider national context [6].

The UNICEF-WHO-World Bank estimates also show the continuing importance of undernutrition in childhood. Earlier research has linked stunting with poorer cognitive development, educational outcomes and economic productivity later in life [1]. The Lancet series on maternal and child undernutrition further identified the period from conception to a child's second birthday as an important stage for nutritional interventions [7].

Nutritional status in North Eastern India

Tantri, Kambara and Bhat examined the nutritional status of women and children across the eight North Eastern states using NFHS data from several rounds [4]. Their findings indicate that economic growth in the region has not been matched by similar improvement in all nutritional indicators. Assam, despite its relatively large share of the regional economy, continued to show weaknesses in several maternal and child nutrition indicators. The study also reported an increase in wasting in Assam over the period covered by the NFHS data.

Singh, Chiero, Kriina and Alea used Local Moran's I and LISA techniques to examine district-level clusters of stunting, wasting and underweight using NFHS-4 and NFHS-5 data [8]. Their analysis identified several persistent high-burden districts in Assam. Dhubri,

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Bongaigaon and Barpeta were among the persistent stunting clusters, while Dhubri, Goalpara, Kokrajhar, Bongaigaon, Karimganj and Darrang appeared repeatedly in relation to underweight.

Maternal malnutrition and child outcomes

Prasad, Kumar, and Singh examined the status of maternal nutrition and its association with under-three children's nutritional outcomes in EAG states (Empowered Action Group) and Assam using NFHS-2 and NFHS-3 data [5]. Their analysis confirmed a statistically significant association between maternal BMI below 18.5 kg/m² (underweight) and higher odds of child stunting, wasting, and underweight. Assam was found to have among the highest rates of underweight mothers in the EAG group, directly contributing to poor child nutritional outcomes.

Boruah, in a study of lactating mothers among Ahom women of Lakhimpur District, Assam, reported widespread undernutrition among lactating mothers, characterised by low body weight, poor dietary diversity, and heavy workloads [9]. The study highlighted how maternal malnutrition during breastfeeding directly compromises breast milk quality and infant growth. Similarly, Dutta, Baruah, and Borbora documented a significant association between maternal BMI below normal and the risk of congenital malformations in children from the tea garden community of Assam, underscoring the multi-generational ramifications of maternal undernutrition [10].

A 2024 study by Saikia, Mahanta, Nirmolia, and Gogoi on Maternal Dietary Diversity in Dibrugarh district, Assam, found low dietary diversity among women, with particular deficiencies in iron-rich and vitamin A-rich foods, contributing to micronutrient malnutrition in both mothers and children [11].

Mishra, Pundir, and Mishra, in a preprint titled 'The Impact of Maternal Nutritional Well-Being on Children's Nutritional Status in India,' confirmed through multivariate analysis that children of anaemic and undernourished mothers face significantly elevated risks of stunting, wasting, and underweight even after controlling for sociodemographic variables [12].

District-level studies in Assam

Islam, Mahanta, Sarma, and others, in a study published in the Indian Journal of Community Medicine, assessed the nutritional status of under-five children from tribal populations in riverine (char) areas of Dibrugarh district [13]. They found substantially higher malnutrition rates in char areas compared to non-char areas, attributing this to geographic isolation, food insecurity due to flooding, poor sanitation, and limited access to healthcare services.

Ronghangpi and Mahanta assessed determinants of Severe Acute Malnutrition (SAM) among under-five children in Dibrugarh district, Assam [14]. Their findings, published in the Indian Journal of Community Health, identified low maternal education, poor dietary diversity, inadequate complementary feeding, and frequent respiratory and diarrhoeal illnesses as key determinants of SAM in the district.

Choudhury and Randhawa, in a cross-sectional study on how flooding affects nutritional status of children in floodplain regions of Assam, published by Springer, found that flood-affected children had significantly higher rates of acute malnutrition and wasting compared to non-flood-affected children, mediated by food insecurity, water contamination, and disruption of healthcare access [15].

Das, Randhawa, Choudhary and colleagues, in an aspirational districts study, found that Assam's aspirational districts among the most nutritionally deprived demonstrated significant knowledge gaps among frontline health workers in IYCF practices, directly undermining intervention delivery [16].

Socioeconomic determinants

Som, Pal, Bhattacharya, Bharati, and Bharati conducted a comparative analysis of socioeconomic differentials in nutritional status of children in West Bengal and Assam, published in the Journal of Biosocial

Science. They found that the incidence of severe malnutrition (WAZ < -3 SD) was significantly higher in Assam, driven by socioeconomic factors including low household income, maternal illiteracy, and poor sanitation access [17].

Das, in the book chapter 'Conflicts Leave a Trail of Poverty and Malnutrition: Evidences from Assam,' published by Springer, demonstrated that children in villages affected by ethnic conflict and violence had significantly higher malnutrition rates, showing that socio-political instability compounds nutritional vulnerability in the state [18].

Dutta, in the Indian Journal of Science and Technology, documented the double burden of malnutrition among reproductive age group women in Assam, finding simultaneous coexistence of undernutrition and overweight/obesity, particularly in urban areas. This reflects the nutrition transition underway in the state [19].

Mondal, Basumatary, and Kropi investigated the double burden of malnutrition among urban school-going Bodo children aged 5–11 years in Udalguri district of Assam, published in Epidemiology, Biostatistics and Public Health, finding that both stunting and overweight coexisted among children from different socioeconomic backgrounds [20].

Taken together, the literature presents a mixed picture of Assam's nutritional situation. The state has a relatively large and growing economy within the NER, but high levels of child malnutrition continue. Government programmes such as ICDS, POSHAN Abhiyaan, NHM and the Mid-Day Meal scheme provide important support, yet the available evidence suggests that progress has not been uniform. Wasting, in particular, increased from 19.0% in NFHS-2 to 21.7% in NFHS-5 [4].

The relationship between maternal health and child malnutrition deserves closer district-level attention in Assam. Maternal undernutrition, anaemia, inadequate dietary diversity and limited use of antenatal care can affect birth outcomes and the nutritional status of children. At the same time, the extent of these problems differs across districts, making a district-level approach useful.

Several districts, especially those affected by poverty, recurrent floods and limited access to services, report higher levels of malnutrition. Examining where these problems are concentrated and how they relate to maternal and household conditions can help in identifying areas that require greater policy attention.

The study is undertaken to meet the following specific objectives

- To examine the trend and current status of child malnutrition (stunting, wasting, and underweight) across districts of Assam using data from NFHS rounds (NFHS-2 to NFHS-5).
- To analyse the nutritional status of women of reproductive age (15–49 years) in Assam, focusing on BMI, anaemia, and dietary diversity.
- To assess the association between maternal nutritional indicators and child malnutrition outcomes at the district level in Assam.
- To identify persistent spatial hotspot clusters of malnutrition at the district level in Assam within the broader NER context.
- To examine the socioeconomic, environmental, and programmatic determinants of maternal and child malnutrition in Assam.
- To suggest evidence-based policy recommendations for improving maternal and child nutrition outcomes in Assam.

Materials and Methods

Study design

The study uses an analytical secondary-data design. Information from national surveys, government sources and published research is brought together to examine maternal and child malnutrition in

Assam. The analysis is mainly descriptive, with emphasis on trends over time, differences between districts and patterns reported in spatial studies.

Data sources

The main data source is the National Family Health Survey, particularly NFHS-2 (1998–99), NFHS-3 (2005–06), NFHS-4 (2015–16) and NFHS-5 (2019–21). These surveys provide information on maternal and child health and nutrition at state and district levels. The paper also uses evidence from the Global Burden of Disease Study, ISEC Working Paper No. 552, and the district-level spatial analysis of Singh et al [4,6]. Other relevant studies on maternal nutrition, IYCF, flooding and nutrition programmes in Assam are included where they help explain the findings.

Variables and indicators

Three standard child nutrition indicators are considered: stunting, wasting and underweight. Stunting is defined as height-for-age below -2 standard deviations and is generally used to indicate chronic undernutrition. Wasting refers to weight-for-height below -2 standard deviations and indicates acute undernutrition. Underweight refers to weight-for-age below -2 standard deviations and may reflect both chronic and acute undernutrition.

For maternal nutrition, the review considers BMI below 18.5 kg/m^2 among women aged 15–49 years, anaemia, dietary diversity, antenatal care use and institutional delivery. These indicators are used to examine the conditions that may be associated with child nutritional outcomes.

Methods of analysis

The analysis compares changes in stunting, wasting and underweight across NFHS rounds and considers Assam in relation to the national average and other North Eastern states. Findings from published studies are then used to discuss maternal nutrition, feeding practices and socioeconomic and environmental conditions. The paper also draws on the Local Moran's I and LISA results reported by earlier NFHS-based research to identify districts that repeatedly appeared as hotspots. The UNICEF conceptual framework is used as a broad way of organising immediate, underlying and structural determinants.

Ethical considerations

The study is based entirely on publicly available secondary data and previously published literature. Since no primary data were collected from human participants, ethical clearance for primary data collection was not required. The NFHS data are publicly available through the DHS Programme and the International Institute for Population Sciences (IIPS).

Results and Discussion

Trends in child malnutrition in Assam: A longitudinal overview

NFHS data show that child nutrition in Assam has improved in some respects but not consistently across all indicators. Stunting fell from 54.0% in 1998–99 to 41.1% in 2005–06 and 35.3% in 2019–21. This is a substantial decline, although more than one-third of children were still stunted in NFHS-5, a figure close to the national average of 35.5%.

Wasting followed a different pattern. It declined from 19.0% in NFHS-2 to 16.7% in NFHS-3 and was about 17.0% in NFHS-4, but rose to 21.7% in NFHS-5. This was higher than the national figure of 19.3%. The rise in wasting is important because acute malnutrition is associated with greater vulnerability to illness and mortality.

Underweight also showed an uneven trend. The prevalence fell from 35.3% in NFHS-2 to 29.8% in NFHS-4, before rising again to 32.8% in NFHS-5. These figures suggest that improvement in one indicator has not necessarily been accompanied by similar progress in others.

Maternal nutrition in Assam: Status and indicators

Maternal nutritional status is an important part of child nutrition. The evidence reviewed here indicates that undernutrition among women of reproductive age remains a concern in Assam. NFHS-5 reported that 18.7% of women aged 15–49 years in India had a below-normal BMI, while studies from Assam indicate a comparatively high prevalence of underweight women. Prasad et al. found that children of mothers with BMI below 18.5 kg/m^2 had higher odds of stunting, wasting and underweight [5].

Anaemia is another major maternal health concern. Evidence from NFHS and the studies reviewed indicates a high prevalence among women in Assam. Anaemia during pregnancy may contribute to adverse birth outcomes such as premature birth and low birthweight, which can increase nutritional risks during childhood. Jakharia, Rozario and Mahanta also discussed maternal malnutrition and anaemia as important factors in maternal health outcomes in Northeast India [22].

Dietary diversity is also relevant to maternal nutrition. Saikia et al., in their study of women in Dibrugarh district, reported limited dietary diversity and inadequate intake of some iron-rich and vitamin A-rich foods [11]. Such gaps may contribute to micronutrient deficiencies during pregnancy and lactation. The findings suggest that maternal BMI, anaemia and diet need to be considered together rather than as separate issues.

District-level disparities in malnutrition in Assam

The burden of malnutrition differs considerably between districts. Studies using NFHS data have identified groups of neighbouring districts with similarly high levels of malnutrition, indicating that state averages do not fully describe the situation within Assam.

For stunting, Dhubri, Goalpara, Bongaigaon and Barpeta were identified among the hotspot districts in NFHS-4. By NFHS-5, the hotspot pattern also included Chirang, Morigaon, Nagaon and West Karbi Anglong. Dhubri, Bongaigaon and Barpeta remained persistent high-high clusters across the two rounds.

Wasting showed a somewhat different pattern. Dhubri, Goalpara and Bongaigaon appeared as hotspots in 2015–16, while Karimganj and Hailakandi emerged prominently in 2019–21. Karimganj recorded 48% wasting, while Cachar recorded 31%. The concentration of high wasting in the Barak Valley points to the importance of local socioeconomic and geographical conditions.

Underweight displayed particularly persistent clustering. Dhubri, Goalpara, Kokrajhar, Bongaigaon, Karimganj and Darrang remained among the persistent hotspot districts across NFHS-4 and NFHS-5. Karimganj recorded 53% underweight prevalence in NFHS-5. Overall, the spatial evidence shows that a state-level average can conceal substantial differences between districts.

Association between maternal health and child malnutrition

The studies reviewed indicate an association between maternal nutritional status and child nutrition. Prasad et al. reported that children of mothers with low BMI had higher odds of stunting and underweight, with odds ratios of 2.14 and 2.08, respectively [5]. These findings support the importance of maternal nutrition when interpreting child nutrition outcomes.

The intergenerational nature of malnutrition is also reflected in studies of maternal nutrition in Assam. Boruah found poor dietary diversity and nutritional status among lactating women in Lakhimpur district [9]. Dutta, Baruah and Borbora further showed that maternal undernutrition was associated with adverse child health outcomes in the tea garden community [10].

Antenatal care is one of the points at which maternal nutritional problems can be identified and managed. The literature reviewed for this paper suggests that weaker use or delivery of recommended antenatal services can occur alongside poorer nutritional outcomes.

ANC can provide opportunities for nutritional counselling, supplementation and referral, although the effectiveness of these services depends on actual access and implementation.

Infant and young child feeding practices

Infant and young child feeding practices are directly related to children's dietary intake. Studies from Assam indicate that breastfeeding is common, but there are concerns about the timing and quality of complementary feeding. Nasrin et al. for example, reported problems related to appropriate and timely complementary feeding among children in urban slums of Kamrup Metropolitan [23].

Dutta, Saikia and Choudhury reported considerable variation between Assam's districts in exclusive breastfeeding, timely complementary feeding, child dietary diversity and minimum acceptable diet. Districts with lower maternal education and household income generally showed weaker feeding indicators [24].

Feeding practices are also influenced by local customs and household conditions. Saikia, Mahanta and Baruah reported culturally influenced practices in Dibrugarh that affect complementary feeding. This suggests that nutrition counselling may be more useful when it takes local food practices and beliefs into account [25].

The capacity of frontline workers is another important consideration. Randhawa et al. identified knowledge gaps among Anganwadi Workers and Auxiliary Nurse Midwives regarding IYCF and child nutrition in aspirational districts [15]. Since these workers form an important link between government programmes and households, strengthening their training and support is essential.

Socioeconomic and environmental determinants

The factors associated with child malnutrition in Assam are not limited to food intake. Poverty, food insecurity, maternal education, living conditions, environmental shocks and access to health services all play a role. In the UNICEF framework used in this paper, inadequate dietary intake and infection are immediate causes, while household food security, care practices and the health environment are underlying factors.

Poverty and food insecurity remain important concerns. The evidence reviewed by Tantri et al. indicates that rural Assam has relatively high poverty and lower monthly per capita expenditure compared with the NER average [4]. Districts with high malnutrition burdens, including Dhubri and Goalpara, are also among the economically disadvantaged areas.

Flooding adds another layer of vulnerability. Research by Choudhury et al. indicates that flood-affected children experience greater acute malnutrition, partly because floods disrupt food supplies, contaminate water sources and interrupt access to healthcare. Recurrent flooding can therefore intensify existing food and health insecurities [26].

Conflict and social instability can have similar effects. Das showed that conflict-affected communities in Assam experienced higher levels of malnutrition because violence disrupted livelihoods, food systems and access to health services [18].

Maternal education is another consistent determinant. Studies indicate that better-educated mothers are more likely to adopt appropriate feeding, hygiene and healthcare practices. Thus, improvements in women's education and empowerment can contribute to better nutritional outcomes for children.

The nutritional situation of tribal and other marginalised communities also requires attention. Geographic isolation, traditional food systems, limited access to health services and socioeconomic disadvantage can combine to increase nutritional vulnerability in tribal areas.

Programme delivery and ICDS performance

Government nutrition programmes provide an important means of addressing maternal and child malnutrition, but their effect depends on how well they reach households. ICDS, established in 1975,

provides supplementary nutrition, child development services and support for mothers and children. The studies reviewed from Assam report several difficulties in programme coverage and implementation.

Evidence from Assam indicates several implementation challenges. Minz and Mohanty reported gaps in ICDS delivery in a tribal district, including inadequate coverage, irregular supplementary nutrition and limited community awareness. Paul, Akhtar and Bhuyan also identified geographical barriers, inadequate infrastructure and weaknesses in monitoring as constraints affecting ICDS functionality in Lakhimpur district [28].

The implementation of POSHAN Abhiyaan has produced some positive results nationally, but the benefits have not been equally distributed. Districts that already had high levels of malnutrition, including several areas of Assam, continue to face resource and implementation constraints [29]. Saikia et al. also identified shortages in trained staff, equipment and therapeutic foods required for the management of severe acute malnutrition in public facilities in Jorhat. These findings point to the need to strengthen both community-based prevention and facility-based treatment [30].

NER comparative perspective

The comparison of NFHS-5 indicators shows that Assam has one of the more concerning nutritional profiles in the North Eastern Region. Assam recorded 35.3% stunting, 21.7% wasting and 32.8% underweight. In comparison, Sikkim recorded 22.3%, 13.7% and 13.1%, respectively, while Manipur recorded 23.4%, 9.9% and 13.3%.

Sikkim's comparatively favourable nutritional outcomes are associated in the reviewed literature with higher literacy, better per capita income and stronger programme implementation. Assam, despite having the largest GSDP among the NER states, recorded the highest wasting and underweight rates in the comparison. This contrast indicates that economic growth by itself does not necessarily produce corresponding improvements in nutritional outcomes. The quality of public services, female education, social equity and programme delivery also matter.

Conclusion

The evidence reviewed in this paper shows that child malnutrition remains a significant concern in Assam. Stunting has declined considerably since the late 1990s, but wasting and underweight remain high, and the trends across the three indicators are not uniform.

Maternal nutrition is closely related to these child outcomes. Low maternal BMI, anaemia and inadequate dietary diversity can increase nutritional risks for mothers and children. These risks are influenced further by household poverty, food insecurity, maternal education, feeding practices, flooding and the quality of public service delivery.

The district-level evidence is also important. Dhubri, Bongaigaon, Barpeta, Goalpara, Kokrajhar, Karimganj and Darrang repeatedly appear among higher-burden areas in the studies reviewed. Severe wasting and underweight have also been reported in parts of the Barak Valley. This variation shows why state-level averages should be supplemented with district-level information.

Overall, the findings support greater attention to district-specific needs. Improving maternal nutrition, supporting appropriate IYCF practices, strengthening women's education, maintaining access to health services and preparing nutrition programmes for flood-related disruption are practical areas for policy attention. Economic progress alone is unlikely to be sufficient unless it is accompanied by effective public services and better access to nutrition.

Policy Recommendations

District-specific nutrition plans

High-burden districts should receive nutrition plans based on their local conditions. Resources, trained staff and monitoring should

be prioritised in the most affected blocks.

Strengthening maternal nutrition programmes

Antenatal services should routinely screen women for anaemia and low BMI and provide appropriate counselling, supplementation and referral. ICDS and related programmes should pay particular attention to nutritional support in high-burden districts.

Improving IYCF practices

Community programmes should promote appropriate breastfeeding and complementary feeding in local languages. Frontline workers need regular training and practical support, while mothers' groups and self-help groups can be used to encourage community participation.

Flood-resilient nutrition systems

In flood-prone districts, nutrition services should include basic preparedness measures. Essential supplies should be available before the flood season, and mobile or alternative service arrangements should be considered when regular services are disrupted.

Female education and empowerment

Continued support for girls' education and women's participation in community and self-help groups can improve access to information and strengthen women's role in household decisions affecting nutrition and health.

Strengthening SAM/MAM management

Health facilities in districts with high wasting should have adequate staff, equipment and supplies for treating severe and moderate acute malnutrition. Community-based approaches can also improve access to treatment where appropriate.

Real-time nutritional surveillance

District-level monitoring should make better use of available programme and health data so that emerging nutritional problems can be identified earlier and resources adjusted where necessary.

Data Availability

Data used in the study can be accessed or will be made available if requested.

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In the preparation of the manuscript, the authors have not used an AI tools.

Author Contribution

Conception of the work: Jitu Tamuli; Acquisition of data: Neha Sarmah; Data analysis and interpretation: Neha Sarmah, Jitu Tamuli, Payel Priya Kashyap; Drafting of manuscript: Neha Sarmah, Jitu Tamuli, Payel Priya Kashyap; Critical revision of the article: Neha Sarmah, Jitu Tamuli; Drafting of references: Neha Sarmah; Final approval of the version to be published: Neha Sarmah, Jitu Tamuli

Ethics Declaration

Does not apply. Authors have duly acknowledged previous studies if cited.

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