Prevalence, Distribution, and Determinants of Child Undernutrition in India: A Study with Focus on Aspirational Districts of Assam

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Declaration

I hereby declare that this doctoral thesis entitled **"Prevalence, Distribution, and Determinants of Child Undernutrition in India: A Study with Focus on Aspirational Districts of Assam"** is my original work and has been completed under the supervision of Dr. Rajshree Bedamatta, Professor of Economics in the Department of Humanities and Social Sciences at Indian Institute of Technology Guwahati. This thesis represents the culmination of my independent research and scholarly efforts conducted at Indian Institute of Technology Guwahati.

In keeping with the general practice of reporting scientific observations, due acknowledgement has been made whenever the work described is based on findings of other investigations. This thesis has not been previously submitted, in whole or in part, for the award of any other academic degree or diploma. The work presented in this thesis is original, except where otherwise indicated by appropriate references and acknowledgements. The data, figures, tables, and other forms of presentation included in this thesis are accurate and have not been manipulated or falsified in any way. The results and conclusions presented in this thesis are based on my own analysis and interpretation of the data collected, and any opinions or views expressed are my own and not those of my institution.

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Certificate

This is to certify that the doctoral thesis entitled "**Prevalence, Distribution, and Determinants of Child Undernutrition in India: A Study with Focus on Aspirational Districts of Assam**" submitted by Jith J R for the degree of Doctor of Philosophy in Development Studies in the Department of Humanities and Social Sciences at Indian Institute of Technology Guwahati embodies bonafide record of research work carried out under my supervision and guidance. The present thesis or any part thereof has not been submitted to any other University/Institute for the award of any degree or diploma. All assistance received by the researcher has been duly acknowledged.

Dr. Rajshree Bedamatta

Thesis Supervisor

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List of Abbreviations

Abbreviations	Expansion
ADP	Aspirational Districts Programme
ALMSC	Anganwadi Level Monitoring and Support Committee
ANC	Antenatal Care
ANM	Auxiliary Nurse Midwife
ARI	Acute Respiratory Infections
ASHA	Accredited Social Health Activist
AWC	Anganwadi Centre
AWW	Anganwadi Worker
BLO	Block Level Officer
BMI	Body Mass Index
BTAD	Bodoland Territorial Areas Districts
BTR	Bodoland Territorial Region
BVR	Barak Valley Region
CBO	Community-Based Organisation
CDPO	Child Development Project Officer
CHW	Community Health Worker
CIAF	Composite Index of Anthropometric Failure
CNNS	Comprehensive National Nutrition Survey
DAP	District Action Plans
DSW	Department of Social Welfare
DSWO	District Social Welfare Officer
EAG	Empowered Action Group
ER	Elected Representative
FGD	Focus Group Discussion
FHC	Family Health Centre
FHW	Frontline Health Worker
GP	Gram Panchayat
HAZ	Height-for-Age standard deviation
HPSR	Health Policy and Systems Research
HWZ	Height-for-Weight standard deviation
ICDS	Integrated Child Development Services
IDI	In-Depth Interviews
IFA	Iron Folic Acid
IFPRI	International Food Policy Research Institute
IMR	Infant Mortality Rate
IYCF	Infant and Young Child Feeding
KII	Key Informant Interviews
LHV	Lady Health Visitor
MCP	Mother and Child Protection
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIS	Management Information System
MMR	Maternal Mortality Ratio

MO	Medical Officer
MPI	Multi-dimensional Poverty Index
MPR	Monthly Progress Report
MUAC	Mid-Upper Arm Circumference
NFHS	National Family Health Survey
NGO	Non-Governmental Organisation
NHM	National Health Mission
NNM	National Nutrition Mission
NNP	National Nutrition Policy
NPAC	National Plan of Action for Children
NPC	National Policy for Children
NRC	Nutrition Rehabilitation Centres
NRHM	National Rural Health Mission
ORS	Oral Rehydration Salts
OTP	One Time Password
PHC	Primary Health Centre
POSHAN	Partnerships and Opportunities to Strengthen and Harmonise Actions for Nutrition in India
POSHAN	Prime Minister's Overarching Scheme for Holistic Nutrition Abhiyaan
PRI	Panchayati Raj Institution
PwD	Persons with Disabilities
RMNCH+A	Reproductive, Maternal, Newborn Child and Adolescent Health
SAAKS	Sadou Asom ASHA Karmi Santha
SAM	Severe and Acute Malnutrition
SDGs	Sustainable Development Goals
SF	Supplementary Feeding
SSA	Sarva Shiksha Abhiyan
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UT	Union Territory
VAS	Vitamin A supplementation
VHSNC	Village Health Sanitation and Nutrition Committee
VHSND	Village Health Sanitation and Nutrition Day
WAZ	Weight-for-Age standard deviation
WHO	World Health Organisation

List of Publications

1. **Child Undernutrition in the States of India: An Analysis Based on Change in Composite Index of Anthropometric Failure from 2006 to 2016**

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2. **The role of local governments in the implementation of evidence-based nutrition interventions in Kerala**

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Abstract

Background: This thesis attempts to contribute to achieving SDG 2.2, which aims to address malnutrition across different life stages and the closely aligned national targets of child undernutrition in India. There is a need to study the scale and distribution of total undernutrition prevalence in India to understand the magnitude of the problem and monitor progress over time. Existing studies have primarily focused on traditional indicators, and there is also a significant research gap in understanding child undernutrition in Assam comprehensively. An underexplored yet critical dimension in the existing literature is examining nutrition interventions from a systems perspective. Understanding the interactions and relationships between frontline workers, the community, and other stakeholders is particularly important as these dynamics significantly influence the effectiveness of interventions.

Objectives: To study the scale, distribution, determinants, and change in the undernutrition problem in India. To study the scale and distribution of the undernutrition problem in Assam, focusing on aspirational districts. To understand the challenges in implementing evidence-based nutrition interventions in Assam in the context of village-level health systems considering the social construct nature of health systems. To understand the pathways through which nutrition-specific interventions reach women and children and the interconnections between them.

Methods: Mixed methods are used to meet the research objectives. Secondary data from three rounds of the National Family Health Survey (NFHS), primary survey data collected from seven select districts of Assam, and primary qualitative data collected from the Dhubri district of Assam through In-Depth Interviews, Key Informant Interviews, and Focus Group Discussions are used for analysis.

Key Findings: The total prevalence of child undernutrition is significantly higher than estimations using traditional indicators and varies significantly. Reductions in indicators are not uniform and are inadequate to achieve nutrition targets. Assam has a higher incidence of anthropometric failure in all categories than the national average, and most aspirational districts have a higher incidence of anthropometric failure than the Assam state average. Among the survey districts, Barpeta, Goalpara, and Darrang have a high prevalence

of anthropometric failures and fare poorly in different basic, underlying, and immediate determinants. The comparatively better-performing districts were Udalguri, Kokrajhar, and Bongaigaon. Coordination of nutrition interventions at the grassroots level is facilitated by interpersonal relationships among frontline workers and through informal communication platforms. In addition, the performance of frontline workers is influenced by the quality of interpersonal relationships between the workers and the community and the workers' relationship with department officials. Delays in salary disbursement, high work burden, and involvement of family members of frontline workers in implementing interventions pose significant challenges. Cultural factors, misconceptions, superstitions, and manifestations of poverty pose challenges at the family level of beneficiaries. Connectivity issues, resistance from the community, resource constraints, undesirable effects of community participation, and gaps in service delivery, particularly in immunisation and distribution of rations, are significant challenges.

Conclusions: Targeted and context-specific interventions, multi-faceted and integrated interventions, and interventions addressing basic determinants are needed to tackle the challenge of child undernutrition. An often ignored but critical aspect of nutrition interventions is the interaction and relationship between frontline workers and the community. Enabling strong interpersonal relationships among frontline workers and the community, ensuring timely salary disbursement, addressing the high work burden of frontline workers, and engaging with family members of frontline workers and beneficiaries to reduce cultural barriers and misconceptions are needed to address the challenges in implementing nutrition interventions. This comprehensive approach may provide a more holistic solution to the multifaceted problem of child undernutrition, recognizing not only the technical and logistical aspects but also the human and sociocultural dimensions.

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Chapter 1. Introduction

1.1 Introduction

Achieving optimum maternal and child nutrition levels provides an individual with numerous benefits throughout the life course. A well-nourished child has decreased risk of morbidity and mortality in childhood, better cognitive, motor, and socioemotional development, and better learning capacity than her undernourished counterparts. She will also have better adult stature, a lower risk of obesity and non-communicable diseases, and higher capacity and productivity. These factors make achieving optimum nutrition levels an essential aspect of human development. The high prevalence of maternal and child undernutrition persists, especially in developing countries, and remains a global public health issue with serious consequences. Despite significant improvements in economic growth and reduction in poverty, the complex issue of undernutrition remains chronic. It shows pervasive nature through the inadequate reduction in outcomes and trend reversals, even in regions where better nutritional outcomes were once achieved.

Sustainable Development Goal 2, Target 2, which is aimed at ending all forms of malnutrition and achieving improved nutrition outcomes, recognises that malnutrition is a multifaceted problem that affects individuals across different life stages, from early childhood to adolescence and adulthood. It acknowledges the critical importance of adequate nutrition during the early years of life for optimal physical and cognitive development and the need to address the specific nutritional requirements of vulnerable groups. It recognises that nutrition is not only a fundamental human right but also a critical foundation for achieving other development goals, such as poverty reduction, education, and economic growth. In addition to SDG 2.2, which calls for an end to all forms of malnutrition by 2030, the Government of India has declared the National Nutrition Mission (NNM or the Prime Minister's Overarching Scheme for Holistic Nutrition Abhiyaan) with specific national targets of reducing child undernutrition by at least 2% per annum.

This thesis is an attempt to contribute to the work towards achieving SDG 2.2 and the closely aligned national targets of child undernutrition. We start by providing insights into the scale of the child undernutrition problem at the national level and then at the district level for all the districts in India. The distribution of prevalence and determinants of child undernutrition are also studied. In the next stage, the scope of the thesis is narrowed down to the state of Assam and its aspirational districts. Further, the district of Dhubri, one of the aspirational districts, is given focus while trying to understand the village-level health systems and the implementation of evidence-based nutrition interventions. SDG 2.2 recognises the need for tailored interventions and strategies that consider regional variations in undernutrition prevalence, determinants, and challenges. The thesis's approach and sequentially narrowing focus onto a specific geographical context becomes relevant in this background. Additionally, the estimations of indicators using primary data is an end in itself, as the survey took place during the gap period between the fourth and fifth rounds of the National Family Health Survey.

We believe this thesis offers valuable insights to inform policies, strategies, and interventions to achieve SDG 2.2, national nutrition targets, and ultimately improve nutrition outcomes for vulnerable populations.

1.2 Plan of the Thesis

The thesis is arranged as follows: The chapter following the introduction provides a comprehensive background for the thesis, introduces key concepts and indicators used, and also analyses literature that estimates the scale, distribution, and determinants of the child undernutrition problem in India. We also trace the history of nutrition interventions in India, synthesise the debates surrounding the same, and briefly summarise different prescriptions for change from the literature.

Chapter 3 consists of a comprehensive overview of the study design, data sources, and methodology used in the study. The research objectives and questions are provided for a clear understanding of the research problem and the specific goals that the study aims to achieve. The research design describes the mixed methods employed for the study and the combination of secondary and primary data. Information on the secondary data and primary data collected through a survey, including the survey settings, sample size, and survey questionnaire used to address the second research objective, is also given. The chapter also describes the collection and use of qualitative data and outlines the methods of data analysis used to examine both qualitative and quantitative data.

Chapter 4 focuses on the prevalence, distribution, and determinants of undernutrition in India. Results of analysis using three rounds of the National Family Health Survey (NFHS-3, 4, & 5) are presented. We examine how traditional indicators calculated using three rounds of NFHS at the state level have changed over time. Then we compare the traditional indicators to the CIAF to see if there are any significant differences. We also look at severe malnutrition and the incidence of multiple anthropometric failures. A population projection exercise is presented to see if the change in indicators over time corresponds to the under-five population in different states. The second subsection of the chapter discusses the determinants of undernutrition in India. One of the main goals of this chapter is also to provide a detailed national context for the subsequent chapters.

Chapter 5 focuses on the undernutrition problem in Assam at the district level, specifically focusing on aspirational districts. The concentration and determinants of undernutrition in the districts are also given focus. The primary data collected from selected districts of Assam is used to understand the input and output indicators. First, the prevalence of traditional indicators of anthropometric failure, severe and acute malnutrition indicators, and the change between the latest two rounds of NFHS are discussed. Indicators for all the districts in Assam are estimated and analysed, and the indicators for aspirational districts are compiled. Then, indicators of nutritional status and different

basic, underlying, and immediate determinants of nutritional status are estimated for each survey district using primary data.

Chapter 6 is an attempt to understand the health system at the village level in Assam, with a specific focus on nutrition interventions. The chapter explores actors and institutions involved in nutrition interventions, the influence of the governing and regulatory framework of the interventions, the influence of the social construct nature of the health system on nutrition interventions, the pathways through which nutrition-specific interventions reach women and children, and the micro and meso-level factors influencing the coverage of selected nutrition interventions.

The final chapter summarises and discusses the findings of each chapter, discusses the limitations of the study and the scope for further research, and concludes the thesis.

Chapter 2. Background and Review of Literature

2.1 Introduction

This review of literature chapter aims to provide a comprehensive background for the study, introduce key concepts and indicators used, and analyse literature that estimates the scale, distribution and determinants of child undernutrition problem in India. We also trace the history of nutrition interventions in India, synthesise the debates surrounding the same, and briefly summarise different prescriptions for change from the literature.

An adapted systematic literature review was carried out to fulfil the review objectives. Systematic literature reviews were carried out to build a background and in the context of each chapter in an iterative manner. The overarching research topic and specific research questions guided the development of search strategies. Relevant search topics and keywords were selected, and inclusion/exclusion criteria were formed for conducting different rounds of the systematic literature review. Boolean operators such as AND, OR, NOT, or AND NOT were used along with the keywords to make the searches accurate. Online databases such as PubMed, Scopus, Web of Science, Cochrane Library, JSTOR, ProQuest, and Google Scholar were searched. Screening of potentially relevant studies was conducted by reviewing the titles and abstracts before retrieving full-text articles. However, using standardised tools to evaluate study quality was not implemented, and the exclusion of studies based on suboptimal quality was determined at the researcher's discretion.

2.2 Child Undernutrition and its Consequences

2.2.1 Consequences of Maternal and Child Undernutrition

Nutrition is scientifically proven to profoundly affect health throughout the human life course. It is closely linked with cognitive and social development, especially in early childhood (Black et al.,

2008). Hence, good early nutrition is essential for children to attain their developmental potential; on the other hand, poor nutrition increases other risks for life and development. Consequences of undernutrition range broadly from raised rates of death from infectious diseases and decreased learning capacity in childhood to increased non-communicable diseases in adulthood (Victora et al., 2008). Nutrition in childhood and adolescence is important for adult health and stature. Women with short stature have an increased risk of complications in delivery, such as obstructed labour. Nutritional status at the time of conception and during pregnancy is crucial for foetal growth. Children with foetal growth restriction have a higher risk of mortality throughout infancy (Adu-Afarwuah et al., 2017).

It is estimated that over 27 per cent of children born in Low- and Middle-Income countries have foetal growth restrictions (Sudfeld et al., 2015). Bhutta et al. (2013), as part of the second Lancet nutrition series, attribute about 800000 neonatal deaths and 400000 post-neonatal infant deaths globally to the increased risk associated with having foetal growth restriction. Small size at birth and stunting during early childhood is associated with reduced human capital, less schooling, reduced economic productivity, and for women, lower offspring birthweight. Undernutrition also manifests in rapid weight gain, high glucose concentrations, blood pressure, and harmful lipid levels later in life (Victora et al., 2013).

Vitamins and minerals deficiencies also have serious health consequences, both through their direct effects and because they increase the risk of infectious diseases. Iron deficiency anaemia, xerophthalmia due to vitamin A deficiency, and iodine deficiency disorders are the direct effect of deficiencies in vitamins and minerals (Ahmed, Hossain & Sanin 2012). Nearly 157000 child deaths are attributed to vitamin A deficiency worldwide, and about 116000 child deaths are attributed to zinc deficiency. 804000 child deaths are associated with nonexclusive breastfeeding during the first six months and inadequate complementary feeding practices after that. It is estimated that different nutritional conditions such as stunting, wasting, foetal growth restriction, deficiencies of vitamin

A and zinc, and suboptimum breastfeeding jointly caused 3·1 million child deaths, constituting 45 per cent of the 6·9 million global child deaths in 2011 (Bhutta et al., 2013).

2.2.2 Importance of the First 1000 Days

The first 1000 days of a child, from pregnancy to two years of age, is often articulated as a "critical window" of opportunity for nutrition interventions. This notion emerged after 2008 when the first Lancet series on maternal and child nutrition (Victora et al., 2008) argued with evidence that undernutrition would have caused irreversible damage by the age of 2, impairing the child forever as she or he progressed toward adulthood. Growing evidence says the physical, mental, and developmental damage caused by undernutrition during the first 1000 days may last a lifetime and even affect later generations. Child and adult health risks, including obesity, hypertension, and diabetes, may be programmed by nutritional status during this period (Baidal et al., 2016; Schwarzenberg & Georgieff, 2018). During the first 1000 days, intense metabolic activity and tissue deposition occur. It is marked by rapid foetal growth and milk production in women, and rapid growth in infants and children, making it difficult for women and children to meet their nutrient needs.

Moreover, the small gastric capacity of infants and children, which limits how much they can consume at a meal, and low meal frequency add to the challenges during this period. For women in developing countries, more challenges are imposed by reliance on a poor-quality diet low in nutrient density, high content of phytates and polyphenols in the diet, which limit nutrient absorption, infections, food avoidance and restrictions that restrict the consumption of important food items. Additional challenges include poor infant and young child feeding (IYCF) practices, inadequate knowledge, and other practical difficulties and challenges such as displacements, conflicts, and emergencies (Horton, 2008; Seth Adu-Afarwuah et al., 2017).

Despite this established understanding of this window's importance, NFHS-4 data suggest that nutritional deficiencies among children in India generally worsen during that period. Almost all

stunting takes place in the first 1000 days after conception. Arnold et al. (2009) noted that the proportion of stunted children rises sharply from 0 to 20 months of age, peaking at 59 per cent, fluctuating thereafter between 48 per cent and 60 per cent. The proportion of underweight children also rises rapidly for the first 20 months of life to 47 per cent. The proportion of children with symptoms of wasting rises from 24 per cent in the first month of life to 32 per cent at the age of 1 month. About one out of every six children aged 38–57 months is wasted. Thus, the first 1,000 days of life are considered the most critical window of opportunity to undertake preventive measures to tackle undernutrition.

2.3 Determinants and Indicators of Child Undernutrition

2.3.1 Determinants of Undernutrition

The understanding of nutritional determinants evolved rapidly between 1970 and 1990. According to Garret et al. (2011), until the 1970s, the understanding of undernutrition was based on a disease model that focused solely on infection and inadequate diet. As a result, responses to undernutrition have been concentrated along medical and technological lines. Interventions focused on the immediate causes and the malnourished individual alone. By the early 1980s, various empirical analyses and research on nutritional status and disparities in developing countries revealed the shortcomings of this approach.

Initially, the studies focused on the basic causes of poverty, income and seasonality in agriculture, and productivity and wage. Longhurst and Payne (1978) observed that as the dry season approaches its end, labour and energy requirements increase, but produce and wages remain low, resulting in poverty and decreased nutritional intake. Studies such as Myrdal and Barber's (1968) and Bliss and Stern's (1978) two-part series focused on the vicious cycle of low consumption leading to low productivity, which leads to low consumption. More recent research (Strauss and Thomas, 1995) observed that higher household income allows families to invest more in food consumption, access to clean water and good hygiene, and effective health care. Increased income

also allowed families to afford more effective childcare arrangements, and higher income led to better access and quality of healthcare centres and water and sanitation systems at the community level.

Many empirical studies emerged in the following years arguing that moderate levels of income increase will not ensure an adequate reduction in undernutrition and that the importance of income in reducing undernutrition is overemphasised while other factors, such as the mother's role, are underemphasised (Behrman and Wolfe, 1983 & 1984; Behrman and Deolalikar, 1987). Furthermore, it was discovered that not all countries that increased their income saw a corresponding improvement in children's nutritional status (Alderman and Garcia, 1994). On the other hand, countries with a nominal increase in economic growth achieved higher levels of nutritional status and overall health achievements through public action (Anand and Ravallion, 1993).

During the same period, numerous studies emerged from Low- and Middle-Income Countries pinning down determinants of immediate causes of the nutritional status of children, such as care and feeding practices (Ruel et al., 1999; Ruel and Menon, 2002). They spanned across disciplines and observed that other than household income, literacy (Chatterjee and Lambart, 1989; Grosse and Auffrey, 1989) mother's education (Christian et al., 1988; Waber et al., 1981), mothers' nutritional status (Gopalan, 1985), cultural practices (Huffman, 1984; Nabbaro, 1984), women's empowerment (Bennnet, 1988; Leslie, 1988), women's time allocation (Popkin, 1980; Nabbaro, 1984), influence of social and community elites, advertisements, health service procedures, access to and use of family planning services (Huffman 1984), social characteristics of the household (Jayachandran and Jarvis, 1986; Pelto, 1987), land ownership (Bouis and Haddad, 1990; Dewey, 1979 ; Martorell et al., 1984), age of the child, birth interval (Chopra et al., 1970) sex of the child (Chen et al., 1981) family size, number of siblings (Heaver and Mundial, 1990; Horton, 1986), and

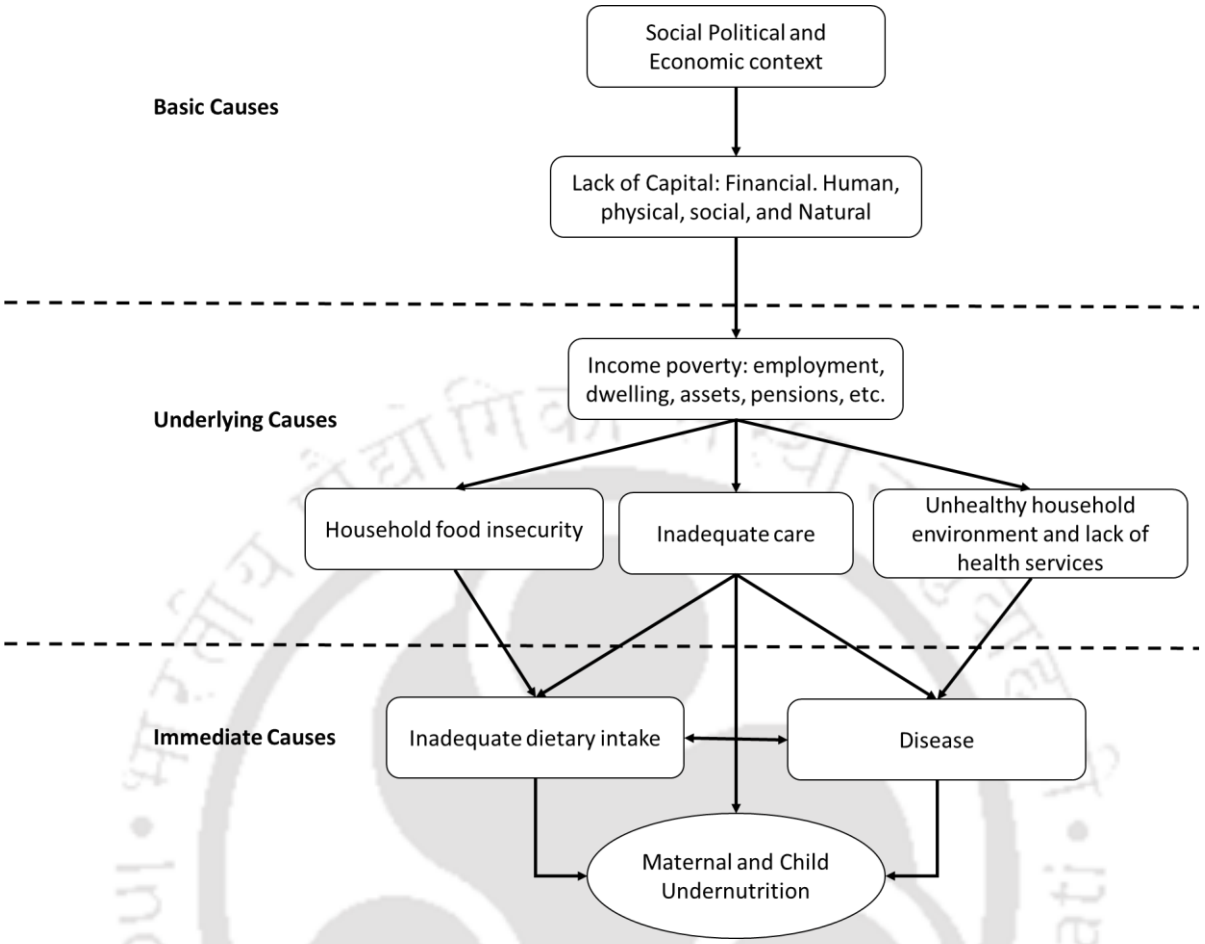
nutrition knowledge of mothers (Christian et al., 1989) have strong influence on the determinants of immediate causes of child undernutrition.

Nutrition has been identified as a public health issue linked to actions and conditions in various sectors, including agriculture, education, economics, and the environment. Addressing the issue of undernutrition demanded addressing both the immediate and underlying causes. A multisectoral understanding of the causes of nutrition revealed the need for a multisectoral institutional response. This new way of thinking was known as "multisectoral nutrition planning," It emphasised the significance of "systems analysis" in nutrition. Soon after, researchers, advocacy groups, and policymakers began incorporating development tools and models for multisectoral nutrition interventions (Alderman et al., 2013).

UNICEF developed a framework (Figure 1) in 1990 that identified different basic, underlying, and immediate determinants of undernutrition based on a multisectoral understanding of nutrition and disseminated this approach more widely than ever before. It identified the basic causes as social, political, and economic context, as well as a lack of capital, which results in underlying causes such as income poverty, household food insecurity, inadequate care practises, a lack of health services, and an unhealthy household environment. These underlying causes lead to immediate causes such as insufficient dietary intake and diseases, resulting in maternal and child undernutrition.

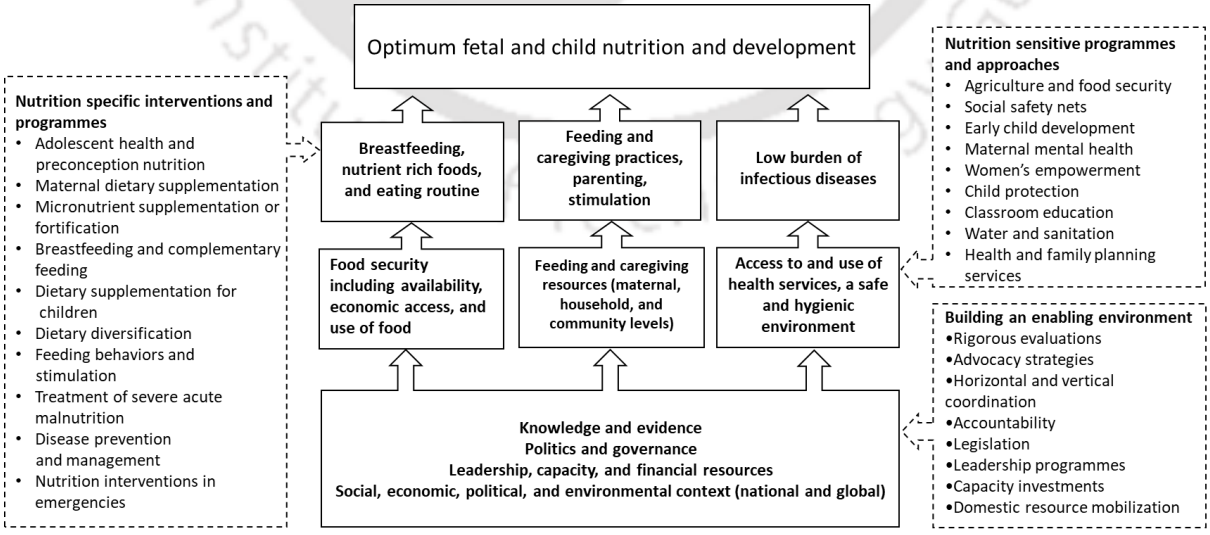
The second Lancet nutrition series, published in 2013, expanded on the 1990 UNICEF model by incorporating various dietary, behavioural, and health determinants of nutrition and how they are affected by underlying food security, caregiving resources, and environmental conditions, all of which are shaped by economic and social conditions, national and global contexts, and governance. This 'means to achievement' model (Figure 2) emphasises the importance of nutrition-sensitive intervention across sectors, evidence-based specific interventions and a life course approach.

Figure 1 Framework of Relations between Different Causes of Undernutrition



Source: UNICEF 1990

Figure 2 Framework for Actions to Achieve Optimum Nutrition and Development



Source: Lancet 2013

2.3.2 Indicators of Undernutrition

The measurement and representation of the undernutrition problem are becoming increasingly important because they constitute the foundation for government interventions and policy formulations. Scaling up interventions and implementing new evidence-based interventions are resource allocation issues that heavily rely on various measures of undernutrition and the performance of various administrative regions. As states, districts, taluks, and local governing bodies compete for resources, a more accurate portrayal of the nutrition problem will allow for more effective allocation (Pelletier et al., 2012).

Nutritional status can be assessed using either "input" or "output" indicators. Input indicators are dietary intake measurements. Output indicators measure clinical signs of malnutrition, physical activity, and anthropometry (Martorell and Ho, 1984). Furthermore, coverage of nutrition programme implementation is considered a "process" indicator, along with indicators of an enabling environment such as food security and policy environment indicators (UNICEF 1990). These indicators provide valuable information about the nature of the undernutrition problem in a particular region. The following section goes into detail about the various types of indicators.

2.3.2.1 Indicators of Biological Outcome

Anthropometric data such as skinfold thickness, height, and weight measurements are used to generate output indicators of undernutrition. Stunting, wasting, and underweight are three common anthropometric indicators of undernutrition. Stunted, wasted, or underweight children have anthropometric measurements that are more than two standard deviations below World Health Organization (WHO) child growth standards. Stunting is an indicator of chronic undernutrition and reflects slowed skeletal growth.

Wasting is the loss of fat and lean tissue, a sign of more acute undernutrition. Wasting is commonly caused by insufficient dietary intake or a high prevalence of infectious diseases, particularly diarrhoea. As a result, Wasting is a sensitive indicator of events such as famines, infectious disease

outbreaks, and emergencies. Being underweight can be caused by wasting, stunting, or a combination of the two (WHO 2006). Though underweight is one of the most commonly used growth indices, it is a composite measure that does not distinguish between acute and chronic malnutrition.

Low birth weight is another common indicator of undernutrition. Birth weight less than 2500 grams is considered low. Low birth weight is a population-level indicator of a multifaceted public health problem, including long-term maternal undernutrition, ill health, laborious work, and poor prenatal care. Anaemia and vitamin A deficiency are useful indicators of a child's nutritional status. Children with a haemoglobin concentration of less than 11g/dL are considered anaemic and are at a higher risk of child mortality. Severe Vitamin A deficiency in children increases the risk of respiratory and diarrhoeal infections, slows bone development, and lowers the chances of survival from a serious illness.

2.3.2.2 Composite Indicator of Anthropometric Failure (CIAF)

Stunting, wasting, and underweight are traditional indicators that provide valuable information about distinct biological processes and enable different clinical responses and policy interventions (Gaiha et al. 2014; Nandy 2005; WHO 1995). They are, however, mutually exclusive and overlap. A child can simultaneously be stunted and wasted, stunted and underweight, underweight and wasted, or stunted, wasted, and underweight at the same time. The estimates using traditional indicators of undernutrition give us a sense of the magnitude of India's undernutrition problem. However, policy interventions typically target only one or the other indicator (either stunting or underweight). As a result, researchers and policymakers frequently overlook the bigger picture of malnutrition (Jith & Bedamatta, 2021).

A Composite Index of Anthropometric Failure is used to overcome this problem and better estimate the overall prevalence of anthropometric failure and the number of children with multiple failures in a region. The CIAF also allows the categorisation of children into four groups of

multiple failures: zero, single, double, and triple failures (Nandy and Svedberg, 2012). Advocates of the Composite Index of Anthropometric Failure (CIAF) have urged for its expanded use in clinical research and suggested exploring alternative indicators since conventional indicators show mixed results regarding the magnitude, extent, and trend of undernutrition (Nandy & Miranda, 2008). A considerable number of scholars have recognised the potential of CIAF and utilised it to assess the overall undernutrition burden in various regional, national, and international studies (e.g., Goswami, 2016; Gupta et al., 2017; Mandal & Bose, 2009; Seetharaman et al., 2007; Sen & Mondal, 2012). In addition, researchers have compared CIAF rates with conventional indicators to illustrate the notable disparities between them. One noteworthy study is by Nandy and Svedberg (2012), which estimated India's CIAF rate using National Family Health Survey-3 data. The study showed that India's CIAF rate was 61.8%, compared to the frequently used stunting indicator of 48.3%; they also highlighted a substantial difference in undernutrition estimates for several countries, including Bangladesh, Nepal, Nigeria, Liberia, Ghana, and Egypt.

2.3.2.3 Indicators of Severe Undernutrition

Severe undernutrition is defined as any form of undernutrition associated with a high risk of severe adverse outcomes such as mortality, morbidity, and delayed development. As previously stated, children are classified as stunted, wasted, or underweight if their anthropometric measurements are more than two standard deviations below World Health Organization (WHO) child growth standards. They are classified as severely stunted, severely wasted, or severely underweight if their anthropometric measurements are more than three standard deviations below WHO child growth standards. The severely stunted, wasted, and underweight categories are life-threatening. Severe Stunting, severe Wasting, severe underweight, and multiple anthropometric failures simultaneously are all indicators of severe undernutrition.

Svedberg (2000) assumed that children with multiple anthropometric failures are at a higher risk of morbidity and mortality than children who are only stunted/wasted/underweight. Nandy and

Svedberg later tested and proved this theory in terms of morbidity (Nandy and Svedberg, 2012). Children with multiple failures were more likely to suffer from diarrhoea and Acute Respiratory Infections (ARI) than those with no or single failures. It was observed that children with multiple deficits are more likely to become ill more frequently and to be severely undernourished (Svedberg, 2005; McDonald et al., 2013). Children with multiple failures are at a higher risk of disease and death. Infections are also more common and severe in malnourished children, though this higher incidence can also be attributed to differences in environmental quality. Malnourished children have a higher case fatality rate for common communicable diseases such as diarrheal diseases than the healthy child population. These higher risks, it is argued, disproportionately affect children from developing countries because all of this occurs in the context of poverty, which results in limited access to healthcare, exposure to contaminated environments, poor childcare, poor complementary feeding practises, and food insecurity (Martorell and Ho, 1984; McDonald et al. 2013).

2.3.2.4 Process Indicators

Long-term interventions and investments in poverty, equity, and food security are required to eliminate maternal and child undernutrition. Women's economic status, education, and empowerment also need to improve. However, there are evidence-based interventions that could improve nutritional status significantly in the short term. Interventions are available to reduce child mortality, micronutrient deficiency, and Stunting. They are expected to reduce the short-term effects of undernutrition by about 25% if implemented on a large enough scale. Coverage of evidence-based interventions is regarded as a 'process indicator' when monitoring and assessing children's nutritional status.

The first and second Lancet nutrition series (Bhutta et al., 2008; Bhutta et al., 2013) reviewed interventions affecting maternal and child undernutrition and nutrition-related outcomes. They included breastfeeding promotion, complementary feeding and micronutrient interventions,

general supportive strategies to improve family and community nutrition, and disease burden reduction (promotion of handwashing and strategies to reduce the burden of malaria in pregnancy). According to the review, breastfeeding counselling and fortification or supplementation with vitamin A and zinc have the greatest potential to reduce the burden of child morbidity and mortality. Furthermore, improving complementary feeding strategies such as nutrition counselling for food-secure populations and nutrition counselling, food supplements, conditional cash transfers, or a combination of these in food-insecure populations could reduce stunting and disease burden. It also stated that maternal nutrition interventions (supplements of iron folate, multiple micronutrients, calcium, balanced energy and protein) could improve maternal health and birth outcomes. POSHAN (Partnerships and Opportunities to Strengthen and Harmonise Actions for Nutrition in India), a multi-year initiative funded by the Bill & Melinda Gates Foundation and led by the International Food Policy Research Institute (IFPRI), compiled a list of 14 essential inputs for child nutrition in the Indian context in 2013. (Avula et al., 2015). The following are the 14 process indicators based on nutrition interventions:

1. Timely initiation of breastfeeding within 1 hour of birth
2. Exclusive breastfeeding during the first six months of life
3. Timely introduction of complementary foods at six months
4. Age-appropriate complementary feeding, adequate in terms of quality, quantity, and frequency for children 6-24 months
5. Prevention of anaemia
6. Safe handling of complementary foods and hygienic complementary feeding practices
7. Full immunisation
8. Reducing Vitamin-A deficiency
9. Reducing the burden of intestinal parasites
10. Prevention and treatment of diarrhoea
11. Timely and quality therapeutic feeding and care for all children with severe acute malnutrition
12. Improved food and nutrition intake for adolescent girls, particularly to prevent anaemia.
13. Improved food and nutrients intake for adult women, including during pregnancy and lactation.

14. Prevention and treatment of malaria

All the 14 listed evidence-based interventions are currently being implemented in all the states in India through the two largest nutrition intervention programs, the ICDS and NHM, with varying interstate and inter-district coverages (NFHS-4).

2.3.2.5 Indicators of Enabling Environment for Nutrition

Aside from nutrition-specific interventions, nutrition-sensitive interventions across multiple sectors are required to create an enabling environment for optimal maternal and child nutrition (Ruel et al., 2013). Indicators of an enabling environment reflect the environment in which the child grows up. These include food security indicators as well as policy environment indicators. Food security indicators include the proportion of the population that consumes less than the minimum amount of dietary energy, per capita availability of major food items, dietary diversity, average household food expenditure, poverty headcount ratio, and the Global Hunger Index or any other measure that reflects food deficiencies.

Policy environment indicators include the adoption and implementation of international codes of marketing and promotion of food products, the existence of intersectional mechanisms to address nutrition issues, the existence of a national nutrition plan or strategy, whether the nutrition plan is part of the national development plan, and the existence of a national nutrition policy. Additionally, national dietary guidelines, budget allocation for the national nutrition plan implementation, and regular nutrition monitoring and surveillance are all indicators of the policy environment. Additionally, the proportion of hospitals and healthcare centres with appropriate supplies for the management of Severe Acute Malnutrition (SAM) and the strength of staff with nutrition skills at each level of service delivery are used as indicators of an enabling environment for nutrition.

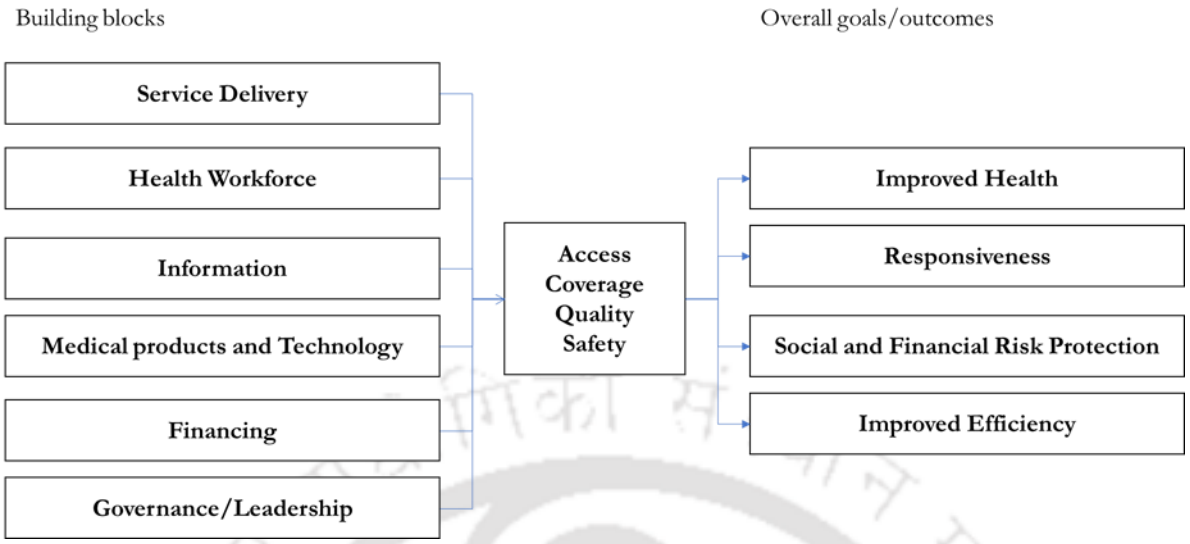
2.4 Health Systems and Child Undernutrition

2.4.1 Definition of Health Systems

'Health system' and 'health sector' are two terms that are often used interchangeably. In this study, we use definitions used in health policy and systems research where the health sector is interpreted as restricted to government actions. 'Health system' is assumed to be comprised of all the organisations, institutions, actors, and resources whose primary purpose is to improve health (WHO 2007). This includes formal and non-formal aspects, as state and non-state actors. Direct activities to improve health and efforts to improve health determinants are considered part of the health system. Preventive, promotive, curative, and rehabilitative interventions are included. One of the most commonly used frameworks of health systems is the WHO building blocks framework, published in 2007. The focus of this framework was to guide the conceptual understanding of what constitutes a health system to strengthen it. The framework identified six essential functions of the health system, namely service delivery, health workforce (human resources), information (data and data systems), medical products and technology, financing, and governance (Figure 3).

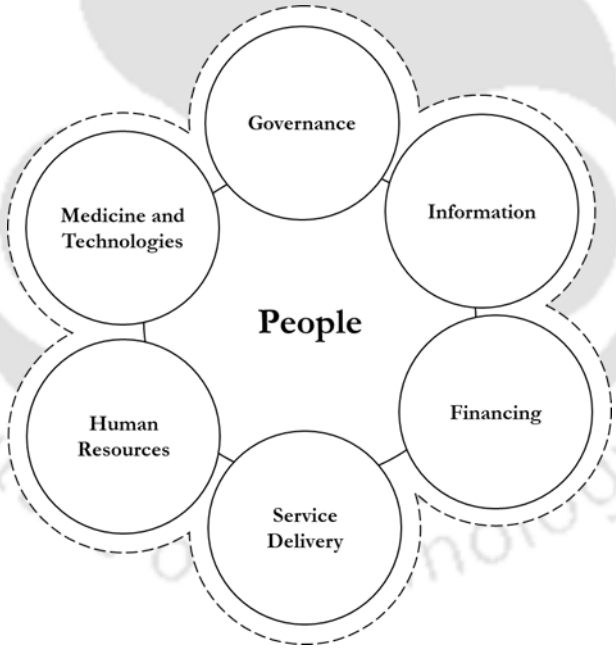
In 2009 an adapted version of this framework was published to acknowledge how the building blocks were inter-connected and interacted. The new version placed people at the centre and acknowledged health system beneficiaries and communities at the centre of the health system (Figure 4). We have oriented our study based on these frameworks with the centre's beneficiaries (mother and child). The nutrition interventions work as tracers for the study to understand the health system and its components at the village level in detail.

Figure 3 WHO Building Blocks Framework of Health Systems



Source: WHO 2007

Figure 4 People-centred version of Building Blocks Framework



Source: WHO 2009

2.4.2 Health Policy and Systems Research and Alternative Perspectives of Health System

Health Policy and Systems Research (HPSR) gathered much attention during the first decade of the 2000s when it became evident that the Millennium Development Goal targets would not be

achieved due to weak global health systems. This shift in focus in research is reflected in almost all public health research fields. Specific departments were established within international organisations, such as the Health Systems and Services cluster at WHO and new research organisations focusing on health systems research, such as the Alliance for Health Policy and Systems Research and the Institute for Health Metrics and Evaluation, emerged during this period (Sheikh et al., 2011). A strong focus was brought to conducting research to address practical operational questions, and these were frequently framed as health systems research. Innovative health reforms in developing countries such as Brazil, China, and India further created enthusiasm around the scope of system-level interventions (Rutter et al., 2017).

Sheikh et al. (2011) argue that it was after the First Global Symposium on Health Systems Research in Montreux in November 2010 that the field of Health Policy and System Research emerged as a question-driven field of research where social science perspectives, including health economics, sociology, political science, and anthropology were applied, and the contributions of individuals and institutions engaged in delivering health services were analysed. This understanding was extended by analysing each of the aspects of the building blocks of the health system. Traditionally, Health policy was seen only as the formal documents, rules, and guidelines that present policymakers' decisions about what actions are legitimate and necessary to strengthen the health system. The new understanding, however, considered the decision-making processes at all levels and the influences that underpin the prioritisation of policy issues, the formulation of policy, the processes of bringing them alive in practice, and their evaluation. It also recognises the role played by the communities and households intended to benefit from the policy in policy implementation and their roles in policy change. Alternative perspectives of health system emerged under the influence of discursive and critical theory through contributions from policy analysis and sociology, which recognised health systems and policies as artifices of human creation embedded in social and political reality and shaped by particular, culturally determined ways of framing problems and solutions (Gilson et al., 2011; Sheikh et al., 2011).

According to Bennet et al. (2011), different arenas, such as international, national, subnational, and local, as well as their intersections, were recognised to be equally part of this concept of the constructed reality of health systems. At the local level, the components of the system consist not only of the delivery of services but also the worlds of health providers, activities of provision, protection, and health promotion in local communities and households. Formal and informal local health governance systems were also given equal importance in understanding health systems' functioning. As a question-driven field, the level of health policy and systems research analysis varied depending on the nature of the questions. The different levels of analysis include the macro-level, where the architecture and oversight of systems are studied, meso-level where the focus is on the functioning of organisations and systemic interventions; the micro level, which considers the roles of individuals involved in activities of health provision, utilisation, and governance, and how systems respectively shape and are shaped by their decisions and behaviour. Research questions were also classified by their intent, such as normative/evaluative or exploratory/explanatory.

Numerous studies emerged in the last decade trying to address different health system challenges and answer practical questions about implementing and evaluating different health system interventions (Adam & Savigny, 2012; Sheikh et al., 2011). One of the studies that used the approach in relation to nutrition intervention is by Bose et al. (2014), who carried out a landscape analysis of nutrition interventions, mapping all the actors, stakeholders and networks. The study found a need for convergent action at the field level in the first 1,000 days of life. The landscape analysis also found that although programme guidelines were detailed in the policy documents, a multisectoral view of nutrition in the state was missing. The stakeholders were recorded to have pointed out implementation gaps, including lack of uniformity, insensitivity to sociocultural issues, lack of convergence with other programmes, lack of community monitoring, and non-involvement of the local leadership and community voices in addressing the multiple determinants of undernutrition.

2.5 Child Undernutrition in India

2.5.1 Historical Background of Nutrition-related Interventions in India

Since the late 1940s, addressing the challenge of malnutrition has been a priority; there have been specific policies and programmes aimed at addressing this public health challenge, as well as policies believed to benefit public nutrition indirectly. Various five-year plans also highlighted the nutrition challenge. During this period, nutrition deficiency diseases like Beri-Beri, Classical pellagra, Kwashiorkor, and keratomalacia were significant health concerns (Gopalan, 2010; Vir et al., 2014). During this initial phase of nutrition interventions, more emphasis was placed on treating malnutrition than its prevention. Even on a global scale, the recommendations were to aid developing nations in implementing hospital-focused nutrition programmes and manufacturing synthetic multivitamin tablets. The establishment of the National Institute of Nutrition in 1958 expedited clinical measures to reduce nutritional deficiencies, particularly deficiencies of specific nutrients, such as B vitamins (Bagchi 1981).

Soon it became apparent that the nutrition issue could not be resolved by focusing solely on the health sector. This lesson prompted the initial shift in programme strategy, which was a shift in emphasis to food production. As the solution, an emphasis on increasing protein consumption was identified. Therefore, fortifying wheat to improve protein quality and producing protein-rich foods for children became a policy focus. In the late 1970s, the focus shifted to increasing children's caloric intake. Initiatives were taken to increase cereal production (Subbarao 1990).

During the fourth five-year plan (1969-1974), Protein-energy malnutrition, vitamin A deficiency, and anaemia received special attention. A national programme for the prevention of anaemia among pregnant women was launched in 1971 as part of the Family Planning Programme for preventing disease and promoting health among mothers and children (Prophylaxis against Nutritional Anaemia among Mothers and Children). This programme was revised in 1991, resulting in new beneficiary selection and implementation guidelines. During the fourth five-year

plan, the anaemia prevention programme, micronutrient and supplementary feeding (SF) programmes, and Balwadi Nutrition Programme were also implemented (Planning Commission, 1969; Vir et al., 2014).

The Ministry of Health and Family Welfare launched a National Programme against Nutritional Blindness due to Vitamin A deficiency during the same time frame. The programme was initially limited to eleven Indian states when it was launched in 1971 but was expanded after an evaluation. It focused on administering vitamin A supplements on a six-monthly basis to children ages 1 to 5. In addition, the programme was revised in 1991 and 2006, gradually expanding coverage to include all children under six (Vijayaraghavan, 2018; Vir et al., 2014).

During the fifth five-year plan (1974-1979), a special emphasis was placed on improving the nutritional status of infants, children, and pregnant and lactating women and promoting breastfeeding throughout the country. The National Policy for Children (NPC) was enacted on August 22, 1974, following the UN Declaration on the Rights of the Child. It emphasised the significance of providing "adequate services to children, both before and after birth and during the growth period, to ensure their complete physical, mental, and social development" (NPC 1974). The NPC prioritised the integrated delivery of early childhood services and those for pregnant and nursing mothers, paving the way for the 1975 implementation of Integrated Child Development Services (ICDS). It was also the first nutrition-related policy to recognise the significance of preventive and promotive measures for child health (Planning Commission, 1974; Kapil, 2002). Since 1975, ICDS has provided a supplementary feeding component as part of its suite of services. Beneficiaries of the programme were infants younger than six months and pregnant and nursing women. Initially, the programme targeted only economically disadvantaged areas. Later, in April 2004, the ICDS programme included universal coverage of supplementary feeding for children, mothers, and adolescent girls (Choudhury, 2011; Vir et al., 2014).

Vir et al. observed that beginning in the early 1980s, various global events and developments heightened attention to the malnutrition challenges faced by developing nations. The Convention on the Rights of the Child (1989), the World Summit on Children (1990), the Hidden Hunger Conference (1991), and the International Congress on Nutrition (1992) all contributed to a heightened awareness of malnutrition, particularly household food security and micronutrient malnutrition. In 1993, India became one of the first developing nations to adopt a nutrition policy. It adopted its National Nutrition Policy in response to WHO's 1992 call for all developing nations to adopt nutrition policies (MHRD 1993; Vir et al., 2014).

The National Nutrition Policy (NNP) identified nutrition as a complex problem linked to agriculture, food production, and poverty. It stated that the prevalence of endemic hunger in intrahousehold food distribution patterns threatened women's and children's nutritional status, particularly in rural households (MHRD 1993). Providing food supplements to children under six, pregnant and lactating women, and adolescent girls was one of the measures recommended by the National Nutrition Policy to combat malnutrition. In addition to these direct interventions, indirect interventions such as nutrition education for creating appropriate behavioural changes among mothers, improved growth monitoring of children 0–3 years old, fortification of essential foods, popularisation of economical nutritious foods prepared from indigenous and low-cost materials, and intensification of pharmaceutical supplement programmes such as vitamin A supplementation (VAS) and iron and folate supplements were implemented (Vir et al., 2014).

The Tenth Five Year Plan (2002-2007) emphasised the deplorable state of infant and young child feeding practices (IYCF) in the country. It highlighted that inappropriate young child feeding in terms of breastfeeding and complementary feeding negatively affects a child's health, survival, and nutrition (Planning Commission 2002). The Government of India, the Ministry of Human Resource Development (MHRD), and the Food and Nutrition Board issued national guidelines on infant and young child feeding in 2004, advocating for improving infant and young child

nutrition through optimal feeding practises nationwide. During this period, the convergence of health and nutrition received considerable attention (Kim et al., 2017).

The Ministry of Women and Child Development published the National Plan of Action for Children (NPAC) in 2005, pledging to protect the rights of children up to 18. Three of the twelve key areas listed in the plan of action aimed to reduce IMR, MMR, and child malnutrition. In addition, it emphasised the importance of expanding access to water and sanitation in rural and urban areas. The Indian Academy of Paediatrics National Task Force for Framing Guidelines for the Management of Diarrhoea reported in 2006 that Zinc deficiency is prevalent among children in India and plays a significant role in the increased morbidity and mortality associated with diarrhoea. In response, the guidelines for managing diarrhoea in children were revised to recommend zinc in addition to ORS for all cases of diarrhoea (MoWCD 2005; IAP 2006; Vir et al., 2014).

Launched in 2005, the National Health Mission (NHM) significantly altered the nation's nutrition policy landscape. It established Nutrition Rehabilitation Centres (NRCs) as a health facility-based approach for managing children with severe and acute malnutrition. Citizens have the opportunity to shape health systems and policies through the VHSNCs, and accredited Social Health Activists (ASHAs) were established as key community health governance mechanisms (Ved et al., 2018). Reproductive, Maternal, Newborn Child and Adolescent Health (RMNCH+A) was launched in 2013 by the Ministry of Health & Family Welfare to influence the key interventions for reducing maternal and child morbidity and mortality. The RMNCH+A strategy is founded on the continuum of care, encompassing all interventions aimed at reproductive, maternal, newborn, child, and adolescent health under a broad umbrella and emphasising a strategic lifecycle approach. It aims to promote links between diverse interventions across thematic areas to increase coverage throughout the child's life in India, thereby improving child survival. This strategy's Health systems

strengthening (HSS) component focuses on infrastructure, human resources, supply chain management, and referral transport measures (NHM 2020).

The National Nutrition Mission (NNM) was established in 2017 as a comprehensive strategy to raise the nation's nutrition level on a war footing. The mission focuses on the mapping and convergence of various schemes contributing to addressing malnutrition, as well as the development of a Real-Time Monitoring system, the incentive of States/UTs for meeting the targets and the establishment of Nutrition Rehabilitation centres, the incentive of Anganwadi Workers (AWWs) for using IT-based tools, the introduction of height measurement of children at Anganwadi Centres (AWCs), and Social Audits (NITI Aayog 2020).

2.5.2 The Scale of the Child Undernutrition Problem in India

Child undernutrition is a persistent problem globally at an alarming scale. An estimated 150 million children under five are stunted, 50 million are wasted, and 340 million are underweight in 2020. The prevalence of child undernutrition varies across countries, with the highest burden observed in South Asia and sub-Saharan Africa. According to the Global Nutrition Report 2018, India alone accounts for one-third of the world's stunted children. It is among the top ten countries with the highest burden of wasted and underweight children. 34.7% of children under five in India suffer from stunting, while the Asian average is 21.8%. 17.3% of children under five are wasted, compared to an average of 9.1% in Asia.

Numerous independent studies have estimated child anthropometric failure in India at different levels, such as state, district, and village levels. A review by Sahu et al. (2015) noted that the estimated prevalence of undernutrition among under-five children was high and varied widely; under-weight: 39-75%, stunting: 15.4-74%, wasting: 10.6-42.3%, depending on the assessment methodology adopted. The variation in estimated stunting is consistently large across and within all states, ranging from 22.1 to 42.3% in Kerala and Uttar Pradesh, respectively. Similar levels of

variation were estimated for underweight also. Wasting ranges from 9.2% in Mizoram to 29.3% in Jharkhand.

The variation in district-wide stunting was larger, ranging from 16.0% in Alappuzha (in Kerala) to 51.1% in Jhabua (in Madhya Pradesh). District-wide underweight rates also varied significantly, ranging from 11% in the Chandel district of Manipur to over 50% in the Dohad district of Gujarat and the Jhabua district of Madhya Pradesh (Kim et al., 2021; Saxena, 2018). Studies also found that India's Empowered Action Group (EAG) states Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, Uttarakhand, Odisha, Jharkhand, and Chhattisgarh, including Assam, have a higher prevalence of undernutrition among children under the age of five than non-EAG states. The majority of the undernutrition gap between EAG and non-EAG states is explained in the study by household wealth, mother's education level, and religion (Chowdhury et al., 2023).

Studies that used regression frameworks to predict child anthropometric failures at the village level and those which quantified the extent of small area variation in child undernutrition found substantial variation in undernutrition across villages ranging from less than 5% for 691 villages to over 70% in 453 villages. Of the highest-burden villages, half of them were concentrated in three states Uttar Pradesh (30.1%), Madhya Pradesh (14.5%), and Bihar (11.7%). For stunting, 56.4% of the total variation was attributed to villages/blocks, followed by 25.8% to states/UTs, and 17.7% to districts. For underweight and wasting, villages/blocks accounted for 38.4% and 50% of India's total contextual variance. Based on heterogeneity within the district, these studies argue that smaller policy units than districts should be considered for program development to address the issue of undernutrition among children. (Kim et al., 2021; Rajpal et al., 2020).

According to the latest available data from the National Family Health Survey (NFHS-5) conducted in 2019-20, the prevalence of stunting among children under five years of age in India is 34.7% and varies widely across different regions, states, and socio-economic groups. Prevalence is highest in India's central and northern states, including Bihar, Uttar Pradesh, and Madhya

Pradesh. In these states, stunting prevalence ranges from around 42% to 49%. Stunting is also high in Jharkhand, Rajasthan, and Chhattisgarh, where prevalence ranges from 38% to 43%. In contrast, southern states like Kerala, Tamil Nadu, and Andhra Pradesh have lower stunting prevalence rates ranging from 19% to 24%. The eastern state of West Bengal also has a lower stunting prevalence rate of 26%. The prevalence of stunting is higher among children from rural areas (37.4%) compared to urban areas (27.6%). Stunting is also higher among children from poorer households (43.4%) than those from richer households (23.2%). Children from scheduled tribes have the highest prevalence of stunting (48.4%) compared to other caste groups.

The prevalence of wasting among children under five in India is 17.3%. Like stunting, the highest prevalence of wasting is seen in India's central and northern states, including Madhya Pradesh, Uttar Pradesh, and Bihar, where prevalence ranges from around 20% to 26%. The southern states of India, such as Kerala and Tamil Nadu, have a relatively lower prevalence of wasting, ranging from 9% to 13%. Wasting prevalence is around 21% among children from the poorest households, compared to 9% among children from the wealthiest households. The prevalence of wasting is higher among children from rural areas (17.7%) than in urban areas (12.8%). Children from scheduled tribes have the highest prevalence of wasting (22.3%) compared to other caste groups.

The prevalence of underweight among children under five years of age in India is 33.4%. Prevalence ranges from around 41% to 45% in the central and northern states and 15% to 18% in the south. Underweight prevalence is around 43% among children from the poorest households, compared to 17% among children from the wealthiest households. The prevalence of underweight is higher among children from rural areas (34.4%) than in urban areas (25.2%). Underweight is also highest among children from scheduled tribes (43.5%) compared to others.

The prevalence of severe stunting, severe wasting, and severe underweight among children under five years of age in India are 14.5%, 3.6%, and 9.3%, respectively. The data shows that these indicators of undernutrition are more common among children in rural areas than in urban areas.

Specifically, severe stunting is more prevalent among rural children (9.2%) compared to urban children (6.1%), and severe wasting is also more common among rural children (3.3%) compared to urban children (2.2%). Similarly, the prevalence of severe underweight is higher among rural children (10.7%) than their urban counterparts (7.5%). In addition, the prevalence of low birth weight in India is 20.4%, anaemia is 40.5%, Vitamin A deficiency is 7.5%, and Iodine deficiency disorders are 8.6%. The prevalence of these indicators is also higher in rural areas compared to urban areas; low birth weight is 22.3% in rural areas compared to 17.6% in urban, anaemia is i42.9% in rural and 32.4% in urban, Vitamin A deficiency is 8% in rural and 6.2% in urban, Iron deficiency disorders are 9% in rural and 7.9% in urban.

2.5.3 Change in the Prevalence of Child Undernutrition Problem in India Over the Years

Over the past few decades, India has made significant progress in reducing the prevalence of stunting, wasting, and underweight among children under five years of age, according to different National Family Health Survey rounds. The prevalence of stunting has decreased by 13.3 percentage points, from 48% in 2005-2006 to 34.7% in 2019-2020. The prevalence of wasting has also decreased by 2.5 percentage points, from 19.8% to 17.3%, while the prevalence of underweight has decreased by 9.1 percentage points, from 42.5% to 33.4%. However, these reductions have not been uniform across all states and regions in India. Independent studies show modest improvements in some measures of undernutrition but highlight that it remains widespread. Improvements are often attributed to changes in household wealth and maternal characteristics such as body mass index and education. (Khan & Mohanty, 2018; Nie et al., 2016).

It was reported and celebrated that between NFHS–3 (2006) and NFHS–4 (2016), the stunting rate in India decreased by nearly ten percentage points (Ministry of Women and Child Development, 2019). The Comprehensive National Nutrition Survey (CNNS; Ministry of Health and Family Welfare et al., 2019) for 2016–2018 reported a 13-point decline. The estimated rate of stunting was 34.7%, the rate of wasting 17.3%, and the rate of underweight 33.4%. In contrast to

global reports claiming a uniform increase across states based on NFHS data, CNNS estimates indicate that some of India's states have significantly reduced their wasting rates (see Development Initiatives, 2018). Distinguished development researchers have noted the media's silence on this critical issue (Drèze & Sen, 2013; Gaiha et al., 2014). Combining findings from the NFHS and CNNS surveys, scholars such as Jose (2019) argued that such incomparable reductions raise data quality concerns. This reduction in wasting reported by CNNS was deemed by Jose (2019) to be "extremely large, historically unprecedented, and impossible under normal conditions." Several additional studies (Raykar et al., 2015; Suri, 2019) have echoed these concerns.

According to the Global Nutrition Report 2020, India has made some progress in reducing stunting, with the prevalence declining from 48% in 2005-06 to 34.7% in 2019-20. However, the rate of decline in stunting has been slow, and India still accounts for a large proportion of the global burden of stunting. Similarly, the prevalence of wasting has declined from 20% in 2005-06 to 17.3% in 2019-20. Furthermore, India has not made significant progress in reducing the prevalence of anaemia among women and children. The prevalence of anaemia among children under five years of age has remained relatively constant at around 59%, while the prevalence among women of reproductive age has declined only marginally from 55% in 2006 to 50% in 2016.

2.5.4 Studies on Determinants of Child Undernutrition in India

Studies on determinants of child undernutrition in India revolve mainly around six interconnected themes: maternal factors, socioeconomic status, diet patterns and food security, sanitation and hygiene, infant and young child feeding practices, and healthcare utilisation.

Maternal factors such as maternal education, maternal age, maternal BMI, maternal anaemia, maternal diet during pregnancy, and maternal nutrition status have been found to be associated with child undernutrition (Katoch & Sharma, 2016; Katoch, 2022; Nie et al., 2016; Striessnig & Bora, 2020). Corsi et al. (2015) evaluated the simultaneous contribution of 15 known risk factors for chronic child undernutrition in India. They identified the most significant childhood

stunting/underweight predictors as short maternal stature, mother's lack of education, and maternal underweight. Women's empowerment is also crucial in improving children's nutritional status. Empowered women are better able to make decisions about their health and their children's health. They are more likely to have access to education, healthcare, and economic opportunities, which can improve their household's socioeconomic status and increase their ability to provide nutritious food for their children. Studies have shown that when women have decision-making power within the household, their children are more likely to receive a diverse and nutritious diet. Additionally, women's empowerment is linked to increased utilisation of healthcare services, including antenatal and postnatal care, which can lead to better maternal and child health outcomes (Imai et al., 2014; Rajaram et al., 2017; Sethuraman et al., 2006; Sharma & Subramanyam, 2021; Shroff et al., 2009).

Low socioeconomic status is noted to be a major determinant of child undernutrition in India. Children from poor families are more likely to be undernourished than those from more affluent families. Poverty leads to inadequate food intake, poor access to healthcare, and inadequate sanitation facilities, all contributing to undernutrition. Many empirical studies conducted in India show a clear linkage between income inequality, poverty and undernutrition among children. These linkages are verified at the state level as well as the district level. Results of some decomposition analysis show that poverty alone explains more than half of the inequality in undernutrition (Das & Sahoo, 2011; Mazumdar, 2010; Subramanyam et al., 2010). Corsi et al. (2016) also noted that households in the lowest wealth quintile significantly predict childhood stunting/underweight. Children who live in multidimensionally poor households are found to be more likely to experience undernutrition as the families may not have access to adequate food, clean water, sanitation, or healthcare, which are all critical for children's growth and development. In addition, multidimensional poverty leads to poor maternal nutrition and health, which affects fetal growth

and contributes to undernutrition among young children (Alkire & Kanagaratnam, 2021; Cowling et al., 2014; Mandal et al., 2023; Mohanty, 2011).

It is also noted that household wealth shapes access to and benefits from different forms of social capital for child health in rural India. The study suggests that efforts to address health inequalities should consider social capital's unequal distribution and geographic location. Studies that analysed the impact of household memberships in bonding and bridging organisations and linking ties to representatives of formal institutions suggest that these different forms of social capital are associated with better child health outcomes, particularly for households with greater wealth. However, access to and benefits from these organisations are also not evenly distributed (Story & Carpiano, 2017; Vikram, 2018). Marginalised communities in India are more vulnerable to undernutrition due to discrimination, poverty, lack of education, poor living conditions, and limited access to healthcare and basic services (Gaiha et al., 2010; Pathak & Singh, 2011; Subramanyam et al., 2010). Results of studies intersecting sub-groups based on caste, economic position, place of residence, and gender show that children from Scheduled Tribe (ST) and Scheduled Caste (SC) had a higher risk of undernutrition regardless of other axes of inequality (Kochupurackal et al., 2021).

Household food insecurity is another significant determinant of child undernutrition that emerged from studies conducted in India. The majority of the population relies on agriculture for their livelihoods, and fluctuations in crop yields and market prices can lead to food shortages and affect the availability and affordability of nutritious food. Many of the population, especially in rural areas, do not have access to food that meets their daily requirements. Additionally, the cost of nutritious food is often too high for many families, making it difficult to purchase sufficient quantities. Many families in India do not have access to adequate and nutritious food, which leads to undernutrition in children. Food insecurity is particularly prevalent in rural areas and marginalised communities (Aguayo et al., 2017; Dhamija et al., 2022; Saxena, 2018). Studies note

that the per capita availability and consumption of food grains have declined in India. Notably, the lower 30 per cent of the population has shown a significantly lower cereal intake compared to the top two deciles of the population; despite the latter group's increased access to fruits and vegetables since 1987, there has been a steady reduction in the consumption of these food groups amongst the bottom half of the population (Gulati et al., 2012; Saxena, 2018).

Inappropriate infant and young child feeding practices, such as the early introduction of complementary foods, inadequate breastfeeding, and poor feeding practices, are associated with child undernutrition in India (Ansuya et al., 2018; Mesharam et al., 2019; Ramji, 2009). Poor dietary diversity is also associated with lower nutritional status outcomes in India. Children who consume diets that lack diversity and are low in essential nutrients such as protein, fat, and carbohydrates, as well as micronutrients such as iron, zinc, and vitamin A, are more susceptible to various forms of undernutrition. (Nie et al., 2015; Patel et al., 2010). Furthermore, socio-economic factors such as poverty, access to healthcare, and education also impact food security and diet patterns, contributing to childhood undernutrition.

Studies consistently show that some traditional practices, such as delayed initiation of breastfeeding, early cessation of breastfeeding, and inadequate complementary feeding, significantly contribute to child undernutrition in India. These practices are often rooted in cultural beliefs and social norms, such as the belief that colostrum harms the newborn or that certain foods are inappropriate for young children (Fiorentini, 2010; Gulati, 2010). In addition, gender discrimination against girls also plays a significant role in undernutrition. Girls are often given less food than boys and are more likely to be malnourished. Early marriage and pregnancy can also lead to maternal and child malnutrition (Sethuraman et al., 2006).

Poor sanitation and hygiene practices are also significant determinants of child undernutrition. Lack of access to clean water and sanitation facilities leads to the spread of diseases, which can further exacerbate undernutrition. (Katoch et al., 2017; Singh et al.,2020). Inadequate access to

health care services, including routine check-ups, immunisations, illness treatment, and nutrition interventions, has been associated with child undernutrition (Gaiha et al., 2010; Subramanyam et al., 2010; Story & Carpiano, 2017). Studies have found a strong correlation between water quality and child undernutrition, particularly in rural areas with limited access to clean water. Contaminated water can lead to diarrhoea, which can cause malnutrition, stunted growth and developmental delays in children (Chambers & Medeazza, 2013; Johri et al., 2019).

Many studies point out the influence of seasonality in the prevalence of child undernutrition, particularly in the case of wasting in India, with higher odds of wasting observed in summer and monsoon seasons, especially in the month of August (Dimitrova & Bora, 2020; Meshram et al., 2014). A study that of particularly important for Assam investigated the association between flooding and child undernutrition in the Jagatsinghpur district of Odisha and found a high prevalence of wasting among children in flooded communities, particularly those repeatedly flooded, compared to those in non-flooded communities, with the largest difference observed for children younger than one year during floods. The study suggests that the long-lasting nutritional effects on children, particularly infants, should be considered and systematically monitored to tailor efficient responses in each context (Rodriguez-Llanes et al., 2016). Some studies discuss the impact of climate change on child undernutrition in India. Climate change can lead to extreme weather events, crop failures, and water shortages, all of which can affect food security and lead to undernutrition among children. Studies have found that climate change can exacerbate existing inequalities in undernutrition, with marginalised communities particularly vulnerable (Ckarabarty, 2016; Mahapatra et al., 2021; Muttarak & Dimitrova, 2019).

2.5.5 Debates Surrounding Nutrition Interventions in India

The debate surrounding nutrition interventions in India revolves around two main aspects, the quality and coverage of the interventions and the effectiveness of the same. Some argue that the interventions are not reaching the most vulnerable children. In contrast, others argue that they are

not effective in addressing the underlying causes of child undernutrition in the first place. The appropriate level of intervention is under debate. While some argue for a targeted approach, others believe that broader systemic changes are necessary to address the underlying causes of malnutrition. Targeted interventions often focus on specific populations, such as pregnant women and children, and provide them with nutritional supplements or feeding programs. These interventions are designed to provide the necessary nutrients to individuals who cannot access a balanced diet. However, critics argue that these interventions are not sustainable in the long term and do not address the root causes of malnutrition.

On the other hand, systemic changes involve addressing the underlying causes of malnutrition, such as poverty, lack of education, and inadequate access to healthcare. These changes may include increasing access to education, improving sanitation and hygiene, and increasing access to healthcare services. Advocates of systemic changes argue that these interventions are more sustainable in the long term and will lead to lasting improvements in nutrition outcomes.

Studies note that the primary challenges of nutrition interventions are inadequate funding and resource allocation. The program is said to be chronically underfunded, leading to a shortage of staff, poor infrastructure, and inadequate supplies and equipment. As a result, the quality of services provided by the program is often suboptimal. Many interventions have reached a significant proportion of the population, particularly in urban areas. However, the program's coverage remains limited in remote and rural areas, where the need for services is often the greatest.

Additionally, the program often fails to reach the most vulnerable and marginalised populations, including tribal communities, migrants, and those living in slums. The lack of coordination and integration across different departments and stakeholders is another key factor limiting the coverage and efficiency of nutrition interventions. Since the intervention involves multiple stakeholders, including the Ministry of Women and Child Development, the Ministry of Health and Family Welfare, and state-level departments, each with its priorities and objectives, the lack of

coordination and collaboration leads to duplication of efforts, fragmentation of services, and gaps in service delivery.

Nutrition interventions also face significant challenges in terms of human resource management. The Interventions rely heavily on a large workforce of Anganwadi workers (AWWs) and Accredited Social Health Activist (ASHA) workers responsible for providing community services. However, these frontline health workers are often overworked, underpaid, and undertrained, leading to high turnover rates, poor job satisfaction, and limited effectiveness. Additionally, there is often a lack of supervision and monitoring of the FHWs, leading to suboptimal service delivery and low accountability. Significant challenges in monitoring and evaluation mechanisms are also noted; the interventions lack robust monitoring and evaluation system, making it difficult to assess the effectiveness and impact of the program. Additionally, there is often a lack of data on the coverage and quality of services the program provides, making it challenging to identify gaps and prioritise areas for improvement.

Several flaws in the policy formulation and implementation process are also identified by researchers, including continuous policy formulation without adequate documentation of past processes, overlapping goals and targets, insufficient use and documentation of evidence in policy formulations, and operationalisation gaps. Different reviews also point out the lack of recent comprehensive and systematic analysis of the policy architecture of nutrition interventions in India, especially at the state level.

Various policy documents emphasise the need for a multi-sectoral approach to addressing undernutrition, specifically calling for convergent action of different sectors to bring together economic empowerment of women, food security, and primary healthcare to improve the nutritional status of children and pregnant and breastfeeding women. Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has been identified as one of the important schemes for income generation and community participation as essential components for

combating malnutrition. The convergence of the National Rural Health Mission and the Sarva Shiksha Abhiyan to improve the nutritional status of children is also recommended. Studies also suggest that targeted interventions are needed to address the specific needs of vulnerable groups and reduce the inequalities that contribute to undernutrition. This may include initiatives to improve access to education, healthcare, clean water, sanitation, and programs to increase income and reduce discrimination against marginalised communities. On the other hand, addressing food insecurity and other basic and underlying determinants of undernutrition in children requires a comprehensive approach that includes improving access to food, enhancing nutritional knowledge, and promoting dietary diversity; this can involve various interventions such as food subsidies, social safety nets, food fortification, and nutrition education programs.

2.5.6 Child Undernutrition and Coverage of Nutrition Interventions in Assam

Assam has one of the highest rates of maternal and child undernutrition in the country. The state's Maternal Mortality Ratio (MMR) stands at 237 deaths per 100,000 live births, the highest in the country. The Infant Mortality Rate (IMR) in Assam is 44 deaths per 1,000 live births, which is also higher than the national average of 34 deaths per 1,000 live births (UNICEF 2020). According to the National Family Health Survey (NFHS) 3 and NFHS-4 conducted in 2005-06 and 2015-16, respectively, there have been some improvements in the prevalence of undernutrition indicators in Assam. The prevalence of stunting decreased from 46.5 per cent to 36.4 per cent, while the prevalence of low birth weight decreased from 19.4 per cent to 13.6 per cent. However, the prevalence of wasting increased from 13.7 per cent to 17 per cent during the same period. Additionally, anaemia among women of reproductive age reduced from 69.3 per cent to 46 per cent. Child morbidity for diarrhoea and acute respiratory infection (ARI) reduced significantly from 8.1% to 2.9% and 7.3% to 1%, respectively.

Findings from different studies shed light on the nutritional status of children in Assam and the state's unique challenges in addressing the problem. A study conducted by Bharali et al. (2019) on

Sonowal Kachari tribal preschool children in flood-affected regions of Assam reported an overall prevalence of 11.6% wasting, 22.9% underweight, 36.2% stunting, and 48.6% CIAF. Girls showed significantly higher rates of undernutrition than boys, emphasising the gender disparity in nutritional status. Islam et al. (2014) examined the nutritional status of under-5 children belonging to tribal populations in the riverine (Char) areas of Dibrugarh district. The study reported a prevalence of 29% underweight, 30.4% stunting, and 21.6% wasting. The prevalence of underweight and stunting was lower than the state's average, but wasting was higher. The study revealed significant associations between undernutrition and socioeconomic status, parental literacy, feeding practices, and family size. Bora and Bora (2022) analysed the distribution of SAM cases in Assam. They found that five districts (Jorhat, Nalbari, Karimganj, Dibrugarh, and Nagaon) accounted for more than 50% of the cases despite having less than 25% of the state's total population. Singh et al. (2022) identified persistent stunting, wasting, and underweight clusters in Assam. Dhubri, Bongaigaon, and Barpeta districts were identified as hotspot clusters for both stunting and underweight. Choudhury et al. (2022) conducted a study on the impact of flooding on the nutritional status of children in Assam. The study revealed that the Barpeta district had the highest prevalence of moderate and severe underweight, stunting, and wasting. Yesmin and Barua (2014) compared the nutritional status of children under five in rural and urban communities of Assam. The study found a higher prevalence of underweight, stunting, and wasting in urban areas, with female children disproportionately affected. Factors such as religion, caste, family structure, maternal education, and income were associated with a higher incidence of child undernutrition. Das et al. (2020) reported 41.33% stunting, 27.56% wasting and 30.22% underweight among Rabha tribal children in Udalguri district.

During the ten years between NFHS-3 and NFHS-4, Assam witnessed certain improvements in the determinants of nutrition. The prevalence of exclusive breastfeeding slightly increased from 63.1 per cent to 63.5 per cent. Additionally, there was an improvement in early breastfeeding

initiation, which increased from 50.7% to 64.4%. However, approximately 36% of children in Assam are still not breastfed within an hour of birth. In the case of complementary feeding practices, the timely introduction of complementary foods declined from 60.1% to 49.9%, and only 8.9% of children between 6 to 23 months of age received an adequate diet.

The coverage of nutrition-specific interventions in Assam improved during 2006-16. The proportion of women who received antenatal care (ANC) during the first trimester increased by 15.1 percentage points, reaching 55.1% in 2016. The proportion of women who received at least 4 ANC visits increased from 23.5% to 46.5%, while iron and folic acid (IFA) consumption during pregnancy improved from 10.3% to 32%. Institutional delivery and birth registration improved substantially, reaching 75% and over 90%, respectively. The coverage of food supplementation increased from 12.7% to 29.8% for pregnant women, from 12.7% to 41.4% for lactating women, and from 24.6% to 71.2% for children. The proportion of children receiving vitamin A supplementation increased substantially from 12.2% to 51.3%, and children with diarrhoea who received Oral rehydration salts (ORS) also increased from 14.5% to 51.9%. However, more than half of the children still do not receive full immunisations in the state.

2.6 The Rationale for Undertaking the Study

In the context of the existing literature, several research gaps have been identified. These gaps can be categorised into three main aspects. Firstly, there is a need to study the scale and distribution of the total prevalence of undernutrition in India to understand the magnitude of the problem and monitor progress over time. While many studies have estimated traditional indicators, there has been a dearth of research on the total prevalence of undernutrition since the work of Nandy and Svedberg (2012). Estimating the total prevalence of undernutrition will enable a deeper understanding of its characteristics and distribution across different segments of society, which is essential for promoting equity and addressing health disparities. It is equally crucial to examine the total prevalence at sub-national levels and explore the social determinants of nutrition to identify vulnerable populations and target interventions to reduce disparities in nutrition outcomes. Unfortunately, few studies have comprehensively examined the indicators of total prevalence along with the constellation of determinants identified in the literature.

Secondly, there is a significant research gap in comprehensively understanding the issue of child undernutrition in Assam. Detailed situational assessment studies with a social science perspective, considering the frameworks of relationships (UNICEF 1990) and framework for action (Lancet 2013), are needed. The total prevalence of child undernutrition in the state needs to be investigated along with the status of different basic, underlying, and immediate determinants of nutrition. The findings of such assessments should be placed within the larger context of the issue at and national levels. Further, the same lens should be used to understand child undernutrition at the district level as development action plans and interventions that consider health and nutrition indicators are formed, and development priorities are set at the district level. Studies specifically focusing on aspirational districts are needed to understand the issue in depth in these comparatively backward districts.

Finally, the nutrition problem is not adequately addressed from a systems perspective that considers the social construct nature of the health system. Existing studies lack an examination of how nutrition interventions interact with the social dynamics and structures of the health system, particularly at the village level. This knowledge gap hinders our ability to identify the pathways through which interventions reach women and children, comprehend the interconnections between different actors and institutions, and assess the factors influencing the coverage of nutrition-specific interventions. To design and improve nutrition interventions effectively, it is crucial to consider the new approaches to health systems and their social construct nature.

Chapter 3. Study Design, Data Sources, and Methodology

3.1 Introduction

This chapter aims to provide a comprehensive overview of the study design, data sources, and methodology used in the research. The research objectives and questions are provided for a clear understanding of the research problem and the specific goals that the study aims to achieve. The conceptual framework and research design describes the overall approach to the study, including the use of mixed methods and the combination of secondary and primary data. Information on the secondary data used to address the first research objective, and primary data collected through a survey, including the survey settings, sample size, and survey questionnaire used to address the second research objective, are also given. The chapter also describes the collection and use of qualitative data to address the third and fourth research objectives and outlines the methods of data analysis used to examine both the qualitative and quantitative data. Concepts, estimations, and regression models used to analyse the data are also described, along with the specific variables used in the analysis.

3.2 Research Objectives and Questions

Based on the research problem and considering the recent developments in the field, the following research objectives and specific research questions are formed. The research objectives and questions are formed with a problem-based approach in order to understand the problem of child undernutrition in Assam in a detailed manner and place it in the larger context of child undernutrition in India.

Research Objective I: To study the scale and distribution of the undernutrition problem in India.

Research Question 1: What is the percentage of undernourished children in the states of India? How has the number changed over the years?

Research Question 2: What are the characteristics of the distribution of the burden of undernutrition across different sections of society?

Research Question 3: What are the different social determinants of nutrition in India? How do they correlate with the nutrition levels of different states?

Research Objective II: To study the scale and distribution of the undernutrition problem in Assam with a focus on aspirational districts.

Research Question 4: What is the percentage of undernourished children in the aspirational districts of Assam? How do they compare to other districts and the state average?

Research Question 5: How is the burden of undernutrition distributed within aspirational districts? How do different determinants of undernutrition correlate with levels of undernutrition in these districts?

Research Objective III: To study the Gram Panchayat level health systems focusing on nutrition interventions in Assam.

Research Question 6: Who are the actors and institutions that are part of nutrition interventions in Assam?

Research Question 7: What is the governing and regulatory architecture within which nutrition-specific interventions operate at the Gram Panchayat level in Assam?

Research Objective IV: To study the social construct nature of health systems at the Grama Panchayat level and its influence on nutrition interventions in Assam.

Research Question 8: What are the pathways through which nutrition-specific interventions reach women and children? What are the interconnections between various actors and institutions?

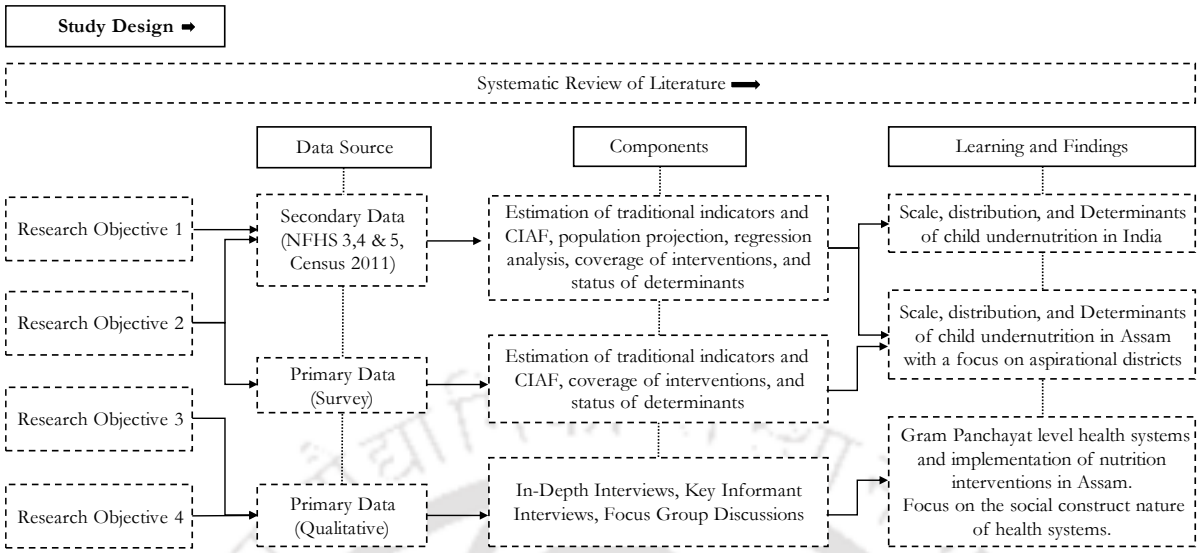
Research Question 9: What are the micro-level (individual) and meso-level (functioning of organisations and interventions), and macro-level (policy architecture) factors influencing the coverage of selected nutrition-specific interventions?

3.3 Conceptual Framework and Research Design

The study takes a problem-solving and root-cause approach to addressing the issue of malnutrition in India. We began by asking important questions about the problem's size, the affected population, the underlying causes, and potential solutions. To guide our research, we conducted a systematic review of existing literature and identified several research gaps. From these gaps, we selected three specific areas for our study and the thesis comprises of three essays that seek to fulfil the identified research gaps. The first area of study aims to examine the scale and distribution of undernutrition prevalence in India to gain a comprehensive understanding of the magnitude of the problem and track progress over time. The second area addresses the research gap concerning child undernutrition in Assam and the need for detailed situational assessment studies with a social science perspective. The frameworks of relationships (UNICEF 1990) and framework for action (Lancet 2013) are considered to gain a comprehensive understanding of the issue in this specific region. The third area of study emphasizes the need to address the nutrition problem from a systems perspective, considering the social construct nature of the health systems and examining how nutrition interventions interact with the social dynamics and structures of the health system, particularly at the village level.

Figure 5 depicts the outline of the research design of the thesis. Mixed methods are used to meet the research objectives. The first objective is addressed using secondary data from three rounds of the National Family Health Survey, while the remaining objectives are met using both primary qualitative data and a combination of primary and secondary data. The following sections of this chapter discuss in detail the data sources, estimations carried out, concepts used, and other aspects of the methodology.

Figure 5 Study Design



3.3.1 Secondary Data

NFHS-3 (2005-06), NFHS-4 (2015-16) and NFHS-5 (2019-20) unit-level data was used for most of the exercises in Chapter 4 and some estimations in Chapter 5. NFHS provides a wide range of information that enables the estimation of nutritional status indicators and determinants. It includes estimates of important indicators on family welfare, maternal and child health, and nutrition. Also, additional information on family life, education, safe injections, perinatal mortality, adolescent reproductive health, high-risk sexual behaviour, tuberculosis, and malaria.

The survey covers all the states and union territories; respondents are women aged 15-49 and men aged 15-54. NFHS-3 collected information from a nationally representative sample of 109,041 households, 124,385 women and 74,369 men. NFHS-4 collected information from 601,509 households, 699,686 women and 112,122 men. The NFHS-5 sample size comprised 636,699 households, 724,115 women, and 101,839 men. For estimations in Chapter 4, only the observations with complete anthropometric data of children under five were used. This brought the analytical sample down to the range of 199,300 to 199,538. NFHS-4 and NFHS-5-unit level data for Assam were used to estimate nutritional status indicators of children under 5 in all districts, including the aspirational districts of Assam, in Chapter 5.

Single-year age return tables of the censuses 2001 and 2011 were used for calculating the under-five population of the states.

3.3.2 Primary Data

3.3.2.1 Survey Setting and Timeline

The seven districts were chosen based on three criteria:

i) All the districts showing higher than Assam-average rates of anthropometric failure (stunting + wasting or stunting + underweight or wasting + underweight)

ii) All the districts belonging to the so-called contiguous territory of lower Assam.

iii) More than half of the districts should be drawn from the Aspirational Districts Programme List.

The decision to confine the survey to lower Assam was made to ensure that the sample is representative of the contiguous region of lower Assam. Given the limitations of time and budget, if we included more districts, we stood the chance of not being able to cover aspirational districts. Of the seven aspirational districts in Assam, six are in lower Assam. The only aspirational district in lower Assam that the survey did not cover was Baksa. Based on the above, the following districts were selected for the survey:

i) Barpeta (Aspirational)

ii) Bongaigaon

iii) Darrang (Aspirational)

iv) Dhubri (Aspirational)

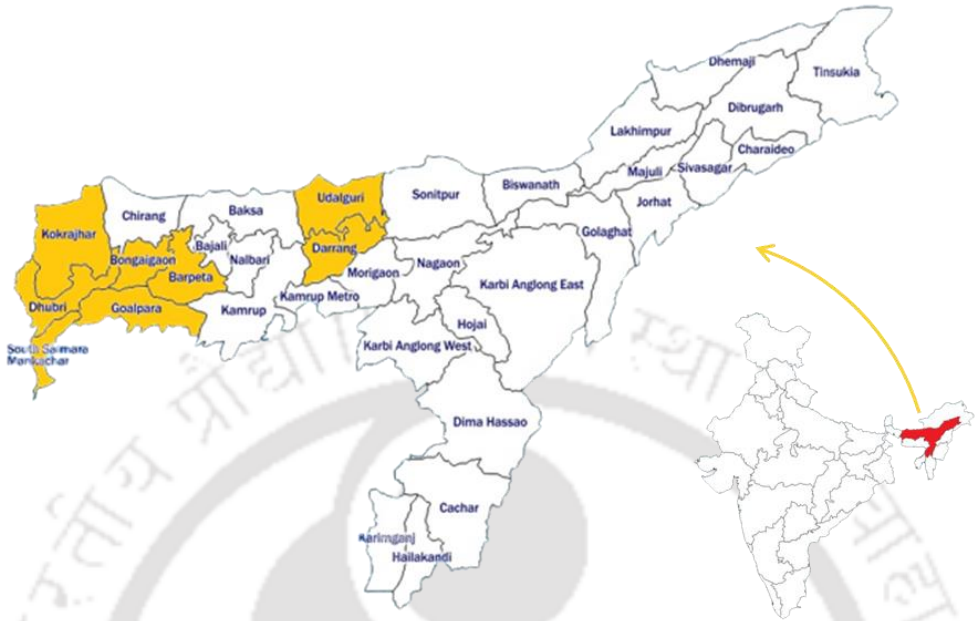
v) Goalpara (Aspirational)

vi) Kokrajhar

vii) Udalguri (Aspirational)

Survey districts are highlighted in the map of Assam in Figure 6.

Figure 6 Survey Districts



The survey was completed in five phases. The first phase of the survey began on 16th September 2019 and collected information from the sample households in Barpeta District. The second phase, from 29th September 2019 to 2nd October 2019, covered households in Kokrajhar. The survey was then interrupted by political protests in the state, followed by the COVID-19 pandemic. A third survey phase began on 25th October 2021 and finished by 30th October, covering Udalguri and Darrang districts. The fourth phase was conducted between 22nd November and 29th November 2021 in Bongaigaon and Goalpara districts. The last phase of the survey concluded from 24th February 2022 to 2nd March 20222, covering Dhubri district after another disruption caused by the second pandemic wave.

3.3.2.2 Survey Sample

We used Cochran's equation to determine the sample size for an unknown population.

$$n_0 = (Z^2 pq)/e^2$$

Where, $\boldsymbol{n_0}$ is the sample size,

$\boldsymbol{Z^2}$ is the abscissa of the normal curve that cuts off an area $\boldsymbol{\alpha}$ at the tails,

$\boldsymbol{(1-\propto)}$ equals the desired confidence level, e.g., 95%,

$\boldsymbol{e}$ is the desired level of precision,

$\boldsymbol{p}$ is the estimated proportion of an attribute present in the population, and q is $\boldsymbol{1 - p}$. The value $\boldsymbol{Z}$ is found in statistical tables which contain area under the normal curve, *e.g.,* $Z = 1.96\ for\ 95\%\ confidence\ level.$

We considered a margin of error of 3% and a 95% confidence level to arrive at a total sample size of households = 1014. We also assumed a response rate of 95% and therefore allowed ourselves some sample drop bringing our sample size to 1065 households. We then allocated these 1065 households to each district following the proportional sampling method by population count in the age group 0-6 years.

In the second stage, we considered the number of ICDS blocks in each district. The total number of ICDS blocks for the seven districts is 48. For choosing the block sample size, we followed a similar procedure as we did for the households. However, the margin of error we assumed is 10% at a 95% confidence level. The number of ICDS blocks sample estimates was 31. So, we allocated 31 blocks to each of the chosen districts following the method of proportional sampling by population count in the age group 0-6 years in each ICDS block.

In the third stage, we considered the number of Anganwadi Centres (AWCs) in each of the chosen blocks. Assuming a 10% margin of error at a 95% confidence level, we estimated 90 AWCs to be allotted to the blocks. The blocks and AWCs were chosen at each stage using simple random sampling.

Post-COVID-19 relaxations, some of the sample AWCs had not yet begun to be operational, so they had to be dropped from the sample. During the survey, a few designated AWCs were found

to be non-functional. They were dropped from the sample. The households mapped to the non-functional AWCs were distributed among the visited AWCs. The survey covered 987 households. Three households were dropped from the sample due to response errors. For households with more than one child in the age group 0-5, we considered the youngest living child's anthropometric, immunisation, and complementary feeding details. The number of ICDS sample blocks allotted to survey districts, the number of households allotted to the chosen ICDS blocks, and the list of Anganwadi centres covered are provided in Appendix 22-24.

3.3.2.3 Survey Questionnaire

The questionnaire was designed with the overall nutrition conceptual framework of immediate and underlying factors influencing child nutrition outcomes in mind. We framed a closed-ended and structured questionnaire for the survey. The questionnaire included tables on details of family members, work status of adult male and female members, details of migration and agriculture, anthropometric details of mother and child, pre-and post-natal checks, 24-hour dietary recall of the child, details of household consumption during the last one month, health-seeking behaviour, attitude towards gender roles, and standard of living. The complete schedule is provided as in Annexure 1.

3.3.2.4 Use of WHO Anthro Software

The WHO Anthro Survey Analyser software (https://worldhealthorg.shinyapps.io/anthro/) was used to calculate z-scores, prevalence estimates, and various stratification. The software analysed four indicators: length/height-for-age, weight-for-age, weight-for-length, and body mass index-for-age. The outputs were stratified based on age groups, sex, districts, social groups, the standard of living, asset ownership, childbirth characteristics, maternal indicators, coverage of interventions, diet and expenditure patterns, and indicators of women empowerment.

3.3.3 Qualitative Data

The research methodology employed qualitative methods to achieve the research objectives 3. & 4. In order to gather data, in-depth interviews (IDIs), Focus Group Discussions (FGDs), and key informant interviews (KIIs) were conducted, with the guidance of a semi-structured questionnaire that was developed based on themes identified from existing literature.

28 IDIs, 6 FGDs, and 4 KIIs were carried out. Participants of the IDIs included AWWs, ASHAs, ANMs, and Elected Representatives. Participants of the FGDs were beneficiaries of nutrition interventions, such as mothers of children under five and pregnant women.

The main themes of the topic guide included tasks carried out by the frontline workers, challenges faced in the implementation of interventions, community participation, financing, nutrition monitoring and surveillance, and initiatives and innovations in interventions. The topic guide used for the interviews is included as an annexure.

3.3.3.1 Survey setting and timeline

The study was conducted in Dhubri, one of the aspirational districts of Assam. Dhubri district is located in the westernmost part of Assam, along the international border with Bangladesh. Interviews for qualitative data collection in the district were conducted in February and March 2022. The survey was conducted in Golakganj, Chapar Salkocha, Gauripur, Birsingjarua, Nayeralga, and South Salmara development blocks. The nutritional status of children, coverage of interventions, diet patterns in the district, compared to other districts and the national average are discussed in detail in the previous chapters.

3.3.3.2 Data analysis

The interviews were conducted in Assamese and Bengali and were recorded, translated, and transcribed into English. A directed content analysis approach was used for the data analysis. The researcher read the transcripts and highlighted relevant text. Initial coding categories were based on the themes from the semi-structured questionnaire. The highlighted text was then coded using

these a priori codes. Any text that did not fit into these categories was assigned new codes, which were then used for a second round of analysis. Data saturation was reached after 18 interviews, and the codes were sorted into categories based on their relationships. These categories were then clustered to form larger final themes, which were presented as subsections in the findings section of the paper. Field notes were organised by date, location, and topic and re-read to identify recurring themes and insights. Notes were highlighted and coded using the same coding system used to analyse interviews. Findings were synthesised by summarising the insights that emerged from the data. Quotes from the field notes are also used to illustrate findings in the results section. By utilising these qualitative methods, the study was able to provide a comprehensive understanding of the topic under discussion.

3.3.4 Concepts and Estimations

3.3.4.1 Estimation of traditional indicators

NFHS data was extracted using STATA, and the indicators were estimated using Height-for-Age standard deviation (HAZ), Weight-for-Age standard deviation (WAZ), and Height-for-Weight standard deviation (HWZ) data. The WHO recommended cut-offs of -2SD and -3SD were used to categorise children into different groups of anthropometric failure such as stunted, wasted, and underweight and their severe categories. Using the same categories, CIAF was also estimated. NFHS-4 &5-unit level data was used to estimate CIAF and traditional indicators of undernutrition for all the districts in India. Indicators were calculated for 640 districts using NFHS-4 and were estimated for 707 districts using NFHS-5-unit level data.

The estimated indicators are represented visually using maps of India prepared using ArcGIS 10.4.1 software.

3.3.4.2 The Conceptual Framework of Composite Index of Anthropometric Failure (CIAF) and its Usefulness

Stunting, wasting, and underweight are traditional indicators that provide valuable information about distinct biological processes and enable different clinical responses and policy interventions

(WHO 1995; Nandy 2005; Gaiha et al. 2014). They are, however, mutually exclusive and overlap. A child can be stunted and wasted, stunted and underweight, underweight and wasted, or stunted, wasted, and underweight simultaneously (Nandy and Svedberg, 2012). A Composite Index of Anthropometric Failure is used to overcome this problem and provide a better estimate of the overall prevalence of anthropometric failure and the number of children with multiple failures in a region.

The conceptual framework of CIAF proposed by Peter Svedberg in 2000 identified six groups of children, namely (1) *no failure (A)*, (2) *wasting only (B)*, (3) *wasted and underweight (C)*, (4) *stunted, wasted, and underweight (D)*, (5) *stunted and underweight (E)*, (6) *stunting only (F)*. Later in 2005, a new group *Underweight only (Y)* was identified and added to CIAF Nandy et al. (2005).

According to Svedberg, the traditional indicator Underweight includes children in groups C, D, and E but excludes children in groups B and F. Children in groups D, E, and F could be captured by Stunting, but children in groups B and C would be missed. Children in groups B, C, and D would be accounted for by wasting, but children in groups E and F would be missed. He computed CIAF, an indicator capable of providing an all-inclusive estimate of children in the non-acceptable state- as follows:

$$CIAF = \frac{1-a}{a+b+c+d+e+f} = \frac{1-a}{1} = 1-a$$

Thus, the CIAF rate is calculated by either counting the number of children in group A and subtracting it from the total population to find the percentage of children with at least one form of anthropometric failure or by counting the number of children in all other groups and adding them up to find the percentage of children with anthropometric failure. The purpose of CIAF is not to replace traditional indicators but to supplement them by providing an additional perspective on the total prevalence of anthropometric failure in a region. Despite being a more aggregate measure of the total prevalence of anthropometric failure, the CIAF is still underutilised in policy

circles. The CIAF is also a more disaggregated measure of undernutrition as it allows us to better understand multiple failures (Nandy, 2005, Nandy and Svedberg, 2012). In this chapter, we use CIAF extensively to estimate the scale of India's undernutrition problem.

3.3.4.3 Population Projection

Assuming that the population grew at a constant rate in the ten years, we projected for 2006 and 2016 using Census 2001 and 2011 data to match the NFHS-3 and NFHS-4 years using an exponential equation logarithmic process. Based on the projected population, we calculated CIAF rates among children.

We followed Nandy et al. (2005) for calculating CIAF rates. We counted the number of children in group A (no anthropometric failure) and reduced it from the total population to find the percentage of children with at least one form of anthropometric failure.

Thus, we have calculated CIAF based on equation (2) mentioned earlier, where,

$$CIAF = \frac{1-A}{A+B+C+D+E+F+Y} = \frac{1-A}{1} = 1 - A$$

The method used to calculate the projected population (PP) is as follows:

$$PP_{2006} = P_{2001}((1 + r_A)^5) \quad (3)$$

$$PP_{2016} = P_{2011}((1 + r_A)^5) \quad (4)$$

Where P2001 is the under-five population for the year 2001 as mentioned in Census 2001 tables, and r_A is the annual growth rate calculated as,

$$r_A = 1 - \left(n^{\left(\frac{1}{n}\right)} * log(1 + r_D)\right) \quad (5)$$

r_D is the decadal growth rate calculated as,

$$r_D = (Under\ 5\ population\ in\ 2011/Under\ 5\ population\ in\ 2001) - 1 \quad (6)$$

The total number of children with anthropometric failure (P_{af}) for each year under consideration is calculated as follows:

$$Paf_{2006} = CIAF_{2006}\,[P_{2001}\,((1 + r_A)^5) \quad (7)$$

$$Paf_{2016} = CIAF_{2016}\,[P_{2011}\,((1 + r_A)^5) \quad (8)$$

For example, for Assam, NFHS-4 unit-level data have anthropometric measurements of 8855 children. Among them,

4424 (0.4996) children have no anthropometric failure (Group A)

476 (0.0537) children are wasted but neither stunted nor underweight (Group B)

559 (0.0631) children are wasted and underweight but not stunted (Group C)

396 (0.0447) children are stunted, wasted, and underweight at the same time (Group D)

1414 (0.1596) children are stunted but neither wasted nor underweight (Group F)

1402 (0.1583) children are stunted and underweight but not wasted (Group E)

184 (0.0207) children are underweight but neither stunted nor wasted (Group Y).

The $CIAF_{2016}$ for Assam is calculated as,

$$CIAF_{2016} = (1 - 0.4996)/(0.4996 + 0.0537 + 0.0631 + 0.0447 + 0.1596 + 0.1583 + 0.0207) = 1 - 0.4996 = 0.5004$$

Similarly, $CIAF_{2006}$ is also calculated using NFHS-3-unit level data and is estimated as 0.5584. The under 5 population of Assam in 2001 (P_{2001}) obtained from Census 2001 tables is 3033998 and under 5 population in 2011 (P_{2011}) obtained from Census 2011 tables is 3212833.

$$r_D = \left(\frac{3212833}{3033998}\right) - 1 = 0.05894$$

$$r_A = 1 - \left(10^{.10*\log(1-0.05894)}\right) = 0.00574362$$

The projected population of 2006 (PP_{2006}) and 2016 (PP_{2016}) for Assam are calculated as,

$$PP_{2006} = 3033998((1 + 0.00574362)^5) = 3122135$$

$$PP_{2016} = 3212833((1 + 0.00574362)^5) = 3306165$$

The total number of children with anthropometric failure (Paf) for 2006 (Paf_{2006}) and 2016 (Paf_{2016}) for Assam is calculated as,

$$Paf_{2006} = 0.5584 \times 3122135 = 1743400$$

$$Paf_{2016} = 0.5004 \times 3306165 = 1654404$$

3.3.4.4 Regression Models

To understand the characteristics of the distribution of the burden of undernutrition across different sections of society and to understand different social determinants of nutrition in India, regression analysis using NFHS-5-unit level data is carried out. We started with a systematic review of the literature, identified the determinants, and categorised them into nine domains based on data availability. These domains were used as independent variables in each regression. Appendix 1 shows the list of independent variables and domains. Height for age standard deviation denoted by HAZ, weight for age standard deviation denoted by WAZ, and height for weight standard deviation denoted by HWZ were used for OLS regressions. The severity cut-offs of these indicators, which represent severe Stunting, severe Wasting, and severe underweight, were used as dependent variables in logistic regressions. Lastly, we used the sub-categories of CIAF as the dependent variables in multinomial logistic regressions. A list of dependent variables is given in Appendix 2. Among the independent variables, the percentage of children receiving a minimum acceptable diet is calculated using the method described in Appendix 3.

Table 1 shows the list of regressions using different combinations of dependent and independent variables and the type of regression. A total of 63 regressions were carried out. Figure 7 depicts the study design of regression exercises.

Figure 7 Design of Regression Models

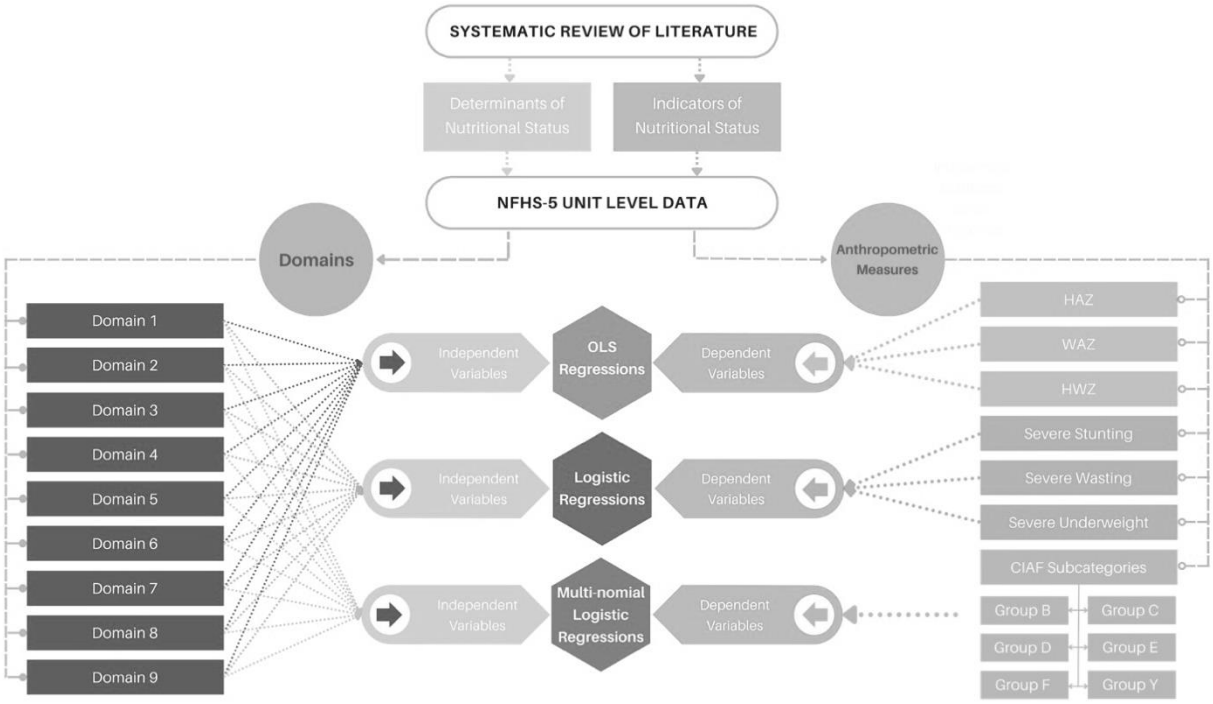


Table 1 List of Regressions

Regression no.	Regression Type	Dependent Variable	Independent Variables
1-9	OLS	HAZ	Domain 1-9
10-18	OLS	WAZ	Domain 1-9
19-27	OLS	HWZ	Domain 1-9
28-36	Logistic	Severely Stunted	Domain 1-9
37-45	Logistic	Severely Wasted	Domain 1-9
46-54	Logistic	Severely Underweight	Domain 1-9
55-63	Multinomial Logistic	CIAF	Domain 1-9

3.3.4.5 Calculation of Multi-Dimensional Poverty Index (MPI)

MPI was calculated by adapting the functional form and indicators used in UNDP Human Development Reports. The updated technical note (2021) was followed for calculations. The index uses ten indicators in three dimensions. The dimensions are Health, Education, and Standard of living. A detailed description of how each indicator is adapted for this study is given as Appendix 4. Each household was assigned a deprivation score according to deprivation scores from each of

the ten indicators. The maximum deprivation is given a score of 100, with each dimension having a weightage of 1/3. The health and education dimensions have two indicators each; hence each indicator is given the weightage of 1/6. The standard of living dimension has six indicators and a weightage of 1/18 each. A household is categorised as multidimensionally poor if the deprivation score exceeds 0.33. Households with a deprivation score higher than 0.5 are considered severely multidimensionally poor. Households with deprivation scores higher than 0.2 and less than 0.33 are considered vulnerable to multidimensional poverty. Household with scores less than 0.2 is considered not poor. The incidence of multidimensional poverty (H) is calculated as the proportion of multidimensionally poor people in the population;

$$H = \frac{q}{n}$$

Here q is the number of households experiencing multidimensional poverty, and n is the total population. The deprivation scores of multidimensionally poor households are summed up and divided by q to calculate the intensity of multidimensional poverty, A:

$$A = \frac{\sum_1^q S_i}{q}$$

Where S_i is the deprivation score the i^{th} multidimensionally poor household experiences and is written as the sum of the weighted deprivation score associated with each indicator in the three dimensions. The MPI is defined as the product of the incidence of multidimensional poverty (H) and the intensity of poverty (A).

$$MPI = H * A$$

The contribution of each of the three dimensions is calculated as

$$contri_d = \frac{\sum_{j \in d} \sum_1^q c_{ij}}{n} \Big/ MPI$$

Where d is the dimension of multidimensional poverty. The inequality among multidimensionally poor people is calculated using the variance of deprivation scores V, expressed as:

$$V = \sum_1^q (S_i - A)^2 \Big/ (q - 1)$$

3.3.4.6 Calculation of Indicators of Women Empowerment

Decision-Making Score of Mothers

Decision-making scores for mothers were calculated based on participation in decision-making (Q1 of table 13 of the survey schedule) on the following aspects:

1) Making household purchases
2) Visits to family or relatives
3) Spending money the mother earns
4) Number of children to have
5) Healthcare for mother

Scores were given under each aspect and aggregated to arrive at the overall decision-making score. The highest score was given for each aspect if the mother had complete decision-making power, and the lowest if she had no say in decision-making.

Land/Home Ownership Score of Mothers

The land/home ownership score is the sum of scores for the nature of the mother's ownership of land and house (Q5 of table 13 of the survey schedule). The highest score was for mothers who own land and house alone and jointly. The lowest score was given to mothers with no land or house in their name, alone or jointly. In addition, two other indicators, mothers' awareness about violence against women and rights, were calculated directly from the responses to Q6 and Q7 of table 13 of the survey schedule.

Chapter 4. Scale, Distribution, and Determinants of Undernutrition Problem in India

4.1 Introduction

Measurements of the prevalence of malnutrition guide various nutrition interventions, policy development, and research. Understanding the nutritional determinants aids in targeting and strategising to achieve nutrition goals efficiently and effectively. This chapter aims to understand the prevalence, distribution, and determinants of undernutrition in India using three rounds of the National Family Health Survey (NFHS-3,4, &5). The three NFHS rounds run from 2005-06 to 2019-20. I attempted to understand the nutrition problem in India, changes in the 15 years between survey rounds, and what secondary data tell us about the determinants by using unit-level data from the DHS network. The main goals of this chapter are to define the indicators and determinants used and provide a detailed national context for the subsequent chapters.

The following section contains the results and discussion, with the first sub-section presenting the findings on the prevalence of under-5 undernutrition in India. We examine how traditional indicators calculated using three rounds of NFHS at the state level have changed over time. Then we compare the traditional indicators to the CIAF to see if there are any significant differences. We also look at severe malnutrition and the incidence of multiple anthropometric failures. A population projection exercise is presented to see if the change in indicators over time corresponds to the under-five population in different states. Then, to understand the geo-spatial distribution of undernutrition, we look at traditional indicators, and the CIAF calculated at the district level and presented in maps. The second sub-section of the results and discussions discusses the determinants of undernutrition in India. The results of the regression analyses are presented and discussed here.

4.2 Anthropometric Failure Among Children Under 5 in India

4.2.1 Traditional Indicators

The anthropometric failure rates among children based on traditional indicators and CIAF rates for all 28 states and 8 Union Territories are given in Appendix 5. Except for Meghalaya, all other states and union territories had stunting rates below 40% in 2020. Only six states/UTs have stunting rates greater than 30%, but all states/UTs have more than 20% stunted children. According to estimates based on NFHS5 data, the states with the highest prevalence of Stunting are Meghalaya, Uttar Pradesh, Bihar, Chhattisgarh, and Gujarat. Kerala, Goa, Tamil Nadu, Manipur, and Jammu Kashmir have the lowest prevalence. Union territories have significantly lower stunting rates than states. According to the most recent NFHS round, India's stunting rate is 32.8 percent.

According to NFHS5 data, more than 20% of children under the age of five are wasted in five states: Gujarat, Maharashtra, Bihar, Jharkhand, and Assam. Manipur, Delhi, Sikkim, Punjab, Mizoram, and Chandigarh have the lowest levels of Wasting, with rates of less than 10%. India's wasting percentage is estimated to be 16.9. In India, nearly 27% of children under the age of five are underweight. More than 30% of children in Bihar, Gujarat, Jharkhand, Maharashtra, and West Bengal are underweight. Mizoram, Manipur, Arunachal Pradesh, and Sikkim perform best, with underweight prevalence rates of less than 15%.

4.2.2 Composite Indicator of Anthropometric Failure (CIAF)

However, when the CIAF rates are compared to the traditional indicators, the magnitude of the problem changes dramatically. According to NFHS5, over 47 percent of children under the age of five in India have at least one form of anthropometric failure. More than half of the children in seven states, namely Gujarat, Bihar, Jharkhand, Meghalaya, Maharashtra, Assam, and Uttar Pradesh, are stunted, wasted, or underweight. The lowest CIAF rates are found in Chandigarh, Sikkim, Punjab, Manipur, and Haryana, which are the only states with CIAF rates less than 35%.

4.2.3 Disaggregated CIAF

The CIAF allows us to categorise children into four groups: zero, single, double, and triple failures. The estimated number of children in each of the four categories is given in Appendix 6. We kept the group names the same as Svedberg (2000) conceptualised in his original paper, adding Group Y following Nandy et al. (2005). This excludes a group of only stunted and underweight children because a child cannot be stunted and wasted without also being underweight (Gaiha et al. 2014). Group B, F, and Y represents categories with single anthropometric failure, namely, wasted only, stunted only, and underweight only, respectively. Groups C and E represent double anthropometric failure, namely, wasted and underweight and stunted and underweight, respectively. Group D represents triple anthropometric failure, giving us the percentage of children who are stunted, wasted, and underweight simultaneously.

The undernutrition profile of states varies in terms of CIAF subgroups, but as a general pattern, Group E (stunted and underweight) accounts for the majority of undernourished children in almost all states. Every other group has a much lower share than Group E. The percentage of stunted and underweight children in the states ranges from 3 to 19, with eight states/UTs having more than 15% of these children. Group C, the other double anthropometric failure category, includes children who are both wasted and underweight. The percentage of children in Group C ranges from 2 percent to 10 percent in the states with six states/UTs, with more than 8 percent of the children in this category. Group D represents triple anthropometric failure, with children who are stunted, wasted, and underweight at the same time. Seven states have more than 5% of children with triple anthropometric failure, and this category ranges from 1% to 7% among Indian states.

Among the groups representing single anthropometric failure, Group F has the highest percentage of children. 8 to 24 percentage of the children fall into this category, with ten states/UTS having more than 15 percent of the children in the stunted-only category. In different states, Group B has 0.5 to 9 percent while Group Y has 0.7 to 2 percent.

4.2.4 Severe and Multiple Anthropometric Failures in India

The prevalence of severe and multiple anthropometric failures in India is given as Appendix 7. According to NFHS5 data, 14 percent of children in India are severely stunted, with Meghalaya, Bihar, Gujarat, Jharkhand, and Uttar Pradesh having the highest incidence. The better-performing states are Chandigarh, Goa, Kerala, Lakshadweep, and Manipur, with less than 8% of children severely stunted. More than 10% of children in 28 of the 36 states and UTs are severely stunted.

In India, 6.8 percent of children under the age of five were severely wasted in 2019-20. Gujarat and Maharashtra have the highest rates of severe Wasting, with more than 10% of children suffering from anthropometric failure. Punjab, Haryana, and Manipur fare better, with fewer than 4% of children severely wasted. In India, nearly 8% of children are severely underweight. More than 10% of children under the age of five are severely underweight in Gujarat, Bihar, Jharkhand, and Maharashtra. In terms of severe underweight, the northeastern states of Manipur, Sikkim, Mizoram, and Arunachal Pradesh perform best.

As mentioned in the previous section, Group D of the CIAF represents a severe form of anthropometric failure: the percentage of children who are stunted, wasted, and underweight at the same time. According to our estimates, 4.4 percent of children in India suffer from triple anthropometric failure, with Gujarat having the highest incidence and Manipur having the lowest. Gujarat has 7.5 percent of children under the age of five in Group D of the CIAF, while Bihar has 6.7 percent. Manipur has only 1% of children with triple anthropometric failure, and Sikkim is the next best-performing state, with 1.2 percent of children falling into Group D.

4.3 District-level Calculations of Anthropometric Failure

Beginning with NFHS4, unit-level data allows for district-level aggregation. CIAF and traditional indicators of undernutrition were estimated using NFHS-4 and NFHS-5-unit level data from all districts in India. Stunting, Wasting, Underweight, Severe Stunting, Severe Wasting, Severe Underweight, and CIAF rates were calculated for 640 districts using NFHS-4-unit level data and 707 districts using NFHS-5-unit level data. Appendix Figures 1-8 depict the estimated indicators represented visually using maps of India.

Appendix Figure 8 depicts the distribution of districts with children with at least one anthropometric failure. There is a clear clustering pattern here, with districts from drought-prone areas of the country showing high prevalence of anthropometric failure. The high prevalence districts are mainly concentrated around the Deccan trap, Dandakaranya Bastar plateau, the Chota Nagpur plateau, Bundelkhand region, Rann of Kutch and nearby hot and dry regions, Vidarbha, and the drought-prone districts of northern Uttar Pradesh, and Meghalaya. A similar distribution pattern can be seen in maps of severe Stunting, severe Wasting, severe underweight, and triple anthropometric failure.

Table 2 summarises the number of districts with the percentage of children in each category of anthropometric failure. As a general trend, the number of districts with high rates of stunting, wasting, and underweight has decreased, as has the number of districts with severe and triple anthropometric failures. According to CIAF rates, 96 of the 640 districts covered by NFHS-4 had more than 65 percent of children with at least one type of anthropometric failure. In NFHS-5, this number was reduced to 14 districts out of the total 707. According to NFHS-4 data, more than half of the children in 387 districts were stunted, wasted, or underweight. In NFHS-5, this number was reduced by 33 percentage points to 263.

Table 2 Distribution of Indicators of Anthropometric Failure in Districts of India

Indicator	% of children	Number of Districts		No. of districts as % of total no. of districts	
		NFHS-4	*NFHS-5*	*NFHS-4*	*NFHS-5*
Stunting	> 50	52	4	8%	1%
	> 30	439	370	69%	52%
	< 20	28	53	4%	7%
Wasting	> 30	78	18	12%	3%
	> 15	483	415	75%	59%
	< 10	44	94	7%	13%
Underweight	> 45	102	12	16%	2%
	> 30	371	221	58%	31%
	< 15	49	95	8%	13%
Severe Stunting	> 25	50	15	8%	2%
	> 15	286	227	45%	32%
	< 10	158	218	25%	31%
Severe Wasting	> 10	155	124	24%	18%
	> 5	458	454	72%	64%
	< 5	182	253	28%	36%
Severe Underweight	> 15	122	24	19%	3%
	> 10	288	159	45%	22%
	< 5	137	216	21%	31%
Triple Anthropometric Failure	> 10	90	22	14%	3%
	> 5	358	231	56%	33%
	< 3	146	235	23%	33%
CIAF	> 65	96	14	15%	2%
	> 50	387	263	60%	37%
	> 30	625	667	98%	94%

Source: Authors' calculations based on unit-level data from NFHS 4 and 5

4.4 Changes in indicators between 2006 and 2020

4.4.1 Change in Stunting and Severe Stunting

Changes in traditional indicators of anthropometric failure and CIAF by state between 2006 and 2020 are shown in Table 3. Table 4 depicts change in Severe and Multiple anthropometric failure. Meghalaya, Uttar Pradesh, Bihar, Chhattisgarh, and Gujarat had more than 50% of their children under five stunted in 2006. By 2016, all states, including the six mentioned, had reduced stunting rates to less than 50%. Ten states reduced stunting rates by at least ten percentage points between NFHS 3 and 4, with the highest reductions seen in Chhattisgarh, Arunachal Pradesh,

Table 3 State-wise Changes in Traditional Indicators of Anthropometric Failure and CIAF, 2006-21 (in percent)

	State	Change in Stunting			Change in Wasting			Change in Underweight			Change in CIAF		
		2006-16	2016-21	2006-21	2006-16	2016-21	2006-21	2006-16	2016-21	2006-21	2006-16	2016-21	2006-21
1	Andaman*	-	3.53(-)	-	-	0.51 (+)	-	-	1.77(+)	-	-	2.11(-)	-
2	Andhra Pradesh*	-	3.15(-)	-	-	2.70(-)	-	-	5.55(-)	-	-	5.66(-)	-
3	Arunachal Pradesh	12.87(-)	4.26(-)	17.13(-)	2.11 (+)	4.65(-)	2.54(-)	13.0(-)	6.76(-)	9.60(+)	8.78(-)	8.48(-)	17.26(-)
4	Assam	8.98(-)	1.49(-)	10.47(-)	2.39 (+)	3.99 (+)	6.37 (+)	7.0(-)	0.66(+)	8.93(-)	5.80(-)	2.14(+)	3.66(-)
5	Bihar	5.69(-)	8.88(-)	14.56(-)	5.43(-)	0.38 (+)	5.05(-)	9.82(-)	7.54(-)	9.59(-)	5.32(-)	7.01(-)	12.33(-)
6	Chandigarh*	-	7.40(-)	-	-	2.64(-)	-		6.35(-)	-		12.40(-)	-
7	Chhattisgarh	13.92(-)	5.09(-)	19.01(-)	4.37 (+)	6.77(-)	2.40(-)	6.89(-)	9.67(-)	5.34(-)	4.56(-)	10.86(-)	15.42(-)
8	Dadra & Nagar Haveli Damn & Diu*	-	1.06(-)	-	-	4.50(-)	-	-	1.26(-)	-	-	6.62(-)	-
9	Delhi	14.76(-)	2.92(-)	17.68(-)	2.22 (+)	8.42(-)	6.21(-)	2.43(-)	8.40(-)	5.20(+)	11.50(-)	9.09(-)	20.59(-)
10	Goa	5.54(-)	5.11 (+)	0.44(-)	5.99 (+)	2.81(-)	3.19 (+)	2.63(-)	2.62(-)	10.42(-)	3.98(+)	1.84(-)	2.14(+)
11	Gujarat	11.66(-)	2.60(-)	14.26(-)	9.43 (+)	3.34(-)	6.09 (+)	3.36(-)	4.60(-)	11.27(-)	3.57(-)	3.81(-)	7.38(-)
12	Haryana	11.67(-)	9.01(-)	20.68(-)	2.13 (+)	11.59(-)	9.46(-)	9.68(-)	11.46(-)	0.62(+)	4.48(-)	18.38(-)	22.87(-)
13	Himachal Pradesh	10.71(-)	4.95 (+)	5.76(-)	4.34(-)	0.65 (+)	3.69(-)	13.2(-)	1.24(+)	6.75(-)	10.61(-)	4.49(+)	6.13(-)
14	J&K*	6.87(-)	-	-	3.06(-)		-	8.59(-)		-	7.92(-)	-	-
15	Jharghand	3.14(-)	7.21(-)	10.35(-)	2.04(-)	9.07(-)	11.10(-)	6.90(-)	12.75(-)	10.21(-)	1.60(-)	12.28(-)	13.89(-)
16	Karnataka	6.00(-)	4.60(-)	10.60(-)	7.10 (+)	7.84(-)	0.75(-)	1.81(-)	8.02(-)	7.13(-)	0.85(+)	9.45(-)	8.60(-)
17	Kerala	4.96(-)	2.86 (+)	2.09(-)	0.37 (+)	1.62(-)	1.25(-)	6.06(-)	0.88(+)	11.23(-)	4.30(-)	1.28(+)	3.02(-)
18	Lakshadeep*	-	2.93 (+)	-	-	4.36 (+)	-	-	0.06(-)	-	-	5.57(+)	-
19	Madhyapradesh	3.93(-)	9.43(-)	13.35(-)	8.12(-)	9.61(-)	17.73(-)	12.3(-)	14.68(-)	5.92(-)	6.92(-)	15.28(-)	22.20(-)
20	Maharashtra	7.85(-)	2.56(-)	10.41(-)	8.80 (+)	1.67(-)	7.13 (+)	1.40(+)	4.55(-)	15.47(-)	0.30(+)	3.59(-)	3.28(-)
21	Manipur	4.59(-)	6.33(-)	10.93(-)	1.90(-)	2.65 (+)	0.75 (+)	7.73(-)	2.19(-)	0.33(+)	6.42(-)	3.37(-)	9.79(-)
22	Meghalaya	11.41(-)	0.64 (+)	10.77(-)	14.52(-)	4.45(-)	18.97(-)	18.9(-)	4.57(-)	4.63(+)	13.86	3.97(-)	17.83
23	Mizoram	10.40(-)	0.09 (+)	10.31(-)	0.89(-)	1.20 (+)	0.31 (+)	6.50(-)	1.34 (-)	5.80(+)	10.60(-)	0.99(+)	9.61(-)
24	Nagaland	8.19(-)	3.95 (+)	4.23(-)	1.09(-)	4.89 (+)	3.80 (+)	7.15(-)	8.28(+)	7.65(-)	8.48(-)	7.88(+)	0.60(-)

25	Odisha	8.96(-)	3.62(-)	12.58(-)	2.91 (+)	4.16(-)	1.25(-)	3.78(-)	7.12(-)	9.49(-)	4.74(-)	6.10(-)	10.84(-)
26	Puducherry*	-	0.46 (+)	-	-	6.73(-)	-	-	3.68(-)	-	-	4.94(-)	-
27	Punjab	11.15(-)	2.67(-)	13.82(-)	6.55 (+)	6.04(-)	0.52 (+)	3.41(-)	5.97(-)	1.97(+)	4.02(-)	7.20(-)	11.22(-)
28	Rajasthan	4.73(-)	8.40(-)	13.14(-)	3.29 (+)	7.21(-)	3.93(-)	2.64(-)	12.40(-)	2.21(-)	0.07(-)	12.61(-)	12.68(-)
29	Sikkim	7.74(-)	8.01(-)	15.75(-)	4.55 (+)	5.92(-)	1.37(-)	5.60(-)	6.79(-)	8.92(+)	1.75(-)	14.69(-)	16.43(-)
30	Tamilnadu	3.01(-)	2.91(-)	5.92(-)	1.43(-)	6.82(-)	8.25(-)	4.89(-)	5.97(-)	8.48(-)	3.41(-)	8.43(-)	11.84(-)
31	Telangana*	-	1.35 (+)	-	-	0.22 (+)	-	-	1.54(-)	-	-	2.63(+)	-
32	Tripura	10.66(-)	6.22 (+)	4.44(-)	7.10(-)	0.33 (+)	6.78(-)	13.8(-)	2.20(-)	8.35(-)	11.18(-)	6.19(+)	4.99(-)
33	Uttarakhand	11.14(-)	7.49(-)	18.64(-)	1.34 (+)	8.95(-)	7.62(-)	11.0(-)	10.26(-)	6.67(+)	5.97(-)	14.56(-)	20.53(-)
34	Uttarpradesh	8.44(-)	9.45(-)	17.89(-)	3.77 (+)	2.18(-)	1.59 (+)	1.03(-)	11.35(-)	2.96(+)	4.20(-)	9.91(-)	14.11(-)
35	West Bengal	7.07(-)	0.93(-)	8.00(-)	4.33 (+)	1.01(-)	3.32 (+)	1.63(-)	3.32(-)	13.84(-)	2.36(-)	1.33(-)	3.69(-)
	India	**5.31**(-)	**5.52**(-)	**10.83**(-)	**2.27(+)**	**3.44**(-)	**1.16**(-)	**2.66**(-)	**7.56**(-)	**6.36**(-)	**1.75**(-)	**7.39**(-)	**9.13**(-)

Source: Authors' calculations based on unit-level data from NFHS-3, 4 and 5.

Note: Grey cells are states that registered an increase in the respective indicators

Table 4 State-wise Changes in Indicators of Severe and Multiple Anthropometric Failure 2006-21 (in percent)

		Change in Severe Stunting			***Change in Severe Wasting***			***Change in Severe Underweight***			***Change in Wasted & Underweight***			***Change in Stunted, Wasted & Underweight***			***Change in Stunted & Underweight***		
1	*NFHS rounds →*	**3-4**	**4-5**	**3-5**	**3-4**	**4-5**	**3-5**	**3-4**	**4-5**	**3-5**	**3-4**	**4-5**	**3-5**	**3-4**	**4-5**	**3-5**	**3-4**	**4-5**	**3-5**
2	Andaman*	-	1.37 (+)	-	-	0.41(-)	-	-	1.73(+)	-	-	0.93(+)	-	-	0.35(-)	-	-	0.64(+)	-
3	Andhra Pradesh*	-	0.52(-)	-	-	0.79(+)	-	-	0.01(+)	-	-	1.22(-)	-	-	0.46(-)	-	-	3.60(-)	-
4	Arunachal Pradesh	8.52(-)	1.74(-)	10.26(-)	2.02(+)	2.06(-)	0.03(-)	5.21(-)	2.01(-)	7.23(-)	0.33(+)	2.13(-)	1.80(-)	2.54(-)	0.50(-)	3.04(-)	10.23(-)	4.05(-)	14.28(-)
5	Assam	6.34(-)	1.24(+)	5.10(-)	1.70(-)	2.73(+)	4.43(+)	3.37(-)	0.78(+)	2.60(-)	1.44(+)	1.64(+)	3.08(+)	1.22(-)	0.41(+)	0.80(-)	6.62(-)	1.45(-)	8.07(-)
6	Bihar	4.32(-)	4.73(-)	9.05(-)	0.74(-)	1.30(+)	0.55(+)	7.47(-)	3.85(-)	11.32(-)	0.45(-)	1.00(+)	0.55(+)	5.59(-)	1.79(-)	7.38(-)	3.69(-)	6.45(-)	10.13(-)
7	Chandigarh*	-	0.39(-)	-	-	2.25(-)	-	-	1.00(-)	-	-	1.03(-)	-	-	0.10(+)	-	-	3.16(-)	-
8	Chhattisgarh	7.44(-)	2.68(-)	10.13(-)	3.40(+)	2.22(-)	1.18(+)	3.89(-)	3.74(-)	7.63(-)	4.69(+)	3.91(-)	0.78(+)	3.77(-)	1.51(-)	5.28(-)	8.89(-)	3.74(-)	12.63(-)
9	Dadra & Nagar Haveli Damn & Diu*	-	3.35(-)	-	-	5.68(-)	-	-	0.07(-)	-	-	2.96(-)	-	-	1.84(+)	-	-	0.92(-)	-
10	Delhi	14.10(-)	0.95(+)	13.15(-)	0.22(-)	2.56(-)	2.78(-)	3.25(-)	2.71(-)	5.96(-)	0.18(+)	2.29(-)	2.12(-)	0.22(-)	2.62(-)	2.84(-)	3.07(-)	3.11(-)	6.19(-)
11	Goa	2.30(-)	0.59(-)	2.89(-)	3.28(+)	1.95(-)	1.33(+)	2.10(-)	0.05(+)	2.05(-)	1.20(+)	3.14(-)	1.94(-)	2.15(-)	2.43(+)	0.28(+)	2.92(-)	0.21(-)	3.14(-)
12	Gujarat	8.27(-)	0.14(-)	8.41(-)	4.49(+)	0.19(+)	4.67(+)	2.18(-)	2.03(-)	4.21(-)	5.43(+)	1.16(-)	4.27(+)	0.50(+)	1.90(-)	1.39(-)	8.30(-)	1.78(-)	10.08(-)
13	Haryana	5.02(-)	4.63(-)	9.65(-)	4.04(+)	5.48(-)	1.44(-)	6.00(-)	3.89(-)	9.88(-)	2.40(+)	5.28(-)	2.88(-)	4.61(-)	2.44(-)	7.06(-)	7.81(-)	3.52(-)	11.33(-)
14	Himachal Pradesh	7.20(-)	4.79(+)	2.41(-)	0.40(-)	1.31(+)	0.92(+)	6.28(-)	0.57(+)	5.71(-)	0.61(-)	0.56(+)	0.05(-)	4.48(-)	0.65(+)	3.83(-)	8.07(-)	0.49(+)	7.58(-)
15	J&K*	3.44(-)		-	0.79(+)	-	-	3.67(-)	-	-	0.76(-)	-	-	2.17(-)	-	-	5.30(-)	-	-
16	Jharkhand	5.51(-)	2.91(-)	8.42(-)	0.30(+)	3.66(-)	3.36(-)	7.18(-)	6.15(-)	13.33(-)	0.79(+)	2.76(-)	1.97(-)	3.82(-)	4.88(-)	8.71(-)	3.47(-)	4.22(-)	7.69(-)
17	Karnataka	3.82(-)	3.05(-)	6.87(-)	3.96(+)	3.09(-)	0.87(+)	0.68(-)	4.91(-)	5.59(-)	2.65(+)	2.80(-)	0.15(-)	0.31(+)	3.24(-)	2.94(-)	4.56(-)	1.73(-)	6.28(-)
18	Kerala	0.28(+)	0.60(+)	0.88(+)	2.56(+)	1.55(-)	1.01(+)	0.48(-)	0.15(-)	0.63(-)	0.53(+)	0.78(-)	0.25(-)	1.78(-)	0.44(+)	1.34(-)	3.09(-)	0.74(+)	2.34(-)
19	Lakshadeep*	-	1.62(+)	-	-	6.15(+)	-	-	1.93(+)	-	-	4.11(-)	-	-	0.86(-)	-	-	4.17(-)	-
20	Madhyapradesh	4.07(-)	5.94(-)	10.01(-)	3.16(-)	3.61(-)	6.76(-)	9.67(-)	6.30(-)	15.97(-)	2.69(-)	3.61(-)	6.30(-)	5.81(-)	4.28(-)	10.09(-)	2.83(-)	6.27(-)	9.10(-)
21	Maharashtra	3.31(-)	0.21(-)	3.52(-)	4.45(+)	0.77(+)	5.22(+)	0.23(+)	0.76(-)	0.53(-)	4.09(+)	0.47(-)	3.62(+)	0.83(+)	1.03(-)	0.20(-)	3.54(-)	2.66(-)	6.20(-)
22	Manipur	3.05(-)	1.64(-)	4.69(-)	0.28(+)	1.54(+)	1.82(+)	2.08(-)	0.35(-)	2.43(-)	0.72(-)	0.70(+)	0.02(-)	0.63(-)	0.38(-)	1.01(-)	5.82(-)	2.44(-)	8.27(-)
23	Meghalaya	10.10(-)	1.57(+)	8.53(-)	12.13(-)	3.10(-)	15.24(-)	19.99(-)	0.96(-)	20.96(-)	3.92(-)	2.49(-)	6.41(-)	12.84(-)	0.21(-)	13.05(-)	1.40(-)	1.50(-)	2.90(-)

24	Mizoram	8.53(-)	3.46(+)	5.07(-)	0.69(-)	1.92(+)	1.23(+)	2.37(-)	0.29(+)	2.08(-)	0.35(+)	0.38(-)	0.03(-)	1.12(-)	0.06(+)	1.06(-)	5.31(-)	0.78(-)	6.08(-)
25	Nagaland	6.98(-)	3.08(+)	3.90(-)	0.34(-)	1.91(+)	1.57(+)	2.13(-)	2.05(+)	0.08(-)	0.02(-)	1.74(+)	1.72(+)	0.91(-)	1.32(+)	0.40(+)	6.10(-)	4.88(+)	1.22
26	Odisha	6.40(-)	1.46(-)	7.86(-)	1.46(+)	0.58(-)	0.88(+)	2.99(-)	2.83(-)	5.82(-)	3.08(+)	1.98(-)	1.10(+)	0.77(-)	2.04(-)	2.82(-)	6.30(-)	2.73(-)	9.03(-)
27	Puducherry*	-	0.40(+)	-	-	3.98(-)	-	-	3.04(-)	-	-	3.99(-)	-	-	1.20(-)	-	-	1.39(+)	-
28	Punjab	9.33(-)	0.44(+)	8.89(-)	3.42(+)	2.39(-)	1.04(+)	2.07(-)	2.08(-)	4.15(-)	3.95(+)	2.90(-)	1.05(+)	0.44(-)	1.82(-)	2.26(-)	6.97(-)	0.93(-)	7.90(-)
29	Rajasthan	5.59(-)	4.66(-)	10.25(-)	1.56(+)	1.32(-)	0.24(+)	2.74(-)	5.27(-)	8.01(-)	2.23(+)	3.18(-)	0.95(-)	0.67(-)	3.72(-)	4.39(-)	4.90(-)	4.78(-)	9.68(-)
30	Sikkim	4.02(-)	2.22(-)	6.24(-)	2.60(+)	1.51(-)	1.09(+)	2.37(-)	0.85(-)	3.22(-)	0.47(+)	1.67(-)	1.20(-)	1.19(-)	0.42(-)	1.61(-)	5.14(-)	3.52(-)	8.65(-)
31	Tamilnadu	0.35(+)	1.88(-)	1.53(-)	0.79(-)	2.93(-)	3.72(-)	0.21(+)	2.34(-)	2.12(-)	1.11(-)	2.30(-)	3.41(-)	1.16(-)	1.41(-)	2.57(-)	2.42(-)	2.16(-)	4.58(-)
32	Telangana*	-	2.78(+)	-	-	2.52(+)	-	-	0.85(-)	-	-	0.85(+)	-	-	1.16(-)	-	-	1.13(-)	-
33	Tripura	6.21(-)	6.71(+)	0.50(+)	1.70(-)	0.62(+)	1.08(-)	9.73(-)	0.07(+)	9.67(-)	1.78(-)	0.74(-)	2.52(-)	6.62(-)	0.29(-)	6.91(-)	4.98(-)	0.51(-)	5.48(-)
34	Uttarakhand	9.38(-)	3.43(-)	12.82(-)	4.30(+)	5.16(-)	0.86(-)	7.75(-)	3.35(-)	11.09(-)	1.92(+)	4.25(-)	2.33(-)	4.49(-)	1.87(-)	6.36(-)	7.62(-)	4.15(-)	11.78(-)
35	Uttarpradesh	9.73(-)	4.30(-)	14.03(-)	1.02(+)	0.82(+)	1.85(+)	2.84(-)	3.78(-)	6.62(-)	2.42(+)	0.78(-)	1.64(+)	0.41(+)	2.34(-)	1.93(-)	4.66(-)	7.62(-)	12.29(-)
36	West Bengal	4.76(-)	2.11(+)	2.65(-)	2.27(+)	0.21(+)	2.48(+)	0.85(-)	0.71(-)	1.56(-)	3.37(+)	1.20(-)	2.17(+)	0.59(+)	0.94(-)	0.36(-)	6.41(-)	0.84(-)	7.25(-)
	India	**4.31**(-)	**2.32**(-)	**6.63**(-)	**1.41**(+)	**0.61**(-)	**0.81**(+)	**2.45**(-)	**2.97**(-)	**5.42**(-)	**1.72**(+)	**1.37**(-)	**0.35**(+)	**1.08**(-)	**1.91**(-)	**2.99**(-)	**3.39**(-)	**3.94**(-)	**7.34**(-)

Source: Authors' calculations based on unit-level data from NFHS-3, 4 and 5.

Note: Grey cells are states that registered an increase in the respective indicators

Haryana, and Gujarat. Tamil Nadu, Jharkhand, Madhya Pradesh, Manipur, and Rajasthan have the lowest reductions, with reductions of less than five percentage points. During this time, however, severe stunting increased in two states: Kerala and Tamil Nadu. Delhi, Meghalaya, Uttar Pradesh, Uttarakhand, Punjab, and Mizoram were the states that significantly reduced severe stunting rates.

The period between NFHS 4 and 5 shows some trend reversals as far as stunting rates are concerned. While most states were able to reduce stunting rates, nine saw an increase. Tripura, Goa, Himachal Pradesh, and Nagaland were the highest increase. Uttar Pradesh, Madhya Pradesh, and Haryana, on the other hand, reduced stunting rates by nearly ten percentage points. Severe Stunting increased in a significant number of 14 states, ranging from 0.4 to 14 percentage points. Tripura and Himachal Pradesh have experienced the highest increase in severe stunting rates. Madhya Pradesh, Bihar, and Rajasthan have the highest reduction in severe stunting rates.

When the 14-year period between NFHS 3 and 5 is considered, all states have reduced stunting rates. Haryana, Chhattisgarh, Uttarakhand, and Uttar Pradesh have the highest reductions, while Goa, Kerala, and Nagaland have the lowest. Even when the long period between NFHS3 and 5 is considered, severe stunting rates increase in Kerala and Tripura. Severe Stunting increased by 0.8 percentage point in Kerala and by 0.4 percentage point in Tripura. During the same time period, ten states reduced severe stunting rates by at least ten percentage points. The states with the highest severe stunting reduction are Uttar Pradesh, Delhi, Uttarakhand, Arunachal Pradesh, and Rajasthan.

4.4.2 Change in Wasting and Severe Wasting

Between 2006 and 2016, wasting rates increased in the majority of states (18 out of 31). Only 11 states have reduced wasting, with Meghalaya, Madhya Pradesh, and Tripura having the greatest reductions. Meghalaya has significantly lowered wasting rates than other states, with a decrease of 14 percentage points, while all other states reduced wasting by less than ten percentage points. Only four states have reduced wasting by more than five percentage points, while five states have

increased wasting by more than five percentage points. Gujarat, Maharashtra, and Karnataka have seen the greatest increase in wasting. A similar pattern is observed in the case of severe Wasting. While Meghalaya reduced severe wasting by 12 percentage points, all other states reduced severe wasting by less than 5 percentage points. Severe Wasting has increased by more than four percentage points in Gujarat, Maharashtra, Uttarakhand, and Haryana.

The period between NFHS 4 and 5 depicts a slightly better picture of wasting rates. 27 out of the 37 states show reductions in wasting. Haryana tops the list with a reduction of 11 percentage points in wasting, along with 13 other states that reduced wasting rates by more than five percentage points. Nagaland, Lakshadweep, and Assam are the three states with the highest increase in wasting during the period. Severe Wasting increased in 14 states and decreased in 23 states. The performance of the states follows a pattern more or less similar to that of wasting rates. Haryana and Uttarakhand reduced severe wasting rates by more than five percentage points. While it significantly increased in Lakshadweep by six percentage points, followed by Assam and Telangana, which show an increase of 2 percentage points.

Ten states have increased wasting rates between NFHS 3 and 5, while twenty states have decreased wasting rates. With a reduction of more than 17 percentage points, Meghalaya and Madhya Pradesh have the highest reduction in wasting, followed by Jharkhand and Haryana. Maharashtra, Assam, and Gujarat, on the other hand, have the highest wasting increase, by more than five percentage points. During these 14 years, however, only 11 states were able to reduce severe wasting rates. Meghalaya stands out among other states, having reduced severe wasting by 15 percentage points. Except for Meghalaya and Madhya Pradesh, which reduced severe wasting rates by more than six percentage points, all other states either increased or reduced severe wasting by less than four percentage points. The states with the highest wasting rates also have the highest severe wasting rates.

4.4.3 Change in Underweight and Severe Underweight

Except for six states, underweight decreased between 2006 and 2016. Among the six states with increased underweight rates, four have increased underweight rates by more than 20 percentage points, with Madhya Pradesh having the highest increase of 25 percentage points. Mizoram, on the other hand, managed to reduce underweight by 18 percentage points, while all other states reduced them by less than 15 percentage points. Among the six states that reduced underweight rates by more than ten percentage points, Manipur, Maharashtra, and Tripura are the next three best-performing. Except for two states, Maharashtra and Tamil Nadu, severe underweight has also decreased. Meghalaya once again stands out among the states that reduced severe underweight rates with nearly 20 percentage points reduction, while all other states reduced severe underweight rates by less than ten percentage points.

During the period between 2016 to 2020, all states except 6 witnessed a decrease in underweight rates. Six states reduced underweight rates by more than ten percentage points, with Haryana showing the greatest decrease of nearly 15 percentage points, followed by Bihar, Rajasthan, and Karnataka. Odisha has an alarmingly high increase in underweight rates during this period, with a 16-percentage point increase, whereas all other states have reduced underweight or increased underweight rates by less than two percentage points. During the period, nine states experienced an increase in severe underweight, with Nagaland, Lakshadweep, and Assam experiencing the greatest increases. Madhya Pradesh, Jharkhand, and Rajasthan are the three best-performing states, with severe underweight rates falling by more than five percentage points.

Underweight rates have decreased significantly in most states and increased in nine states between NFHS 3 and 5. Meghalaya and Kerala have seen a significant reduction in underweight, with more than a 20% drop. Madhya Pradesh, West Bengal, Odisha, and Assam were the next states to reduce underweight rates by more than 15 percentage points. Underweight rates have increased by more than five percentage points in four states, with Tripura and Uttar Pradesh at the bottom of the list.

Severe underweight has decreased in all states during this time period. Meghalaya has the highest reduction, with a reduction of 20 percentage points, and is the only state with such an achievement. Madhya Pradesh, Jharkhand, Bihar, and Uttarakhand were the next states to reduce severe underweight by more than ten percentage points. Nagaland, Maharashtra, and Kerala have the lowest reductions, with less than a one percentage point decrease in severe underweight.

4.4.4 Change in CIAF and Multiple Failures

Between 2006 and 2016, the total prevalence of undernutrition as measured by CIAF decreased in all but three states. CIAF has increased in Goa, Karnataka, and Maharashtra. Goa has the greatest increase, with a 3-percentage point increase, while Karnataka and Maharashtra have increases of 0.8 and 0.3 percentage points, respectively. The better-performing states are Meghalaya, Delhi, Tripura, Himachal Pradesh, and Mizoram, which reduced total prevalence by more than ten percentage points. During the same time period, triple anthropometric failure among children increased in five states: Maharashtra, West Bengal, Gujarat, Uttar Pradesh, and Karnataka, but the increase was negligible in all states, with an increase of less than one percentage point in each.

Meghalaya, on the other hand, shows a reduction of ten percentage points in the triple anthropometric failure category, followed by Tripura, Madhya Pradesh, and Bihar, all of which show a reduction of more than five percentage points in total prevalence. However, the percentage of children in Group B, which represents the double anthropometric failure of wasting and underweight, increased in 20 of the 29 states. Gujarat, Chhattisgarh, and Maharashtra have seen the greatest increase, while Meghalaya, Madhya Pradesh, and Tripura have seen the greatest decrease. Meghalaya shows a nearly four percentage point decrease in Group B. Group E of the CIAF represents the double anthropometric failure of Stunting and Underweight. Between NFHS 3 and 4, the percentage of children in Group E decreased in all states. Arunachal Pradesh has the highest reduction, followed by Chhattisgarh and Gujarat, and Meghalaya, Tamil Nadu, and Madhya Pradesh have the lowest. Arunachal Pradesh is the only state that has reduced the proportion of

children in Group E by more than ten percentage points. The reduction is less than five percentage points in most states.

Between 2016 and 2020, CIAF increased in 8 of the 35 states for which data was available. The greatest increase was in Nagaland, Tripura, and Lakshadweep, where the total prevalence of undernutrition increased by more than 5%. Haryana and Madhya Pradesh had the best change, with CIAF dropping by more than 15 percentage points. Aside from the top two states, six more states reduced CIAF rates by more than ten percentage points. A similar pattern can be seen in Group D of the CIAF. Goa, Nagaland, and the UT of Dadra Nagar Haveli, Daman, and Diu saw the greatest increase in triple anthropometric failure. The prevalence of triple anthropometric failure increased by two percentage points in Goa. Jharkhand and Madhya Pradesh, on the other hand, reduced triple failure by more than four percentage points. During the same time period, Group C exhibits a similar pattern. Lakshadweep, Nagaland, and Assam rank last among the eight states where the percentage of children in Group C has increased. Only five states out of the 35 show an increase in the percentage of children in Group E. Haryana and Uttarakhand top the list of states with a decreased percentage of children in Group C. The percentage of children in this double anthropometric failure group increased by nearly five percentage points in Nagaland. In contrast, the percentage of children in Group E decreased by more than five percentage points in Uttar Pradesh, Bihar, and Madhya Pradesh, making these three states the best performers among the 30 states that managed to reduce the incidence of this double anthropometric failure.

In the 14 years between NFHS 3 and NFHS 5, CIAF decreased in all states except Goa, where it increased by two percentage points. Haryana, Madhya Pradesh, Delhi, and Uttarakhand are the significantly better performing states, with a more than 20 percentage point decrease in the percentage of children showing at least one form of anthropometric failure. During this time, more than half the states were able to reduce CIAF rates by more than ten percentage points. Except for Nagaland and Goa, where the percentage of children in Group D of the CIAF increased by

0.4 and 0.2 points, respectively, triple anthropometric failure decreased in most states. Meghalaya and Madhya Pradesh are the two states that have a reduction of more than ten percentage points in the number of children who are simultaneously stunted, wasted, and underweight. Children in CIAF Group C have also decreased significantly in the two states, with reductions of more than six percentage points. Out of the 28 states studied, 17 show a decrease in the percentage of children in Group C. Among the states with an increase in the percentage of children in Group C, Gujarat, Maharashtra, and Assam have the highest increase with more than three percentage points. The percentage of children classified as CIAF Group E has decreased in all states. Seven states reduced the proportion of children in Group E by more than ten percentage points, with Arunachal, Chhattisgarh, and Uttar Pradesh at the top of the list.

4.5 Change in Indicators of Anthropometric Failure and Change in Under-5 Population

Although the change in indicators can inform the performance of the states over these years, it will only gain traction once the change in the under-five population is considered. Appendix 8 depicts the changes in indicators and under five population in 27 states from 2006 to 2016. Jammu and Kashmir, which appeared to be one of the better performing states in terms of stunting rates and CIAF rates in NFHS-3 and NFHS-4, may have seen a slower reduction in child undernutrition due to an increase in the under-five population of more than 40% over the ten years. Comparatively, the decline in anthropometric failure, regardless of the indicator we choose to use, is less than 10%.

The rates of stunting (25.3%) and CIAF (24.5%) decreased the most in Himachal Pradesh, and the under-five population decreased by 2.7 percentage points. Therefore, it is clear that over the ten years, Himachal Pradesh has made significant progress in addressing the issue of child undernutrition. Manipur, Mizoram, Tripura, Assam, Nagaland, and Arunachal Pradesh are six north-eastern states that may not have seen significant improvements in child nutrition because

their under-five population has increased at a rate faster than the decline in anthropometric failure even though they did not appear to be worse off in NFHS-3 or NFHS-4 in terms of stunting or CIAF. Despite an improvement in relative rank when compared to the other north-eastern states, Meghalaya still has a high level of child deprivation. Meghalaya had the highest rates of stunting among the Indian states in 2006, but by 2016 it had improved.

CIAF rates increased marginally in four states: Goa, Karnataka, Maharashtra, and Rajasthan. However, the direction of change of under-five population and anthropometric failure was different in each of the four states. The under-five population in Goa decreased by 2.5 percentage points, while stunting decreased by 8.3 percentage points and CIAF increased by 3.6 percentage points. We will consider this a decrease in child well-being because the CIAF rate has increased faster than the U5 population. In Karnataka, the under-five population increased by two percentage points, CIAF increased by one percent, and stunting decreased by 5.6 percent. In Maharashtra, the under-five population decreased by 1.7 percent, while the CIAF increased by 0.48 percent and the stunting rate decreased by 7.7 percent. In Rajasthan, the under-five population increased by 0.9 percent, and the CIAF increased by 0.01 percent, but the stunting rate decreased by 4.4 percent.

We can divide the 27 states into four groups based on CIAF rates and changes in the under-five population between 2006 and 2016. Table 3 shows the states in each group. Despite an increase in the under-five population, states in Group 1 have reduced the number of children experiencing anthropometric failure. This group consists of 13 states. The second group consists of states that have reduced the number of children with anthropometric failure and the under-five population. The third category includes states where anthropometric failure has increased in tandem with an increase in the under-five population. The fourth group consists of states in which the number of children with anthropometric failure has increased despite a decrease in the under-five population. According to these classifications, states in groups 3 and 4 require immediate policy attention.

However, when designing resource allocation policies for states in groups 1 and 2, we must also consider the rate of change in CIAF rates versus the rate of change in population.

Understanding the performance of the states serves purposes other than ensuring adequate resource allocation. A more accurate assessment of the states' performance promises the development of better policies that can be replicated in similar situations. Should we see the 4 percent decrease in Kerala's anthropometric failure the same way we see the 4 percent decrease in Uttar Pradesh's anthropometric failure? The 4% reduction in CIAF in Uttar Pradesh could have reduced the actual number of nutritionally deficient children by 1.5 million, and the 4% reduction in Kerala could have contributed to a 200,000 decrease in children with anthropometric failure. Similarly, Goa's 8% increase in anthropometric failure may have added 4000 children to the malnourished category, while Bihar's 5% increase must have added more than 500,000 children. In addition, with the exception of Bihar, the absolute number of children experiencing at least one form of anthropometric failure has decreased in all states.

Table 5 Groups of States by Changes in Children under Five Population and by CIAF

Group 1 **Ch-U5↑ CIAF↓**	**Group 2** **Ch-U5↓CIAF↓**	**Group 3** **Ch-U5↑ CIAF↑**	**Group 4** **Ch-U5↓CIAF↑**
Arunachal Pradesh	Himachal Pradesh	Bihar	Goa
Assam	Kerala	Jharkhand	Maharashtra
Chhatisgarh	Sikkim	Jammu&Kashmir	
Gujarat	Uttar Pradesh	Karnataka	
Haryana	West Bengal	Manipur	
MadhyaPradesh		Rajasthan	
Mizoram		Meghalaya	
Nagaland			
Odisha			
Punjab			
Tamilnadu			
Tripura			
Uttarakhand			

Source: Authors' compilation based on estimates

4.6 Determinants of Undernutrition in India

The section provides a comprehensive overview of the determinants of the nutritional status of children under five in India. It contributes to the generation of evidence on different basic, underlying, and immediate causes of the nutritional status of children. Results from regression analyses are presented in Table 6-8. Table 6 depicts coefficients from OLS regressions, Table 7 odds ratios from logistic regressions, and Table 8 coefficients from multinomial logistic regressions. The results are summarised domain-wise in the following subsections.

4.6.1 Breastfeeding and Complementary Feeding

Children who are breastfed within 1 hour of birth have better height for age scores and weight for age scores. They are also less likely to be Severely Stunted and fall into the subcategories B, D, E, F, and Y of CIAF. A strong positive relationship is observed between children who receive a minimum acceptable diet and their HAZ, WAZ, and HWZ scores. They are also less likely to be severely stunted and fall into C, D, E, F, and Y subcategories of CIAF. However, an inverse relationship is observed between minimum acceptable diet and height for weight standard deviation and group B of CIAF, both of which represent Wasting.

4.6.2 Selected Interventions

Children whose height and weight are measured regularly have better HAZ and WAZ scores and are less likely to be severely stunted. And severely underweight. An inverse relationship is observed between height and weight measurement HWZ score representing wasting and B, C, D, E, and F groups of CIAF mostly representing double and triple anthropometric failures. Fully immunised children have better HAZ, WAZ, and HWZ scores and are less likely to be severely stunted or severely underweight. An inverse relationship is observed between immunisation and severe wasting and group B and Y of CIAF representing wasting only and underweight only categories. Children who received a vitamin A dose in the last 6 months have lower HAZ, WAZ, and HWZ scores than their counterparts and are more likely to fall into group D of CIAF, which is triple

Table 6 Results from OLS regression analysis (Coefficients)

	Independent Variables	Dependent Variables								
		HAZ	Std. Err.	95 % Conf. Interval	**WAZ**	Std. Err.	95 % Conf. Interval	**HWZ**	Std. Err.	95 % Conf. Interval
Domain 1	breastfed_within1	5.72	0.80	(4.16, 7.3)	7.31	0.58	(6.17, 8.45)			
	min_diet	143.40	1.09	(141.26, 145.55)	58.61	0.79	(57.05, 60.16)	114.71	4.07	(106.73, 122.68)
Domain 2	monitor_HW	45.44	1.47	(42.54, 48.34)	5.2	0.99	(3.27, 7.14)	-63.52	4.82	(-72.96, -54.08)
	immunised	37.84	1.71	(34.49, 41.19)	10.43	1.14	(8.19, 12.66)	51.68	5.57	(40.77, 62.6)
	vitaminA	-21.67	1.47	(-24.57, -18.79)	-3.26	0.98	(-5.19, -1.33)	-36.92	4.8	(-46.33, -27.51)
Domain 3	diarrhoea				-6.02	1.11	(-8.19, -3.85)	-15.29	5.67	(-26.4, -4.18)
	ARI				-6.3	0.85	(-7.97, -4.64)	-19.51	4.34	(-28.02, -11)
	low_birthweight	-29.61	0.99	(-31.57, -27.67)	-33.4	0.7	(-34.77, -32.03)	-11.92	3.58	(-18.94, -4.9)
	anemic_child	-20.89	0.43	(-21.75, -20.04)	-12.04	0.31	(-12.64, -11.43)	-28.66	1.57	(-31.74, -25.57)
Domain 4	ANC_4	3.28	0.46	(2.37, 4.2)	2.73	0.33	(2.09, 3.37)			
	STR_mother	-5.30	2.17	(-9.57, -1.04)						
	IFA_100	8.77	1.03	(6.74, 10.81)	7.54	0.73	(6.11, 8.97)			
	MCP_card	14.81	1.64	(11.6, 18.03)	12.92	1.15	(10.67, 15.18)			
	financial	-5.70	1.03	(-7.73, -3.69)	-5.56	0.72	(-6.98, -4.14)	-31.38	3.62	(-38.47, -24.29)
	nutrition_aware	-3.75	1.25	(-6.22, -1.29)	-7.67	0.88	(-9.41, -5.94)	-10.71	4.42	(-19.36, -2.06)
	tetanus	24.32	1.58	(21.21, 27.43)	10.38	1.11	(8.19, 12.56)			
Domain 5	edu_mother	12.63	0.37	(11.91, 13.36)	11.68	0.26	(11.17, 12.19)			
	underage	-2.93	1.00	(-4.89, -0.97)	-4.12	0.7	(-5.49, -2.76)			
	age_firstbirth	1.62	0.12	(1.38, 1.87)	1.52	0.09	(1.35, 1.69)	1.37	0.46	(0.47, 2.27)
	anemic_mother	-6.59	0.41	(-7.41, -5.78)	-4.86	0.29	(-5.42, -4.29)			
	low_BMI	-25.59	1.09	(-27.75, -23.44)	-40.37	0.76	(-41.87, -38.88)	-44.65	4.08	(-52.64, -36.66)
	high_BMI	102.59	1.42	(99.8, 105.38)	68.21	0.99	(66.27, 70.15)	48.87	5.28	(38.53, 59.21)
	height_mother	4.60	0.06	(4.49, 4.73)	3.35	0.04	(3.27, 3.44)	1.56	0.23	(1.12, 2.01)
Domain 6	decisionmaking									

	owns_landhouse	32.26	2.02	(28.3, 36.22)	7.47	1.43	(4.66, 10.28)			
	movement				1.92	0.54	(0.87, 2.98)			
Domain 7	improved_drinking				-7.86	0.99	(-9.79, -5.92)			
	improved_sanitation	27.87	0.96	(25.98, 29.77)	30.46	0.68	(29.13, 31.78)	18.75	3.46	(11.97, 25.53)
	clean_cooking	28.67	0.84	(27.01, 30.33)	24.55	0.59	(23.38, 25.71)	14.88	3.04	(8.93, 20.84)
	electricity	23.48	2.05	(19.46, 27.5)	15.88	1.44	(13.06, 18.7)			
	size_family	-1.21	0.16	(-1.53, -0.91)	-0.9	0.11	(-1.12, -0.68)			
Domain 8	wealth - Poorest ®									
	wealth - Poorer	23.06	1.16	(20.78, 25.35)	22.3	0.81	(20.71, 23.88)	13.63	4.18	(5.44, 21.82)
	wealth - Middle	40.43	1.25	(37.98, 42.89)	37.79	0.87	(36.09, 39.49)	24.88	4.49	(16.08, 33.67)
	wealth - Richer	61.44	1.36	(58.78, 64.12)	55.06	0.95	(53.2, 56.91)	35.1	4.88	(25.53, 44.66)
	wealth - Richest	84.70	1.59	(81.59, 87.82)	79.44	1.1	(77.28, 81.6)	47.76	5.7	(36.59, 58.92)
	rural_urban- urban ®									
	rural_urban - rural	2.91	1.15	(0.66, 5.17)	3.8	0.8	(2.24, 5.37)	-1.09	4.12	(-9.16, 6.99)
	religion - Hindu ®									
	religion - Muslim	-3.16	1.33	(-5.78, -0.56)						
	religion - Christian	17.30	1.67	(14.02, 20.59)	41.99	1.16	(39.71, 44.26)	49.86	6.01	(38.08, 61.63)
	religion - Sikh				21.62	2.17	(17.38, 25.86)			
	religion - budhist/neo	30.14	4.21	(21.88, 38.4)	53.42	2.92	(47.69, 59.15)	74.35	15.1	(44.76, 103.94)
	religion - Jain									
	religion - Jewish									
	religion - Parsi/Zoroa									
	religion - No religion	87.06	22.70	(42.55, 131.57)	98.18	15.75	(67.3, 129.06)			
	religion - Other	10.77	3.68	(3.56, 18)						(50.19, 101.93)
	group_social - SC ®									
	group_social - ST	13.69	1.42	(10.91, 16.48)	8.67	0.99	(6.74, 10.6)	12.58	5.09	(2.61, 22.55)
	group_social - OBC	9.06	1.11	(6.87, 11.25)	4.12	0.78	(2.6, 5.63)			
	group_social - None	25.94	1.40	(23.2, 28.69)	24.6	0.97	(22.7, 26.51)	14.58	5.02	(4.74, 24.42)
	insurance									

Domain 9	institutional	26.221	1.17	(23.92, 28.52)	16.9	0.82	(15.28, 18.51)			
	sex_child - Male ®									
	sex_child - Female	11.565	0.78	(10.03, 13.1)	6.9	0.55	(5.82, 7.97)	9.32	2.82	(3.79, 14.84)
	order_birth	-9.881	0.30	(-10.47, -9.29)	-7.78	0.21	(-8.19, -7.36)	-3.99	1.08	(-6.11, -1.87)
	low_birthweight	-34.060	0.99	(-36.02, -32.11)	-36.45	0.7	(-37.82, -35.08)	-14.93	3.59	(-21.97, -7.9)

Note: All non-significant coefficients are removed from the table; ® represent reference category

Table 7 Results from logistic regression analysis (Odds Ratio)

	Independent Variables	**Dependent Variables**								
		Severe Stunting	Std. Err.	95 % Conf. Interval	**Severe Underweight**	Std. Err.	95 % Conf. Interval	**Severe Wasting**	Std. Err.	95 % Conf. Interval
Domain 1	breastfed_within1	0.93	0.01	(0.9,0.95)						
	min_diet	0.81	0.02	(0.78, 0.84)				2.54	0.05	(2.45, 2.64)
Domain 2	monitor_HW	0.96	0.02	(0.92, 1)	0.95	0.03	(0.9, 1)	1.51	0.04	(1.43, 1.59)
	immunised	0.71	0.02	(0.68, 0.74)	0.86	0.03	(0.81, 0.91)	1.11	0.03	(1.05, 1.19)
	vitaminA	1.07	0.02	(1.03, 1.12)				0.83	0.02	(0.79, 0.87)
Domain 3	diarrhoea	1.05	0.03	(1, 1.1)	1.12	0.03	(1.05, 1.19)	1.08	0.04	(1.01, 1.16)
	ARI				1.06	0.03				
	low_birthweight	1.39	0.02	(1.35, 1.43)	1.73	0.03	(1.68, 1.79)	1.23	0.02	(1.18, 1.28)
	anemic_child	1.29	0.01	(1.28, 1.31)	1.24	0.01	(1.22, 1.26)			
Domain 4	ANC_4	0.93	0.01		0.93	0.02				
	STR_mother									
	IFA_100	0.87	0.01		0.89	0.02				
	MCP_card	0.94	0.02		0.93	0.03				
	financial									
	nutrition_aware				1.06	0.03				
	tetanus	0.95	0.02					1.43	0.05	(1.33, 1.53)

Domain 5	edu_mother	0.81	0		0.8	0.01		0.91	0.01	(0.89, 0.92)
	underage				1.05	0.02				
	age_firstbirth	0.99	0	(0.98, 0.99)	0.99	0	(0.98, 1)			
	anemic_mother	1.06	0.01		1.05	0.01				
	low_BMI	1.27	0.02	(1.23, 1.32)	1.68	0.03	(1.62, 1.75)	1.21	0.03	(1.16, 1.27)
	high_BMI	0.39	0.01	(0.37, 0.42)	0.32	0.02	(0.29, 0.36)			
	height_mother	0.94	0	(0.94, 0.94)	0.95	0	(0.95, 0.95)	0.99	0	(0.99, 1)
Domain 6	decisionmaking							0.95	0.01	(0.93, 0.98)
	owns_landhouse							1.44	0.07	(1.32, 1.57)
	movement									
Domain 7	improved_drinking	1.11	0.03		1.14	0.03				
	improved_sanitation	0.71	0.01	(0.69, 0.73)	0.64	0.01	(0.62, 0.66)	0.83	0.02	(0.79, 0.86)
	clean_cooking	0.73	0.01	(0.71, 0.75)	0.72	0.01	(0.7, 0.75)	0.93	0.02	(0.9, 0.97)
	electricity	0.68	0.02		0.73	0.03		0.87	0.04	(0.8, 0.94)
	size_family	1.01	0		1.01	0				
Domain 8	wealth - Poorest ®									
	wealth - Poorer	0.73	0.01	(0.7, 0.75)	0.69	0.02	(0.66, 0.72)	0.89	0.02	(0.85, 0.93)
	wealth - Middle	0.58	0.01	(0.56, 0.6)	0.55	0.01	(0.52, 0.57)	0.82	0.02	(0.78, 0.87)
	wealth - Richer	0.43	0.01	(0.41, 0.45)	0.4	0.01	(0.38, 0.42)	0.77	0.02	(0.72, 0.81)
	wealth - Richest	0.34	0.01	(0.32, 0.36)	0.3	0.01	(0.28, 0.32)	0.69	0.03	(0.64, 0.74)
	rural_urban- urban ®									
	rural_urban - rural	0.93	0.02	(0.89, 0.96)	0.86	0.02	(0.82, 0.91)	0.92	0.02	(0.87, 0.97)
	religion - Hindu ®									
	religion - Muslim	1.2	0.03		1.13	0.03		1.23	0.03	(1.17, 1.3)
	religion - Christian	0.91	0.02	(0.86, 0.96)	0.5	0.02	(0.46, 0.54)	0.68	0.03	(0.63, 0.73)
	religion - Sikh	0.81	0.05		0.63	0.06		0.5	0.05	(0.41, 0.6)
	religion - budhist/neo				0.67	0.07				
	religion - Jain									

	religion - Jewish										
	religion - Parsi/Zoroa										
	religion - No religion										
	religion - Other				0.69	0.05		0.66	0.06	(0.55, 0.78)	
	group_social - SC ®										
	group_social - ST	0.91	0.02	(0.87, 0.95)				1.15	0.03	(1.08, 1.22)	
	group_social - OBC	0.89	0.02		0.93	0.02					
	group_social - None	0.73	0.02	(0.7, 0.77)	0.75	0.02	(0.7, 0.79)	0.9	0.03	(0.85, 0.96)	
	insurance	0.93	0.01		0.96	0.02					
Domain 9	institutional	0.71	0.01		0.74	0.02					
	sex_child - Male ®										
	sex_child - Female	0.86	0.01	(0.84, 0.88)	0.91	0.01	(0.88, 0.94)	0.88	0.02	(0.85, 0.91)	
	order_birth	1.14	0	(1.13, 1.15)	1.12	0.01	(1.11, 1.13)	1.03	0.01	(1.02, 1.04)	
	low_birthweight	1.48	0.02	(1.44, 1.52)	1.83	0.03	(1.77, 1.89)	1.24	0.02	(1.19, 1.29)	

Note: All non-significant odds ratios are removed from the table; ® represents the reference category

Table 8 Results from multinomial logistic regression analysis (Coefficients)

Domains	**Independent Variables**	**Dependent Variables**											
		Group B	Std. Err.	**Group C**	Std. Err.	**Group D**	Std. Err.	**Group E**	Std. Err.	**Group F**	Std. Err.	**Group Y**	Std. Err.
Domain 1	breastfed_within1	-0.05	0			-0.12	0.02	-0.19	0.01	-0.05	0.01	-0.12	0.03
	min_diet	1.35	0.02	-0.27	0.03	-0.26	0.03	-0.54	0.02	-0.15	0.02	-0.72	0.06
Domain 2	monitor_HW	0.66	0.03	0.06	0.03	0.07	0.04	0.05	0.02				
	immunised	0.24	0.04			-0.53	0.04	-0.39	0.03	-0.4	0.02	0.21	0.07
	vitaminA	-0.31	0.03			0.16	0.04			0.12	0.02	-0.23	0.06
Domain 3	diarrhoea	0.1	0.04	0.18	0.03	0.18	0.04						

	ARI			0.08	0.03	0.13	0.03						
	low_birthweight	0.11	0.03	0.43	0.02	0.72	0.02	0.53	0.02	0.16	0.02	0.45	0.04
	anemic_child	-0.05	0.01	0.14	0.01	0.35	0.01	0.28	0.01	0.22	0.01		
Domain 4	ANC_4					-0.04	0.02	-0.13	0.02	-0.03	0.01		
	STR_mother									0.12	0.04		
	IFA_100	-0.06	0.02	-0.09	0.02	-0.16	0.03	-0.13	0.02	-0.12	0.02		
	MCP_card			-0.13	0.04			-0.21	0.03	-0.14	0.03		
	financial	-0.07	0.02					0.09	0.02				
	nutrition_aware			0.07	0	0.14	0	0.09	0.02			0.2	0.05
	tetanus	0.38	0	0.22	0			-0.21	0.03	-0.08	0.03		
Domain 5	edu_mother	-0.1	0.01	-0.17	0.01	-0.28	0.01	-0.27	0.01	-0.15	0.01	-0.1	0.02
	underage			0.08	0.02	0.1	0.03	0.09	0.02			0.11	0.04
	age_firstbirth					-0.02	0	-0.03	0	-0.02	0	-0.02	0.01
	anemic_mother	-0.02	0.01	0.04	0.01	0.08	0.01	0.09	0.01	0.03	0.01	0.1	0.02
	low_BMI	0.2	0.03	0.57	0.02	0.92	0.03	0.57	0.02	0.08	0.02	0.65	0.04
	high_BMI	0.26	0.03	-0.79	0.04	-1.4	0.07	-1.22	0.04	-0.72	0.03	-0.98	0.09
	height_mother	-0.01	0	-0.04	0	-0.08	0	-0.08	0	-0.05	0	-0.04	0
Domain 6	decisionmaking	-0.04	0.02										
	owns_landhouse												
	movement												
Domain 7	improved_drinking					0.23	0.04	0.17	0.02	0.05	0.02		
	improved_sanitation	-0.2	0.02	-0.39	0.02	-0.63	0.02	-0.54	0.02	-0.23	0.02	-0.38	0.04
	clean_cooking	-0.07	0.02	-0.28	0.02	-0.46	0.02	-0.46	0.01	-0.27	0.01	-0.24	0.04
	electricity	-0.21	0.05	-0.19	0.05	-0.39	0.05	-0.39	0.03	-0.33	0.03		
	size_family	-0.01	0					0.02	0				
Domain 8	wealth - Poorest ®												
	wealth - Poorer	-0.11	0.03	-0.34	0.03	-0.47	0.03	-0.41	0.02	-0.2	0.02	-0.22	0.05
	wealth - Middle	-0.21	0.03	-0.51	0.03	-0.79	0.03	-0.76	0.02	-0.36	0.02	-0.35	0.05
	wealth - Richer	-0.28	0.03	-0.67	0.03	-1.22	0.04	-1.13	0.02	-0.57	0.02	-0.52	0.06

	wealth - Richest	-0.38	0.04	-0.99	0.04	-1.57	0.05	-1.56	0.03			-0.96	0.07
	rural_urban- urban ®												
	rural_urban - rural	-0.07	0.03	-0.08	0.03	-0.15	0.03	-0.09	0.02				
	religion - Hindu ®												
	religion - Muslim	0.24	0.03	0.21	0.03	0.13	0.04	0.17	0.02				
	religion - Christian	-0.19	0.04	-0.76	0.04	-0.89	0.05	-0.45	0.03			-0.84	0.08
	religion - Sikh	-0.52	0.09	-0.49	0.09	-0.63	0.13	-0.32	0.06				
	religion - budhist/neo	-0.24	0.11	-0.35	0.1	-0.68	0.14	-0.58	0.08			-0.97	0.25
	religion - Jain												
	religion - Jewish												
	religion - Parsi/Zoroa												
	religion - No religion							-1.21	0.53				
	religion - Other	-0.49	0.1	-0.61	0.09	-0.61	0.11	-0.37	0.06			-0.68	0.18
	group_social - SC ®												
	group_social - ST							-0.18	0.02				
	group_social - OBC			-0.06	0.03			-0.13	0.02				
	group_social - None	-0.18	0.03	-0.28	0.03	-0.43	0.04	-0.47	0.03			-0.25	0.06
	insurance	-0.06	0.02			-0.07	0.03						
Domain 9	institutional			-0.12	0.03	-0.37	0.03	-0.42	0.02			-0.16	0.05
	sex_child - Male ®												
	sex_child - Female			-0.13	0.02	-0.37	0.02	-0.07	0.01			0.12	0.03
	order_birth	0.04	0.01	0.09	0.01	0.16	0.01	0.16	0			0.06	0.01
	low_birthweight	0.12	0.03	0.46	0.02	0.8	0.02	0.59	0.02			0.46	0.04

Note: All non-significant coefficients are removed from the table; ® represents the reference category

anthropometric failure. This inverse relationship needs to be investigated further to understand if Vitamin A is administered with priority to children with anthropometric failure, which could explain the counter-intuitive regression results.

4.6.3 Child Health and Recent Illness

Children with a reported incidence of diarrhoea in the last 2 weeks have lower WAZ scores and are more likely to fall into severely stunted, severely wasted, and severely underweight categories. They are also more likely to fall into Group B, C, and D categories of CIAF, representing wasting, stunting and wasting, and triple anthropometric failures. Children who reported acute respiratory infection (ARI) symptoms in the last 2 weeks have lower WAZ and HWZ scores and are more likely to fall into severe underweight, severe wasting categories and Group C and D of CIAF. Children with anaemia have lower HAZ, WAZ, and HWZ scores and are more likely to be severely stunted and severely underweight. Anaemic children are also more likely to fall into group D, E, and F of CIAF.

4.6.4 Antenatal Care

Mothers who had at least four antenatal check-ups have children with higher HAZ and WAZ scores. Their children are less likely to fall into severely stunted and severely underweight categories or groups of children with double or triple anthropometric failure, denoted by groups C, D, and E of CIAF. Mothers who consumed iron folic acid for 100 days or more when they were pregnant have children with higher HAZ and WAZ scores. Their children are less likely to be severely stunted or severely underweight, and the subcategories of CIAF. Mothers with registered pregnancies for which they received Mother and Child Protection (MCP) card have children with higher HAZ and WAZ scores. Their children are less likely to be severely stunted or severely underweight or fall into groups C, E, and F of CIAF. An inverse relationship is observed between HAZ, WAZ, and HWZ scores of children and if their mothers received financial assistance under any scheme for births delivered in an institution. Similarly, an inverse relationship is observed

between mothers who reported health workers talking to them about nutrition and anthropometric measures of their children. As with Vitamin A administration, this relationship also requires further probing. Mothers whose last birth was protected against neonatal tetanus have children with higher HAZ and WAZ scores. Their children are less likely to fall into the severely stunted category. However, an inverse relationship is observed between severe wasting, and Group B, and C of CIAF.

4.6.5 Maternal Indicators

Mother's education shows a strong positive relationship with anthropometric measures of the children. Mothers with higher education have children with higher HAZ and WAZ scores. Their children are also less likely to be severely stunted, severely underweight, or severely wasted. Mother's education also shows an inverse relationship between the likelihood that children fall into CIAF categories with multiple anthropometric failures. Women married before 18 years of age have children with lower HAZ and WAZ scores. Their children are more likely to fall into severely underweight category and categories of CIAF with multiple anthropometric failures. Mother's age at first childbirth also has a positive relationship with HAZ, WAZ, and HWZ scores of the children and an inverse relationship with the likelihood that the child falls into severely stunted and severely wasted categories, and group D, E, and F of CIAF. Anaemic mothers have children with lower HAZ and WAZ scores. Their children are more likely to fall into severely stunted and severely wasted categories and all subcategories of CIAF. Mothers whose Body Mass Index (BMI) is below normal have children with lower anthropometric measurements, and their children are more likely to show severe and multiple anthropometric failures. An inverse relationship is observed between mothers who are overweight or obese and the likelihood that their children show anthropometric failures. Mother's height shows a positive relationship with anthropometric measures of the child. Taller mothers have children with higher HAZ, WAZ, and HWZ scores. Their children are also less likely to be severely stunted or severely underweight, or severely wasted. The children of taller

mothers are also less likely to fall into the categories of CIAF and show multiple anthropometric failures.

4.6.6 Women's Empowerment Indicators

Children with mothers who usually participate in household decisions are less likely to be severely wasted or fall into the wasted only (group b) category of CIAF. Mothers owning a house and/or land alone have children with higher HAZ and WAZ scores. Mothers with higher freedom of movement have children with higher WAZ scores.

4.6.7 Household Profile

Children of households with improved sanitation facilities, households using clean cooking fuel, and households with electricity have better anthropometric measures. They are also less likely to fall into categories of severe anthropometric failures and show multiple anthropometric failures. On the other hand, family size is inversely related to anthropometric measures of children. Children from larger families have lower HAZ and WAZ scores. They are also more likely to fall into severely stunted and severely underweight categories.

4.6.8 Socio-Economic Profile

Household wealth categories show a strong positive relationship with all anthropometric indicators. HAZ, WAZ, and HWZ scores of children increase with household wealth category improvement. The likelihood of children falling into severely stunted, severely wasted, and severely underweight decreases with an increase in household wealth status. Children from wealthier households are less likely to have multiple anthropometric failures. Children from rural areas have higher HAZ and WAZ scores and lower HWZ scores. They are less likely to be severely stunted, severely underweight or severely wasted compared to their urban counterparts. Children from Muslim households have lower HAZ scores than those from Hindu households. They are also more likely to be severely stunted, severely wasted, and severely underweight. Children from Muslim households are also more likely to fall into the categories of CIAF. Children from

Christian, Buddhist, and households without any reported religion have higher HAZ, WAZ, and HWZ scores than those from Hindu households. Children from Christian households are less likely to be severely stunted, severely wasted, and severely underweight than children from Hindu households. They are also less likely to fall into categories of CIAF and show multiple anthropometric failures. Children not belonging to Scheduled Caste, Scheduled Tribe, and Other Backward Caste have higher HAZ, WAZ, and HWZ scores than others. They are also less likely to show severe anthropometric failure and fall into the categories of multiple anthropometric failures. Children from Scheduled Tribes and OBC have higher HAZ, WAZ, and HWZ scores than children from Scheduled Caste. Compared to SC, children from ST are also less likely to be severely stunted or severely wasted. Children belonging to OBC have higher HAZ and WAZ scores compared to SC and are less likely to be severely stunted or severely underweight. Children from households covered under any kind of insurance are less likely to be severely stunted or severely underweight. They are also less likely to fall into group B, D, and F of CIAF.

4.6.9 Birth-Related Variables

Children delivered in private or public institutions have higher HAZ and WAZ scores compared to children born at home. Children with institutional delivery are also less likely to be severely stunted or severely underweight or fall into most categories of CIAF. Female children have better anthropometric measures compared to the male children. They are less likely to be severely stunted, severely underweight or severely wasted. Female children are also less likely to fall into categories of CIAF except group Y representing underweight only. Birth order of the child have an inverse relationship with anthropometric measures. Children with higher birth order have lower HAZ, WAZ, and HWZ scores. They are also more likely to be severely stunted, severely wasted, and severely underweight or show multiple anthropometric failures. Low birthweight is associated with low HAZ, WAZ, and HWZ scores and an increased likelihood of children falling into severe anthropometric failures categories and show double and triple anthropometric failures.

4.7 Chapter Summary and Conclusions

The chapter aimed at understanding the prevalence of undernutrition in India, its determinants, and distribution. The outcome indicators of undernutrition, i.e., anthropometric indicators were estimated using the latest three rounds of NFHS data spanning over fifteen years. A detailed national context of undernutrition problem is constructed with the results.

The estimations of the traditional indicators using the latest NFHS round data show that almost one third of children in India are stunted, more than one fourth are underweight, and almost one fifth are wasted. The indicators vary significantly among the states. The total number of children showing at least one form of anthropometric failure, estimated using CIAF provides an even grimmer insight. It shows that almost fifty percent of children under five years of age show at least one form of anthropometric failure. Even in the best performing states one-third of the children show some form of anthropometric failure. Among the children with anthropometric failure, children who are stunted only, and stunted and underweight simultaneously are the majority among the sub-categories of CIAF.

We have also estimated the prevalence of Severe and Acute Malnutrition (SAM) using cut-offs as per WHO standards, and subcategories of CIAF that capture double and triple anthropometric failure. The results show that incidence of Severe Stunting is very high, with 14 percent of the children under five Severely Stunted at the national level. Severe Wasting and Severe Underweight ranges from 6 to 8 percentage on an average. Triple anthropometric failure is estimated at slightly more than four percentage on an average. All forms of severe and acute malnutrition also have high inter-state variability.

The disparity in nutritional outcomes is brought to light even more by the district level estimations of indicators. All the indicators of nutritional status and SAM show high inter-district variance.

From the visual representation of prevalence using maps of India, the high prevalence districts are observed to cluster around the drought-prone areas of the country.

Changes in indicators between 2006 and 2020 is observed to be not uniform and inadequate to achieve national nutrition targets. There is significant reduction in stunting rates across the states over the years but this improvement is not reflecting in other indicators and indicators of SAM. There are also trend reversals where indicators are showing an increase even at states where improvements were once achieved. Especially in the case of Wasting, and Severe Wasting, rates have gone up significantly in many states. There are instances where achievement of the ten-year period between NFHS-3 and NFHS-4 are undone within the 4-5-year period between NFHS-4 and NFHS-5. The results from the population projection exercise also show that the reductions in indicators are not in correspondence with the changes in under five population.

The results of regression analyses throw light on the fact that among the constellation of determinants of undernutrition identified by researchers, the basic determinants of poverty and income remain the most impactful. We can see that children from families with higher wealth status have significantly better anthropometric indicators and also their risk of severe, and multiple anthropometric failures is considerably less. The results also show that the marginalised communities remain more vulnerable and affected by undernutrition and open the discussion to the more vulnerable intersections.

Timely start of breastfeeding, a diverse diet and minimum diet frequency are important immediate determinants of nutritional status of children. Different essential nutrition interventions implemented through the Integrated Child Development Services (ICDS) programme and National Health Mission seem to have a significant influence on nutritional outputs. Especially, ANC visits, IFA supplements, nutrition awareness creation carried out by frontline workers, regular monitoring of anthropometric measurements of the child, immunisation, and issue of

Mother and Child Protection (MCP) cards have positive correlations with many indicators of nutritional status.

In line with the literature, a strong correlation is observed between wasting and the incidence of recent illness, clean drinking water and sanitation. Across different rounds of NFHS, wasting show low reductions, and trend reversals even in regions where improvements were made in the past. The results from this study along with the existing literature points to the fact that improvements are needed in water, and sanitation facilities, and control of infectious diseases in order to curb wasting.

The results from each domain also suggest the areas that need policy focus in the fight against undernutrition. Further, the counter-intuitive correlations observed between undernutrition and some of the determinants call for qualitative and mixed-method studies to explore the pathways of nutrition intervention implementation and other factors that could have contributed to the result.

Chapter 5. Nutritional Status of Children Under Five in Assam; With Focus on Aspirational Districts

5.1 Introduction

Estimation of the prevalence of malnutrition and understanding the status of nutritional determinants are necessary to guide policy and strategize nutrition interventions to achieve nutrition goals. Information should be available not only at the national or state level but also at the lower levels, such as district and block. Information on food and nutrient consumption at the household level needs to be collected along with nutritional status indicators. The government and non-government agencies have conducted various nutrition surveys in Assam; however, district-level nutrition data is available only from the National Family Health Surveys.

In Assam, seven districts– Goalpara, Barpeta, Hailakandi, Baksa, Darrang, Udalguri, and Dhubri- are identified as aspirational districts under the Aspirational Districts Programme (ADP) of the Government of India, which aims at the quick and effective transformation of the most underdeveloped districts. The ADP district action plans (DAPs) consider development indicators of health and nutrition, education, agriculture, and water resources, financial inclusion and skill development, and basic infrastructure when forming district development priorities. Due to this integrated approach, the aspirational district programme fits well with the framework for action for achieving optimum nutrition and development discussed in the previous chapter.

The main objectives of this chapter are to study the undernutrition problem in Assam at the district level with a special focus on aspirational districts. The concentration and determinants of undernutrition in the districts are also given focus. The same indicators introduced in the previous chapter are extensively used in this chapter to understand the nutritional status outcomes in the districts of Assam. The primary data collected from selected districts of Assam enabled the study of input and output indicators to understand the complex operation between them more clearly. In terms of the sampling procedure and the method of collecting data, the primary data collected

differs from the NFHS. A distinct sampling procedure is devised, moving from district to block to the Anganwadi Centre level.

The following section contains results from both secondary and primary data analysis. First, the nutritional status of children under five in Assam is discussed. The prevalence of traditional indicators of anthropometric failure, severe and acute malnutrition indicators, and the change between the latest two rounds of NFHS are discussed. Indicators for all the districts in Assam are estimated and analysed, and the indicators for aspirational districts are compiled. The next sub-section presents the results of primary data collected and analysed from seven selected districts in the lower Assam region. Indicators of nutritional status and different basic, underlying, and immediate determinants of nutritional status are estimated for each survey district. The Z-score distribution of the sample compared to WHO standards is presented, and the same is used to understand how the nutritional outcomes are distributed based on these determinants.

5.2 Anthropometric Failure among Children Under 5 in Assam

5.2.1 Traditional Indicators

Appendix 9 shows the anthropometric failure rates among children based on traditional indicators and CIAF for all the districts in Assam estimated from NFHS4 and NFHS5 unit-level data. In 2020, the stunting rate in Assam was 34.5%, marginally higher than the national average of 32.8%. Out of the 27 districts considered for analysis using NFHS5 data, 17 have stunting rates higher than 30%, and four districts, namely, Bongaigaon, Baksa, Dhubri, and Chirang, have stunting rates more than 40%. Bongaigaon has the highest prevalence of stunting, with more than 44% of the children stunted. The better-performing districts are Kamrup, Kamrup Metro, and Golaghat. However, only Kamrup has stunting rates of less than 20%.

According to NFHS5 data, wasting in Assam is high at 20%, compared to the national average of 17%. Among the districts, Karimganj shows an alarmingly high prevalence of wasting at 46.5%, significantly higher than all other districts. Cachar has the second highest incidence of wasting at

29%, further emphasising the high prevalence of wasting in Karimganj. 19 districts have wasting rates higher than the national average, and ten districts have wasting more than 20%. The comparatively better-performing districts are Nagaon, Kamrup, Nalbari, Morigaon, and Jorhat, all of which have wasting less than 15%. The lowest prevalence of wasting is in Nagaon, with 12.6% of the children showing anthropometric failure. The prevalence of underweight in Assam is 29%, which is also higher than the national average by three percentage points. The Barak Valley region districts of Karmiganj, Hailakandi, and Cachar, along with Chirang district, have the highest incidence, with 46.2%, 36.8%, 33%, and 36% of the children underweight, respectively. 19 districts have underweight rates higher than the national average, and 16 have underweight rates higher than the state average of 29%. Kamrup is the best-performing district as far as underweight rates are concerned, with 14.7% of children under five years of age showing anthropometric failure. Only two districts in Assam, Kamrup and Dima Hassao, have an underweighted prevalence of less than 20%.

5.2.2 Composite Index of Anthropometric Failure (CIAF)

While considering the traditional indicators of anthropometric failure, we get the impression that one-third of the children in Assam have some form of anthropometric failure. However, when considering CIAF rates, it becomes clear that this is not the case. Only one district, Kamrup, has a prevalence of anthropometric failure near 30%, and all the other districts have a much higher proportion of children showing at least one form of anthropometric failure. All the districts except Kamrup have more than 40% of children under five showing anthropometric failure; 14 districts have more than 50% of the children with anthropometric failure; and two districts, namely Karimganj and Bongaigaon, have more than 60% of their children showing at least one form of anthropometric failure. Assam's state CIAF is 51.8%, and the national average is 47.4%. 19 districts in Assam have CIAF higher than the national average, and 11 of them are higher than the state average. The better-performing districts are Kamrup, Nalbari, Golaghat, Kamrup Metropolitan, and Dibrugarh, all of which have CIAF rates of less than 45%.

5.2.3 Severe and Multiple Anthropometric Failure in Assam

District-wise indicators of severe and multiple anthropometric failures among children under five years of age in Assam estimated using NFHS4, and NFHS5 unit-level data are given in Appendix 10. According to NFHS5 estimates, severe stunting in Assam is 15%, and the national average is slightly less at 14%. The order of performance of the districts changes when considering severe stunting in comparison to stunting rates. 15 districts have severe stunting rates higher than the national average, with Bongaigaon, Dhubri, Chirang, and Baksa at the top of the list, with more than 20% of the total children under five years of age severely stunted. On the other hand, Tinsukia, Dibrugarh, and Kamrup are the better-performing districts, with less than 10% of the children showing severe stunting. Tinsukia is the best-performing district among districts, with slightly less than 8% of the children having anthropometric failure.

In 2020, severe wastage was alarmingly high in Karimganj, with almost 30% of the children severely wasted. This is considerably higher than other districts, more than four times that of the national average, and more than three times that of Assam's state average. Goalpara, the district with the second highest prevalence of severe wasting, has slightly more than 13% of its children severely wasted. The better-performing districts are Sivasagar, Nagaon, Nalbari, Jorhat, and Kamrup, all of which have less than 5% of the children severely wasted. Sivasagar is the best-performing district and has slightly more than 4% of the children severely wasted. Karimganj also has the highest incidence of severe underweight among children under five, with more than 18% of the children being severely underweight. Severe underweight rates are 8.5% for Assam and 7.7% for India. Among the districts of Assam, Karimganj stands out by a large margin. Goalpara has the second highest incidence of severe underweight, with 13.2% of the children showing anthropometric failure. Dhubri, Bongaigaon, and Chirang are the other three districts, with more than 10% of the children under five years of age severely underweight. Kamrup, Dima Hassao, Nalbari, and Dhemaji are the better-performing districts, with less than 5% of the children showing severe underweight. Among them, Kamrup has a significantly lower prevalence, with only 2% of the children severely underweight.

Group D of CIAF represents the triple anthropometric failure of stunted, wasted, and underweight children. At the national level, 4.4% of children under five years of age fall into this category of severe malnutrition. In Assam, the percentage of children falling into Group D of CIAF is slightly higher at 4.8%. According to NFHS5 data, 9.4% of children in Karimganj district fall into this triple anthropometric failure category, raising the alarm. On the other hand, Kamrup and Kamrup metro have only 1.6% of the children in Group D of CIAF. Dhemaji, Dima Hassao, Udalguri, and Nalbari are the other better-performing districts, with less than 3% of children falling into Group D of CIAF. Kokrajhar, Bongaigaon, and Karbi Anglong are other districts with a high incidence of triple anthropometric failure, with more than 6% of children falling into the category. 15 districts in Assam have triple anthropometric failure prevalence higher than the national average.

5.3 Changes in Indicators of Nutritional Status in Assam Between 2016 And 2020

The percentage change in indicators of anthropometric failure and CIAF in Assam between 2016 and 2020 are shown in Appendix 11. The table also contains estimates of change in severe and multiple anthropometric failures for the same period.

5.3.1 Change in Stunting and Severe Stunting

Between NFHS4 and NFHS5, stunting was reduced in most districts in Assam. 16 out of the 27 districts reduced their stunting rates during this period. The biggest decrease in stunting rates was observed in Kamrup, Barpeta, and Karimganj districts, where the stunting rates went down by more than ten percentage points. On the other hand, Jorhat and Baksa saw an increase in stunting by more than ten percentage points. At the state level, stunting rates went down by 1.5%; at the national level, the reduction was 5.5%. 10 districts in Assam brought down stunting by more than the national average reduction. However, severe stunting in Assam increased by 1.2% between NFHS4 and NFHS5, while it decreased by 2.3% at the national level. Severe stunting increased in 19 districts out of the 27 considered, and the biggest increase was observed in Baksa, which increased alarmingly by 12.5%. Tinsukia, Goalpara, and Darrang were the better-performing

districts for reductions in severe stunting; these three districts managed to reduce the anthropometric failure by more than five percentage points.

5.3.2 Change in Wasting and Severe wasting

A similar pattern of severe stunting is also observed in the case of wasting among districts in Assam. 19 districts witnessed an increase in the proportion of children under five who are wasted between NFHS4 and NFHS5. Among the districts, the highest increase was in Karimganj and Dima Hasao, where wasting increased by 28.5% and 16.5%, respectively. The increase was 4% at the state level. At the national level, wasting decreased by 3.4 percentage points during the same period. Kamrup was the better-performing district, which managed to reduce wasting rates by more than five percentage points. Dhubri and Bongaigaon saw a decrease of more than two percentage points in wasting rates. Wasting increased by more than five percentage points in 9 districts between the five years between NFHS4 and NFHS5. Severe wasting increased in 20 districts out of the 27. While wasting increased by 28% in Karimganj, severe wasting increased by almost 24%. This increase is more than ten times the state average increase and more than double the second-highest increase district of Dima Hassao, where severe wasting increased by ten percentage points. Bongaigaon, Nalbari, Golghat, and Dhubri are the better-performing districts where severe wasting decreased by 3.5%, 2%, 1.3%, and 1.3%, respectively. At the national level, severe wasting went down by 0.6 percentage points during the same period.

5.3.3 Change in Underweight and Severe Underweight

The prevalence of underweight increased in Assam by 0.6 percentage points, while it decreased at the national level by 7.5 percentage points. Among the districts of Assam, underweight increased in 16 districts and decreased in 11. Kamrup stands out among the districts with a reduction of almost 15 percentage points in underweight children under five years of age. The second-best performing district, Barpeta, saw a decrease of 9.3 percentage points. Goalpara experienced a similar decrease of 9.2 percentage points. The highest increase in underweight percentage was in the districts of Chirang, Karimganj, and Jorhat, where the prevalence of underweight increased by more than ten percentage points. Only four districts, namely Kamrup, Barpeta, Goalpara, and

Darrang, could reduce the underweight prevalence at a rate higher than the national average. Kamrup's exceptional underweight reduction compared to other districts is not reflected as far as reductions in severe underweight are concerned, but it remains the better-performing district in Assam. Severe underweight in Kamrup decreased by 5.8 percentage points, followed by Darrang at 5.2% and Cachar at 3.2%. Severe underweight went down in 11 districts and increased in 16 districts. The highest increase is again in Karimganj, where the prevalence of severe underweight increased by 8.8 percentage points between NFHS4 and NFHS5. At the national level, the incidence of severe underweight went down by almost three percentage points, while in Assam, it increased by 0.8 percentage points.

5.3.4 Change in CIAF and Multiple Failures

Between NFHS4 and NFHS5, CIAF rates in India saw an average decrease of 7.4 percentage points; however, CIAF rates in Assam increased by 2.1 percentage points. CIAF rates increased in 16 districts, with a significant increase in the districts of Lakhimpur, Baksa, Chirrang, and Karimganj, where they increased by more than ten percentage points. The highest increase is in Lakhimpur and Baksa, where CIAF increased by 14.2% and 13.6%, respectively. 12 districts in Assam saw an increase in CIAF rates by more than five percentage points. Kamrup, on the other hand, managed to bring down CIAF rates by almost 19 percentage points, more than double that of the next best-performing districts of Barpeta, where CIAF decreased by 8.6 percentage points. Dhubri, Dibrugarh, and Cachar are the other three districts that managed to reduce CIAF rates by more than five percentage points. Children falling into Group D of CIAF, which represents triple anthropometric failure, decreased at the national level by almost two percentage points between NFHS4 and NFHS5, but it increased in Assam by 0.5 percentage points. The highest increase in the proportion of children falling into this category was in Karimganj, with an increase of more than four percentage points. Kokrajhar, Golaghat, Jorhat, and Sonitpur witnessed an increase of 2 percentage points in the proportion of children under 5 with triple anthropometric failure. The better-performing districts are Kamrup, Cachar, and Darrang, where the incidence of triple anthropometric failure went down by 4%, 3.8%, and 2.3%, respectively.

5.4 Nutritional Status of Children in Aspirational Districts of Assam

Baksa, Barpeta, Darrang, Dhubri, Goalpara, Hailakandi, and Udalguri are the seven aspirational districts of Assam. According to NFHS-5 data, except for Barpeta and Udalguri, all other aspirational districts have stunting rates higher than the state average. Dhubri (after bifurcation) has the highest incidence of stunting among all the districts of Assam, and the aspirational district of Baksa has the third highest incidence of stunted children under 5. Combined, the average prevalence of stunted children in aspirational districts is 38.3%, compared to 32.7% in non-aspirational districts. Between NFHS4 and NFHS5, stunting rates went down in all aspirational districts except for Baksa and Hailakandi, which increased by 10.7% and 1.36%, respectively. On the other hand, the biggest reduction in stunting happened in the aspirational districts of Barpeta and Udalguri, where stunting rates decreased by 12.4% and 6.7%, respectively.

Severe stunting in all aspirational districts is higher than the state average of 14.8%. Aspirational districts of Dhubri and Baksa have more than 20% of the children under five severely stunted, more than double the rate of the best-performing non-aspirational districts. Darrang and Barpeta have the lowest incidence of severe stunting among the aspirational districts. While the aspirational districts, on average, have 17.5% of the children severely stunted, non-aspirational districts have 14% of the children falling into the severely stunted category. Between NFHS4 and NFHS5, Baksa witnessed a huge increase in severely stunted children, with an increase of 12.5 percentage points. Severe stunting also increased in the aspirational districts of Hailakandi and Udalguri by 2.6% and 1.3%, respectively. On the other hand, the prevalence of severe stunting went down in the aspirational districts, with the highest reductions in the districts of Goalpara and Darrang.

According to NFHS5 data, the prevalence of wasting is higher than the state average of 19.6% in five aspirational districts and lower in two, namely, Baksa and Barpeta. The highest incidence is in Darrang, followed by Goalpara, where the wasting rates are 23.6% and 22.8%, respectively. Three non-aspirational districts, namely, Karimganj, Cachar, and Biswanath, have higher wasting rates than any aspirational district. As discussed earlier in the chapter, the rate of wasting in Karimganj

is alarmingly high. On average, slightly more than 20% of children in aspirational districts are wasted, compared to 19.4% in non-aspirational districts. Between NFHS4 and NFHS5, wasting rates increased in all but one aspirational district in Assam. In the aspirational district of Dhubri, wasting decreased by 2.8 percentage points. The highest increase in wasting among aspirational districts is observed in Baksa, with an increase of 5.9 percentage points. Seven non-aspirational districts witnessed a higher increase in wasting than any aspirational district in Assam.

The incidence of severe wasting is lower than the state average of 8.2% in five of the seven aspirational districts. Goalpara and Udalguri are the only two aspirational districts with a higher incidence of severe wasting than the state average. The lowest incidence of severe wasting among aspirational districts is in Baksa and Dhubri. On average, 8.5% of children under five in aspirational districts are severely wasted compared to 8.1% in non-aspirational districts. Karimganj district also has a higher incidence of severely wasted children than any other aspirational district. Among the aspirational districts, Goalpara and Udalguri have the highest incidence of severe wasting, with 13.5% and 11%, respectively. Between NFHS4 and NFHS5, the prevalence of severe wasting increased in all but one aspirational district of Assam, along with 14 non-aspirational districts. Most aspirational districts show a change in prevalence revolving around the median of change among districts of Assam. Non-aspirational districts Karimganj, Dima Hasao, Dhemaji, Tinsukia, and Morigaon have seen a greater increase in severe wasting prevalence than any aspirational district.

Barpeta and Baksa are the only two aspirational districts with a lower prevalence of underweight among children under five than the state average in 2020. The highest incidence of underweight is in the districts of Hailakandi and Dhubri among aspirational districts where underweight is 36.8% and 35.5%, respectively. On average, 30.4% of children in aspirational districts are underweight, compared to 27.9% in non-aspirational districts. However, during the period between NFHS4 and NFHS5, the prevalence of underweight decreased in five of the seven aspirational districts, with the highest reductions in Barpera and Goalpara, where the prevalence of underweight went down

by nine percentage points. Baksa and Hailakandi are the two aspirational districts that saw an increase in the prevalence of underweight, along with 14 non-aspirational districts.

Severe underweight decreased in four aspirational districts and increased in three between the two rounds of NFHS. The prevalence of severe underweight increased significantly in Baksa by almost four percentage points and marginally in the aspirational districts of Udalguri and Goalpara by less than 0.3 percentage points. 13 non-aspirational districts also witnessed an increase in severe underweight during the same period, with an average increase of 3 percentage points compared to the 1.4 percentage point average increase in aspirational districts that witnessed an increase. On the other hand, the aspirational districts that managed to bring down severe underweight did so with an average reduction of 2.7 percentage points, compared to an average reduction of 2 percentage points in non-aspirational districts. As of 2020, four aspirational districts have a higher incidence of severe underweight than the state average of 8.23%, with the highest incidence in Goalpara and Dhubri at 13.25% and 11.8%, respectively. The lowest incidence of severe underweight is in Barpeta and Dhubri, with a prevalence of 6.9%.

When we consider CIAF, according to NFHS5 data, all aspirational districts, except Barpeta, have higher CIAF rates than the state average of 51%. Dhubri, with the highest prevalence, has 62.4% of children having at least one form of anthropometric failure, followed by Darrang (59.2%), Hailakandi (57.2%), Goalpara (56.7%), Baksa (56.7%), and Udalguri (51.2%). The comparatively better-performing Barpeta has a CIAF rate of 47.3%. On average, 56% of children in aspirational districts fall into the CIAF category, compared to 49% in non-aspirational districts. Karimganj is a non-aspirational district with a higher incidence of CIAF than any aspirational district. The non-aspirational districts of Bongaigaon, Biswanath, and Chirang also have higher CIAF rates than all but one aspirational district. Between the latest two rounds of the NFHS survey, the prevalence of CIAF decreased in four aspirational districts along with seven non-aspirational districts and increased in three aspirational districts along with 15 non-aspirational districts. The highest

increase in CIAF among aspirational districts is in Baksa, where CIAF increased by 14 percentage points, second only to the non-aspirational district of Lakhimpur.

The proportion of children falling into Group D of CIAF, which represents triple anthropometric failure, is higher than the state average of 4.6% in 4 aspirational districts, with the highest prevalence in Dhubri (6.84%) followed by Goalpara (6%). The lowest prevalence is in Udalguri (2.7%). On average, 5% of children under five in aspirational districts fall into Group D of CIAF, compared to 4.5% in non-aspirational districts. Karimganj, Biswanath, and West Karbi Anglong are the non-aspirational districts with a higher incidence of children falling into Group D than all the aspirational districts in the state. Between NFHS4 and NFHS5, the percentage of children in Group D decreased in four aspirational districts and increased in 3. Baksa saw the highest increase, with an increase of 1.8 percentage points. The largest reduction was in Kamrup, where the percentage of children in Group D went down by 4 points. Triple anthropometric failure in five non-aspirational districts, namely, Karimganj, Kokrajhar, Golaghat, Jorhat, and Sonitpur, increased at a higher rate than in any aspirational district during this period.

5.5 Nutritional Status of Children in Select Districts of Assam

5.5.1 Traditional Indicators and CIAF

A compilation of indicators of anthropometric failure for all districts surveyed is shown in Table 9. Traditional indicators such as stunting, wasting, and underweight are estimated using survey data along with the composite index of anthropometric failure. Furthermore, the percentage of mothers who report child death and children with low birthweight are estimated.

The stunting rate for the region is 41%, the wasting rate is 13%, and the underweight rate is 28%. However, the CIAF shows that almost 50% of the children have at least one form of anthropometric failure. Barpeta (54.2%), Dhubri (48%), and Goalpara (43.8%) districts have higher than lower Assam average stunting rates. at 20%, reflects the lowest incidence of stunting rates among the lower Assam districts. Bongaigaon's stunting rate is estimated at 21.5%. We need

Table 9 Compilation of Indicators of Anthropometric Failure

No	Indicator	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
	Traditional Indicators								
1	Children under 5 years who are stunted (height-for-age) (%)	54.8	21.5	38.6	48	43.8	20	24	41.2
2	Children under 5 years who are severely stunted (%)	27.1	11.4	18.8	24.2	20.8	3	16	19.9
3	Children under 5 years who are wasted (weight-for-height) (%)	15.8	8.9	15	11.8	17.2	6.7	11.5	12.9
4	Children under 5 years who are severely wasted (%)	5.9	0	5.6	3.4	4.3	2.9	0	3.8
5	Children under 5 years who are underweight (weight-for-age) (%)	41	12	25.9	32.8	32.3	7.9	14.3	28.2
6	Children under 5 years who are severely underweight (%)	14.4	3.6	14.8	10.1	18.8	0	7.1	10.8
7	Children under 5 years with Low Birthweight (%)	19.3	4.5	27.0	16.0	5.7	9.6	22.9	15.9
8	Mothers reporting child death (%)	10.1	0.0	4.2	7.2	6.5	11.0	3.2	6.7
	Composite Indicator of Anthropometric Failure								
9	Composite Indicator of Anthropometric Failure of children under 5 years (%)	66.1	26.6	49.0	56.7	52.2	23.5	33.3	49.8
10	Children under 5 years who are Wasted Only (Group B) (%)	4.5	2.5	3.8	0.9	0.0	2.9	3.7	2.6
11	Children under 5 years who are Wasted and Underweight (Group C) (%)	4.5	2.5	3.8	5.6	6.7	2.9	7.4	4.8
12	Children under 5 years who are Stunted, Wasted and Underweight (Group D) (%)	7.1	3.8	7.7	5.2	11.1	1.0	0.0	5.7
13	Children under 5 years who are Stunted and Underweight (Group E) (%)	22.8	6.3	9.6	19.5	12.2	3.9	7.4	14.7
14	Children under 5 years who are Stunted Only (Group F) (%)	23.2	11.4	20.2	24.2	22.2	12.7	14.8	20.2
15	Children under 5 years who are Underweight Only (Group Y) (%)	4.0	0.0	3.8	1.3	0.0	0.0	0.0	1.8

to note here that both Kokrajhar and Bongaigaon are not covered under the Aspirational Districts Programme of the State. A higher-than-average wasting rate is estimated for Goalpara (17.2%), Barpeta (15.8%), and Darrang (15%). Kokrajhar reflects the lowest wasting (6.7%) among the surveyed districts, followed by Bongaigaon (8.9%). The highest incidence of underweight children is in Barpeta (41%), Dhubri (32.8%), Goalpara (32.3%), and Darrang (25.9%). Bongaigaon, Kokrajhar, and Udalguri reflect lower than the region's average. However, mothers reporting child death are the highest in Kokrajhar (11%). Barpeta (10.1%) and Dhubri (7.2%) are the other two districts with higher-than-average incidences of mothers reporting child death in the survey districts. The sample from Bongaigaon had zero mothers reporting child death, and the sample from Udalguri had a low (3.2%) percentage of mothers who reported child death.

Lower Assam has 15.9% of children born with low birth weight. We observe wide variations by district. It is highest in Darrang (27%), followed by Udalguri (22.9%) and Barpeta (19.3%). Children facing at least one form of anthropometric failure as measured by CIAF are as high as 66.1% in Barpeta, 56.7% in Dhubri, 52.2% in Goalpara, and 49% in Darrang. Lower than average rates are noticed for Kokrajhar (23.5%), Bongaigaon (26.6%), and Udalguri (33.3%). The group of children facing failures on all three counts—stunting, wasting, and underweight (Group D)—are at 11.1% in Goalpara, which is the highest. Udalguri has zero children in Group D, followed by Kokrajhar (1%) and Bongaigaon (3.8%). On average, 5.7% of children in the lower Assam region fell into Group D of CIAF. Group C and Group E of CIAF, which are the two subcategories of CIAF representing double anthropometric failure, had 4.8% and 14.7% of children falling into them, respectively. Barpeta (22.8%) also has the highest number of children in Group E, and Udalguri (7.4%) has the highest number of children in Group C.

Severe stunting for the region is 20%, severe wasting is 3.8%, and severe underweight is 11%. Severe stunting is highest in Barpeta (27.1%), followed by Dhubri (24.2%), and Goalpara (20.8). These are also the three districts with severe stunting rates that are higher than the lower Assam region average. Severe stunting rates are significantly lower in Kokrajhar (3%). Bongaigaon also

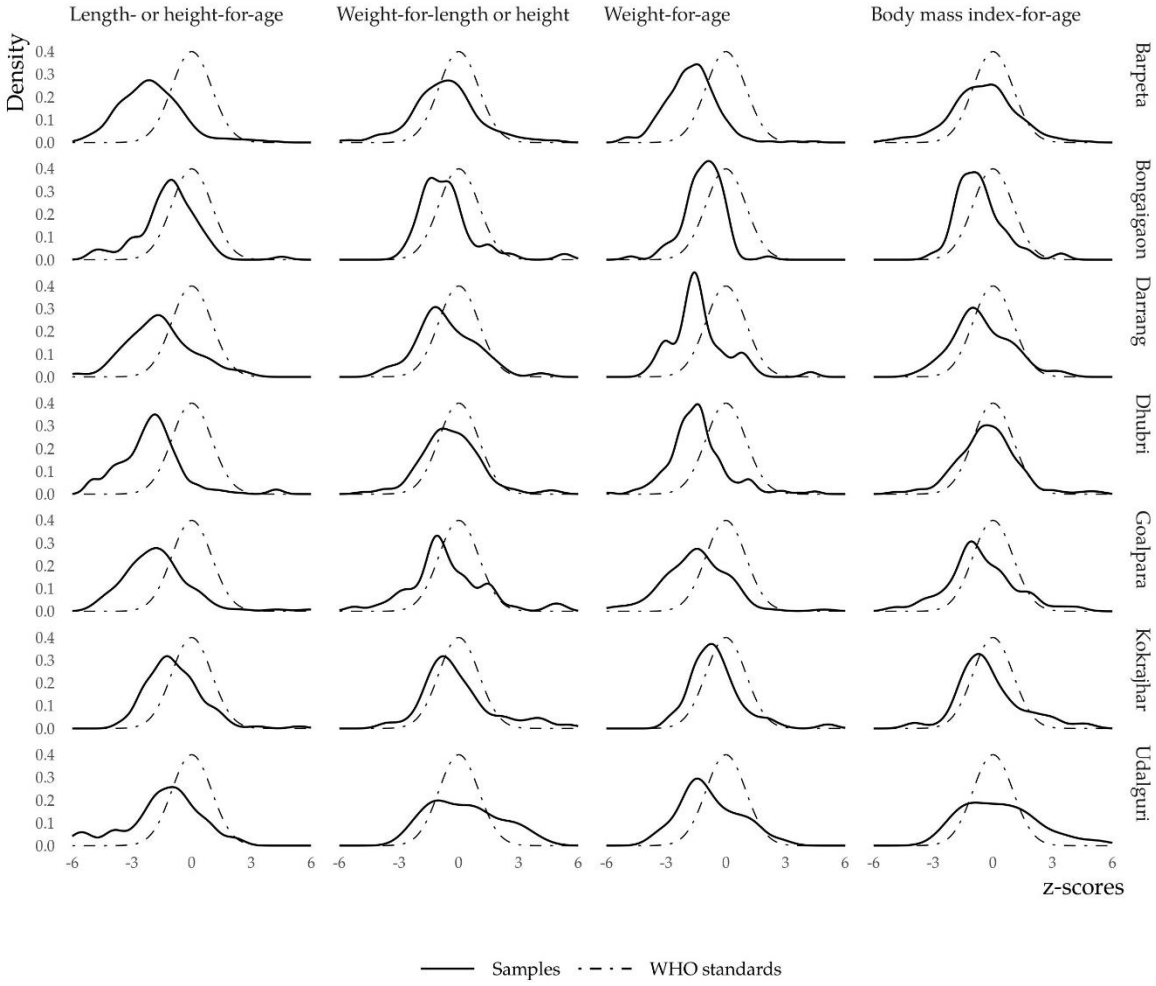
has a relatively lower prevalence, with 11.4% of the children severely stunted. Severe wasting is highest in Barpeta (5.9%), followed by Darrang (5.6%). The sample from Udalguri and Bongaigaon shows no severe wasting among children. The highest incidence of severe underweight is in Goalpara (18.8%), followed by Darrang (14.8%), and Barpeta (14.4%), while the survey sample of Kokrajhar reflects zero severe underweight. Bongaigaon (3.6%) and Udalguri (7.1%) also have a considerably less severe underweight prevalence than other survey districts.

Barpeta shows the highest percentage of children stunted, wasted, and underweight, as well as severe anthropometric failures, except for severe underweight, for which Darrang shows the highest incidence. Barpeta district also has the highest incidence of children with at least one form of anthropometric failure, with 66% falling into the CIAF category. Goalpara has the highest incidence of wasting, and Darrang has the highest incidence of low birth weight. The three BTAD districts show a general trend of a lower prevalence of anthropometric failure and a significantly lower prevalence of severe and acute malnutrition indicators. Figure 8 depicts the distribution of Z-scores from the sample against WHO standards for the survey districts.

5.5.2 Z-score distribution by Age groups and Sex

The Z score distribution for height for age, weight for age, and weight for height, are given as Appendix 12-14, respectively. Figure 9 represents the distribution of z-scores based on age groups, and Figure 10 represents the distribution of z-scores based on sex. Stunting is seen to be the highest among children in the age group 6 to 11 months (48.9%), and severe stunting is highest among children in the age group 12 to 23 months (27.5%), followed closely by the age group 6 to 11 months (27.2%). The lowest levels of stunting (30.4%) and severe stunting (12.4%) are among children aged 36–47 months. Boys are generally more stunted (43.1%) and severely stunted (20%) than girls. While considering different combinations of sex and age groups, boys in the age group 12-23 months have the highest prevalence of stunting (54%), followed by severe stunting (33%).

Figure 8 Z-score Distributions by Districts



The lowest percentage of stunted children are girls in the age group 36–47 months (29.5%), and the lowest percentage of severe stunting is among boys in the age group 36–47 months (7.9%).

Wasting is highest among children in the age group 6 to 11 months (19.4%), and severe wasting is highest among children in the age group 12 to 23 months (6%), followed closely by the age group 6 to 11 months (5.8%). The lowest levels of wasting (5.4%) and severe wasting (1.8%) are among children in the age group 0–5 months. Boys are generally more wasted (13.5%) and severely wasted (5.0%) than girls. While considering different combinations of sex and age groups, girls in the age group 12-23 months have the highest prevalence of wasting (27.2%), and boys in the age group 24-35 months have the highest prevalence of severe wasting (9.1%). The lowest percentage of wasted children are girls in the age group 0–5 months (3.6%), and the lowest percentage of severe

wasting is among boys in the age group 0–5 months and girls in the age group 48–59 months; the samples for both reflect zero anthropometric failure.

Underweight (37%) and severe underweight (13.7%) are the highest among children in the age group of 48 to 59 months. The lowest levels of underweight (11.3%) and severe underweight (1.9%) are among children in the age group 0–5 months. Boys are generally more underweight (30.5%) and severely underweight (11.2%) than girls. While considering different combinations of sex and age groups, boys in the age group 48–59 months have the highest prevalence of underweight (44.1%) and severe underweight (16.2%). The lowest percentage of underweight children are girls in the age group 0–5 months (6.9%), and the lowest percentage of severe underweight is among boys in the age group 0–5 months; the sample reflects zero anthropometric failure.

Figure 9 Z-score Distributions by age group (Lower Assam)

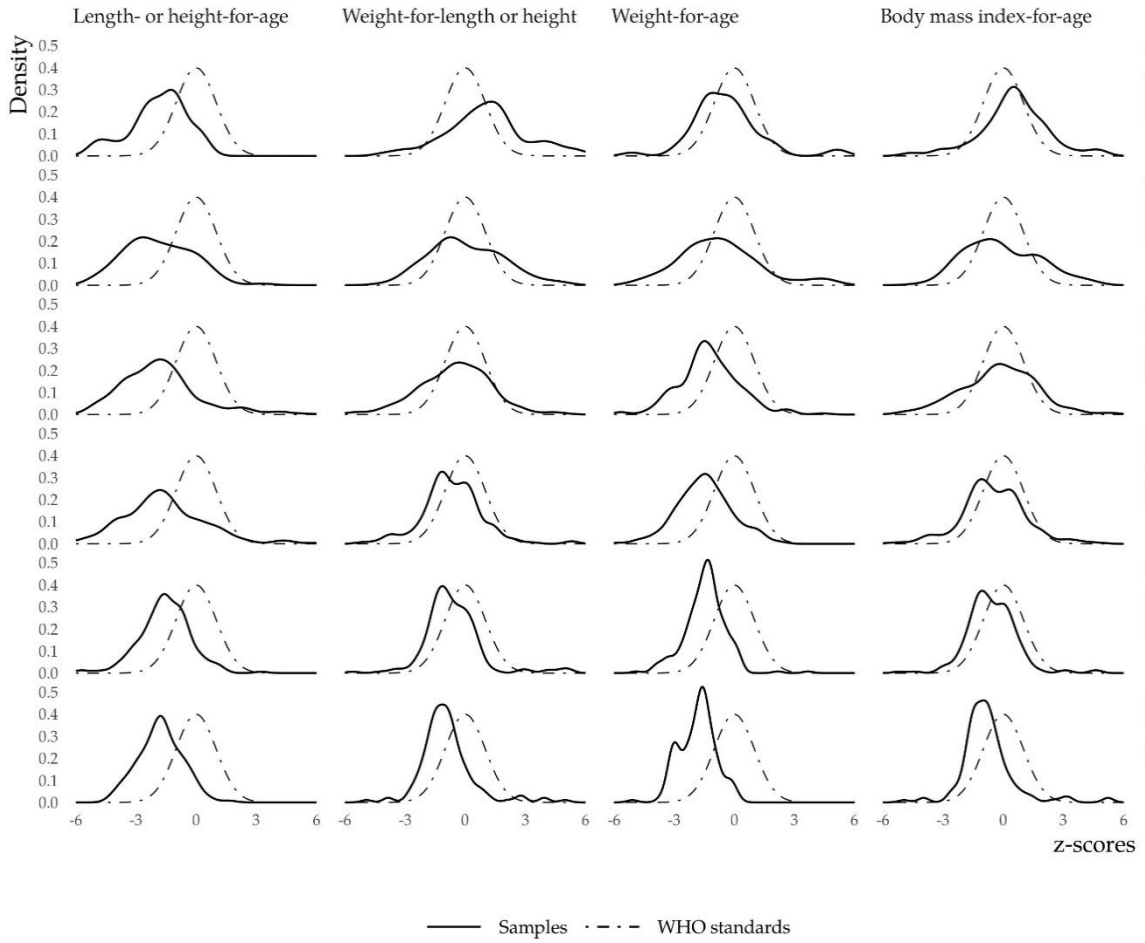
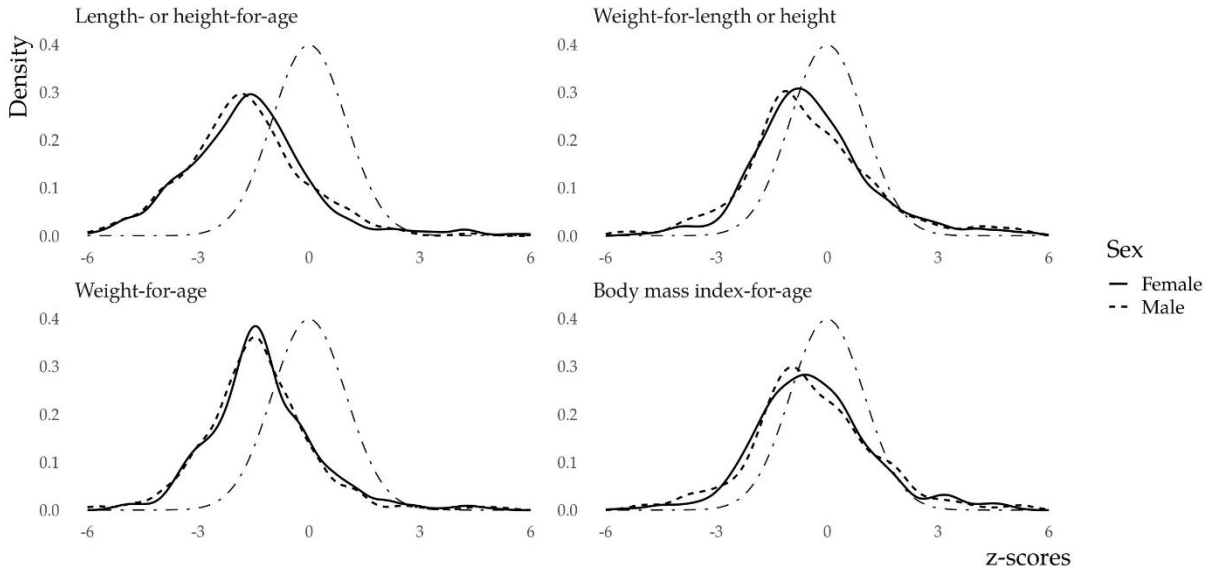


Figure 10 Z-score Distributions by sex (Lower Assam)



5.5.3 Status of Determinants of Nutritional Status in Select Districts of Assam

5.5.3.1 Nutrition Surveillance, Monitoring, Child Immunization and Child Care

The status of determinants of child nutritional outcomes, such as nutrition surveillance and monitoring, child immunisation and other childcare interventions, and details of recent illnesses in survey districts are given as Table 10. Barpeta has the lowest coverage of nutrition surveillance and monitoring among the districts. For the survey region, 85.2% of the children reported receiving supplementary take-home ration, 85.6% reported having had their height and weight measured at regular intervals, and 70.6% of the mothers were aware of the growth monitoring card for the child. The highest percentage of children receiving supplementary take-home rations was in Kokrajhar (95.4%) and the lowest in Udalguri (68.3%), both falling under the BTAD areas. Almost all the mothers in Darrang reported that their child's height and weight were measured by frontline workers at regular intervals; however, in Barpeta, only 62% of the mothers reported regular monitoring of child growth by frontline workers. Barpeta (48.6%) also has the lowest percentage of mothers aware of the child growth monitoring card.

Table 10 Compilation of Indicators of Child Care for Survey Districts

No	Indicator	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
	Nutrition Surveillance and Monitoring								
1	Children receiving supplementary take-home ration (%)	77.7	94.3	94.1	86.9	86.9	95.4	68.3	85.2
2	Mothers who wash their hands with soap before feeding the child (%)	95.1	92.0	95.8	90.0	84.1	100.0	93.7	92.4
3	Children whose height and weight are measured at a regular interval (%)	61.9	96.6	99.2	95.6	91.6	87.2	93.7	85.6
4	Mothers who are aware of the growth monitoring card for the child (%)	48.6	87.5	85.6	79.7	87.9	52.3	81.0	70.6
	Child Immunization and other childcare								
5	Children aged 12-23 months fully immunized (BCG, measles, and 3 doses each of polio and DPT) (%)	79.0	86.4	57.1	65.5	61.4	60.8	35.0	61.7
6	Children who have received 3 doses of polio vaccine (%)	83.1	88.2	96.8	97.5	96.6	93.6	89.5	90.8
7	Children who received a vitamin A dose in the last 6 months (%)	62.1	64.5	85.7	94.1	87.5	83.2	69.2	74.6
8	Prevalence of diarrhoea (reported) in the last 2 weeks preceding the survey (%)	21.8	9.1	3.2	6.7	3.4	11.2	17.3	13.0
9	Children with diarrhoea in the last 2 weeks taken to a health facility (%)	54.7	40.0	100.0	100.0	0.0	57.1	56.5	58.8
10	Prevalence of symptoms of acute respiratory infection (ARI) in the last 2 weeks preceding the survey (%)	70.8	47.3	50.8	60.5	46.6	32.8	49.6	53.9
11	Children with fever or symptoms of ARI in the last 2 weeks preceding the survey taken to a health facility (%)	48.3	63.5	43.8	52.8	48.8	43.9	40.2	47.7

The lowest percentage of fully immunised children is in Udalguri (35%), and the highest is in Bongaigaon (86.4%). Immunisation coverage in lower Assam is estimated at only 61.7 percent. 74.6% of the children received vitamin A doses in the six months preceding the survey. Barpeta (62.1%) has the lowest percentage of children receiving Vitamin A, and Dhubri has the highest (94.1%) percentage. The highest reported prevalence of recent illnesses, such as diarrhoea and ARI, is also in Barpeta, where around 70% of children reported having symptoms of ARI in the two weeks preceding the survey, and 21.8% reported having had diarrhoea. On average, 13% of the children in the survey districts reported having diarrhoea, and 53.9% reported having ARI symptoms. Only 58.8% and 47.7% of the children with symptoms of diarrhoea and ARI were taken to a health facility for treatment, respectively.

The distribution of Z-scores based on childcare interventions is shown in Appendix 15. Children with a vaccination card were fewer in the categories of stunted, severely stunted, and underweight than those who reported not having a vaccination card. Children who received vitamin A doses in the last six months were less stunted, severely stunted, underweight, and wasted than those who did not receive vitamin A. However, children who received vitamin A doses were more than those who did not receive vitamin A doses in the severely underweight and severely wasted categories. Children for whom deworming is done were fewer in the stunted and severely stunted categories but more in the wasted and severely wasted categories. Fully immunised children were fewer in the stunted, severely stunted, and underweight categories but more in the wasted and severely wasted categories. Similarly, children who were reported to have benefited from midday meal schemes were fewer in stunted and severely stunted groups and more in underweight, severely underweight, wasted, and severely wasted groups.

The incidence of recent illness significantly impacts children's nutritional status, according to the Z-score distribution tables. Children who experienced episodes of diarrhoea in the two weeks preceding the survey were more in number in all categories of anthropometric failure, and those

who experienced symptoms of ARI were more in number in stunted, severely stunted, and severely wasted categories.

5.5.3.2 Maternity and Delivery Care

The status of different maternity and delivery care indicators for the survey districts are given as Table 11. More than 90 percent of mothers received antenatal check-ups in the region, which included weighing, blood pressure monitoring, blood sample collection, an abdomen examination, and urine sample collection. Mothers who received neonatal tetanus injections were 75.5%, with the highest coverage in Goalpara (99.1%) and lowest in Barpeta (47.4%). Mothers who consumed iron folic acid for more than 100 days during pregnancy were very low in the survey districts. On average, only 34.2% of mothers consumed IFA for more than 100 days, and the coverage is lowest in Barpeta (25.5%) and Kokrajhar (26.6%) and highest in Bongaigaon (44.3%). More than 90 percent of mothers in the survey districts except Barpeta and Dhubri received Mother and Child Protection cards for registered pregnancies, and in Darrang, all the mothers interviewed for the survey reportedly received MCP cards. Almost 53% of mothers received financial assistance through the JSY scheme for births delivered in an institution.

Among the mothers interviewed for the survey, 21.8% had a below-normal BMI, and 17.8% were overweight or obese. The highest percentage of mothers with below-normal BMI was in Darrang (32.8%), and the lowest was in Bongaigaon (12.4%) and Kokrajhar (13.6%). The highest percentage of overweight mothers was in Udalguri (33.3%) and the lowest in Goalpara (9.3%). Mothers in lower Assam reported that a frontline worker talked to them about nutrition (83.1%), the importance of institutional delivery (87.2%), and family planning (74%). All the mothers interviewed in Udalguri reported that they were talked to by a frontline worker about nutrition; similarly, all the mothers interviewed in Darrang reported that frontline workers talked to them about the importance of institutional delivery. Mothers to whom frontline workers talked about nutrition (75.3%) and institutional delivery (76.5%) were lowest in Dhubri, and regarding family planning, they were lowest in Bongaigaon (62.5%).

Table 11 Compilation of Maternity and Delivery Care Indicators for Survey Districts

	Indicator	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
	Mothers who had antenatal check-ups in the first trimester								
1	a. Mothers who were weighed (%)	90.7	98.9	99.2	93.2	99.1	99.1	88.7	94.1
2	b. Mothers whose blood pressure was measured (%)	96.4	96.6	97.5	93.6	99.1	89.9	95.2	94.6
3	c. Mothers whose blood sample was collected (%)	96.0	96.6	95.8	89.6	95.3	96.3	98.4	93.8
4	d. Mothers whose abdomen was examined (%)	93.1	97.7	95.8	90.8	92.5	93.6	95.2	92.7
5	e. Mothers whose urine sample was collected (%)	92.3	89.8	94.1	88.4	83.2	93.6	95.2	89.9
6	Mothers whose last birth was protected against neonatal tetanus (%)	47.4	96.6	85.6	88.0	99.1	67.0	72.6	75.5
7	Mothers who consumed iron folic acid for 100 days or more when they were pregnant (%)	25.5	44.3	34.7	41.8	37.4	26.6	40.3	34.2
8	Registered pregnancies for which the mother received Mother and Child Protection (MCP) card	63.2	95.5	100.0	86.5	98.1	95.4	98.4	85.6
9	Mothers who received financial assistance under Janani Suraksha Yojana (JSY) for births delivered in an institution (%)	61.5	54.5	60.2	36.7	37.4	75.2	65.1	52.9
10	Mothers whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2)14 (%)	19.0	12.4	32.8	26.7	22.4	13.6	27.0	21.8
11	Mothers who are overweight or obese (BMI ≥ 25.0 kg/m2)14 (%)	20.2	22.5	16.8	13.4	9.3	20.0	33.3	17.8
12	Health worker ever talked to Mothers about Nutrition (%)	85.8	85.2	87.3	75.3	79.4	88.1	100.0	83.1
13	Health worker ever talked to Mothers about Institutional Delivery (%)	82.2	96.6	100.0	76.5	95.3	92.7	98.4	87.2
14	Health worker ever talked to Mothers about Family Planning (%)	78.5	62.5	70.3	72.5	70.1	86.2	82.3	74.1
	Delivery Care								
15	Institutional births (%)	79.8	85.5	96.8	95.0	86.4	73.6	66.5	79.5
16	Institutional births in a public facility (%)	74.5	72.7	82.5	85.7	61.4	71.2	60.5	71.3
17	Births assisted by a doctor (%)	29.2	29.1	57.1	65.5	71.6	29.6	12.8	34.8
18	Births assisted by a nurse/LHV/ANM/other health personnel (%)	49.4	63.6	38.1	30.3	18.2	53.6	53.8	47.2

Only 79.5% of the deliveries were institutional, and 71.3% of them were in a public health facility. Institutional deliveries were lowest in Udalguri (66.5%) and highest in Darrang (96.8%). Among the institutional deliveries, only 34.8% were assisted by a doctor, and 47.2% by a nurse, LHV, ANM, or other health personnel. Deliveries assisted by a doctor were also lowest in Udalguri (12.8%), where 53.8% of deliveries were assisted by other health personnel. 71.6% of deliveries in Goalpara were assisted by a doctor, the highest among the survey districts. Dhubri also had a high proportion of institutional deliveries (95%), the highest proportion of deliveries in public health facilities (85.7%), and a high percentage of deliveries assisted by a doctor (65.5%).

The distribution of Z-scores based on some maternity and delivery care indicators and birth characteristics is given as Appendix 16. The child's birth order has been shown to have a significant impact on their nutritional status. First-born and middle children are fewer in all categories of anthropometric failure compared to youngest children. When compared to children with normal or high birth weights, children with low and very low birth weights are more likely to be in all categories of anthropometric failure except wasting. Children of mothers who consumed IFA for more than 90 days were fewer in the severely stunted, severely underweight, wasted, and severely wasted categories than children of mothers who did not consume IFA. The lowest number of children in the categories of stunted, severely stunted, underweight, and severely underweight were those whose mothers consumed IFA for more than 180 days. Children of mothers who received nutrition education from frontline workers are fewer in the stunted, severely stunted, and underweight categories than children of mothers who did not; however, they are more in the wasted, severely wasted, and severely underweight categories.

5.5.3.3 Education, Marriage, and Women Empowerment Indicators

Indicators of education, marriage, women's empowerment indicators, and household profiles in the survey districts are given in Table 12. We estimated that 76.5% of all women and 80.6% of all men in the surveyed households were literate, but only 35.4% of women had ten or more years of schooling. Underage marriage among women was high at 36.2% for the region, and 21.1%

Table 12 Compilation of Education, Marriage, Women Empowerment Indicators and Household Profiles for Survey Districts

	Indicator	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
	Education and Marriage								
1	Women who are literate (%)	72.3	89.7	78.1	70.3	81.0	83.5	80.6	76.5
2	Men who are literate (%)	79.5	83.2	91.0	74.2	76.0	87.0	87.0	80.6
3	Women with 10 or more years of schooling (%)	26.7	50.5	43.2	27.1	37.3	43.7	54.8	35.4
4	Women married before age 18 years (%)	34.4	25.2	30.3	52.7	51.6	16.5	14.0	36.2
5	Men married before age 21 years (%)	21.2	20.8	15.8	27.2	28.9	13.9	11.7	21.1
	Women's Empowerment								
6	Currently married women who usually participate in household decisions (%)	54.4	30.7	18.6	22.3	25.2	94.3	45.2	40.2
7	Women owning a house and/or land (alone or jointly with others) (%)	42.7	47.7	37.3	31.1	38.3	15.1	46.8	36.1
	Household Profile								
8	Households with an improved drinking-water source (%)	99.2	96.6	99.1	98.8	95.4	93.6	98.4	98.4
9	Households using improved sanitation facility (%)	84.9	96.6	93.3	74.5	88.8	92.7	90.5	85.6
10	Households using clean fuel for cooking (%)	71.0	75.3	59.7	35.5	39.3	86.2	65.1	58.4
11	Households with electricity (%)	93.5	100.0	98.3	92.0	85.0	99.1	100.0	94.1
12	Households with any usual member covered by a health scheme or health insurance (%)	52.8	34.8	39.8	30.3	22.4	59.1	23.8	38.4
13	Households owning homestead land (%)	94.7	100.0	100.0	90.5	100.0	92.6	96.8	95.2
14	Households owning agricultural land (%)	28.0	52.8	42.9	29.4	55.6	52.6	55.6	39.3
15	Households with Ration card (%)	67.63	63.64	68.64	58.61	62.62	60.55	75.81	63.67

of men were also married before the legal age. Dhubri had the lowest percentage of literate women (70.3%) and men (74.2%), as well as the highest prevalence of underage marriages (52.7%) among women. On the other hand, Udalguri has the lowest incidence of underage marriage among women (14%), and men (11.7%). Bongaigaon (89.7%) had the highest literacy rates among women, and Darrang (91%) had the highest literacy rates among men. Barpeta, Dhubri, and Goalpara are the districts with below-average literacy rates among men and women.

40 percent of married women reported that they usually participate in household decisions, and 36.1% owned a house or land. Kokrajhar stands out among the districts, with 94.3% of women participating in household decisions, more than double the average and 40 points higher than the next best district (Dhubri 54.4%). However, the lowest percentage of women owning a house or land is also in Kokrajhar (15.1%), whereas Bongaigaon (47.7%) has the highest percentage of women owning a house or land. The lowest percentage of women participating in household decisions is in Darrang (18.6%).

Appendix 17 shows the Z-score distribution based on some marriage and women empowerment indicators. Children of mothers who had their first child before the age of 15 were more than those who had their first child after the age of 21 in all categories of anthropometric failure by a huge margin. Mothers who had their first child between 18 and 21 years of age also have fewer children in the anthropometric failure categories of stunted, severely stunted, underweight, and severely wasted compared to mothers who had their first child before 18 years of age. Mothers with high decision-making power had fewer children in stunted, severely stunted, wasted, and severely wasted categories than mothers with no decision-making power, as estimated from the survey data. Whether the mother wanted the pregnancy or not is also to be seen along with her decision-making power, as children of mothers who reported they did not want the pregnancy at the time of conceiving were more in stunted, severely stunted, underweight, severely underweight, and severely wasted categories. Mothers with high awareness of violence against women and their rights in marriage had fewer children in all categories of anthropometric failure than those with

no, low, or moderate awareness scores. Counter-intuitively, children of mothers with high land-house ownership scores were more in all categories of anthropometric failure compared to those with nil, low, and moderate land/house ownership scores.

5.5.3.4 Household Profile

Most of the households surveyed had access to an improved drinking water source (98.4%), electricity (94.1%), and owned homestead land (95.2%). Access to improved sanitation facilities (85.6%) was comparatively less, and households using clean fuel for cooking (58.4%) were low. Households with any member covered under the health insurance scheme (38.4%) and households owning agricultural land (39.3%) were significantly low. Only 63.6% of the households had a ration card.

Barpeta had the lowest percentage of households using improved sanitation facilities (85%) and households owning agricultural land (28%). Goalpara had the highest percentage of households without electricity (85%) and the lowest percentage of households with at least one member covered under an insurance scheme (22.4%). Households using clean cooking fuel (35.5%) were lowest in Dhubri, which also had the lowest percentage of households owning homestead land (90%) compared to other districts. Households with an improved drinking water source (93.6%) and households with ration cards (60.5%) were the lowest in Kokrajhar district.

Appendix 18 depicts the Z-score distribution based on some socio-economic characteristics of the households. The highest percentage of children with anthropometric failure in all categories were from Muslim households compared to Christian and Hindu households. Households with an improved sanitation facility had fewer children in the stunted, severely stunted, wasted, underweight, and severely underweight categories compared to households without an improved facility. Households with an improved source of drinking water had fewer children in the stunted, underweight, severely underweight, wasted, and severely wasted categories. Households using clean cooking fuel had fewer children in the stunted, severely stunted, underweight, and severely underweight categories and more children in the wasted and severely wasted categories.

Households with electricity had fewer children in the severely stunted, wasted, and severely wasted categories and more children in all other categories. When considering land ownership, households that owned homestead land had fewer children in all categories of anthropometric failure, and households that owned agricultural land had fewer children in all categories of anthropometric failure except severely wasted. Households with ration cards had more children in all categories of anthropometric failure.

5.5.3.5 Nutritional Status and MPI

Indicators of multidimensionally poor households in the survey districts are given in Table 13. The headcount ratio of multidimensionally poor households in lower Assam is 43.7%. This percentage also broadly corresponds to the percentage of children found to be nutritionally deprived. There is, therefore, a broad indication that poverty of households continues to play an underlying role in contributing to nutrition deprivation among children. Approximately 16% of the households were found to be severely multidimensionally poor, requiring institutional support from various government programmes. Deprivation on account of education and health outcomes exceeds the standard of living. Barpeta has the highest percentage of multidimensionally poor (58%), severely multidimensionally poor (28.2%), and vulnerable to multidimensionally poverty (31.5%) households. The intensity of poverty is also estimated to be highest in Barpeta (49%). Bongaigaon has the lowest percentage of multidimensionally poor (12%), severely multidimensionally poor (2.4%), and vulnerable to multidimensional poverty (20.4%) households; however, the intensity of poverty is lowest in Kokrajahar (13%). Barpeta, Goalpara, and Dhubri are districts with a higher-than-average incidence of multidimensional poverty and severely multidimensionally poor households. Barpeta and Goalpara also have higher than the average intensity of poverty.

The Z-score distribution based on multidimensional poverty is given as Table 14. As evident from the distributions, multidimensionally poor households have a higher incidence of anthropometric failure than non-multidimensionally poor households and households vulnerable

Table 13 Incidence of Multidimensional Poverty, All Survey Districts

	Indicator	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
1	Multidimensionally Poor Households (%)	58.09	12.04	41	47.54	47.6	33	27.5	43.7
2	Severely Multidimensionally Poor Households (%)	28.21	2.4	11	16.39	18.1	4.5	6.89	16.04
3	Households vulnerable to Multidimensional Poverty (%)	31.53	20.48	30	27.04	23.8	29.5	20.68	27.45
4	Intensity of Poverty "A" (%)	49	41	43	43.7	47.1	13	41.6	46
5	MPI (H*A)	0.28	0.05	0.18	0.2	0.22	0.13	0.11	0.2
6	Variance of Deprivation	0.01	0.01	0.01	0.008	0.008	0.008	0.01	0.01
7	Contribution of Education Deprivation to Multidimensional Deprivation (%)	42	40	48	27	38	34	40	38
8	Contribution of Health Deprivation to Multidimensional Deprivation (%)	36	32	33	37	29	43	40	36
9	Contribution of Standard of Living Deprivation to Multidimensional Deprivation (%)	22	27	19	35	32	23	20	27

Table 14 Z-Score Distribution based on Multidimensional Poverty

Group	-3SD (95% CI)	-2SD (95% CI)	z-score mean (95% CI)	z-score SD
Height for Age				
MPI.Status: MP	25.6 (20.4; 31.6)	56.8 (50.4; 63.1)	-2.1 (-2.3; -1.9)	1.5
MPI.Status: Not MPI Poor	6.9 (4.4; 10.9)	13.1 (9.4; 17.9)	-1.0 (-1.2; -0.8)	1.55
MPI.Status: Severe MP	33.8 (26.4; 42.1)	61.2 (52.8; 68.9)	-2.2 (-2.4; -1.9)	1.51
MPI.Status: Vulnerable to MP	21.0 (16.3; 26.7)	45.5 (39.2; 51.9)	-1.8 (-2.0; -1.6)	1.67
Weight for Age				
MPI.Status: MP	13.7 (10.0; 18.6)	43.1 (37.1; 49.4)	-1.6 (-1.8; -1.4)	1.38
MPI.Status: Not MPI Poor	5.1 (3.0; 8.7)	9.5 (6.4; 13.8)	-0.8 (-1.0; -0.7)	1.34
MPI.Status: Severe MP	17.5 (12.1; 24.6)	44.8 (36.8; 53.0)	-1.9 (-2.1; -1.7)	1.23
MPI.Status: Vulnerable to MP	10.7 (7.4; 15.2)	25.0 (20.0; 30.8)	-1.3 (-1.5; -1.2)	1.43
Weight for Height				
MPI.Status: MP	3.3 (1.6; 6.4)	17.6 (13.3; 22.9)	-0.5 (-0.7; -0.3)	1.71
MPI.Status: Not MPI Poor	2.8 (1.3; 5.7)	6.7 (4.2; 10.6)	-0.4 (-0.5; -0.2)	1.36
MPI.Status: Severe MP	8.6 (5.0; 14.6)	20.9 (14.9; 28.4)	-0.8 (-1.0; -0.5)	1.66
MPI.Status: Vulnerable to MP	3.0 (1.4; 6.1)	10.6 (7.3; 15.2)	-0.4 (-0.6; -0.2)	1.52

to multidimensional poverty in all categories. Severe multidimensional poverty is associated with a higher incidence of anthropometric failure in all categories compared to households that are multidimensionally poor, vulnerable to multidimensional poverty, or not multidimensionally poor. Similarly, households vulnerable to multidimensional poverty have a higher incidence of anthropometric failure compared to multidimensionally not poor households. This points to a clear and strong influence of multidimensional poverty on nutritional status outcomes and its severity cutoffs. Figure 11 depicts a sample z-score distribution against WHO standards based on multidimensional poverty status.

5.5.3.6 Breastfeeding and Complementary Feeding Practices

Compilation of the survey districts' status for different breastfeeding and complementary feeding indicators are given as Table 15. The percentage of breastfed children under age 3 within one hour of birth is 84.7% in lower Assam. Darrang (79.4%), Dhubri (80.7%), Udalguri (81.2%), and Barpeta (82.7%) have below average percentages of children breastfed within one hour of birth.

Table 15 Compilation of Indicators of Feeding Practices for Survey Districts

No	Indicator	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
1	Children under age 3 years breastfed within one hour of birth (%)	82.7	88.2	79.4	80.7	93.2	89.6	81.2	84.7
2	Children under age 6 months exclusively breastfed (%)	71.2	74.3	68.1	71.2	85.6	80.2	69.2	74.5
3	Children aged 6-23 months receiving a minimum acceptable diet (%)	31.1	36.8	36.8	14.9	43.3	9.1	14.8	25.8
4	Children aged 6-23 months receiving minimum diet diversity (%)	31.1	36.8	36.8	28.4	40.0	9.1	14.8	28.8
5	Children aged 6-23 months receiving minimum meal frequency (%)	71.1	73.7	68.4	32.8	86.7	45.5	66.7	64.6
6	Children aged 6-23 months receiving breast milk or milk products two or more times a day (%)	91.1	89.5	100.0	52.2	98.7	93.9	74.1	72.2
7	Children aged 6-23 months received Grains, roots and tubers in the last 24 hours (%)	63.3	31.6	47.4	50.7	70.2	48.5	59.3	55.6
8	Children aged 6-23 months received Legumes and nuts in the last 24 hours (%)	6.7	31.6	15.8	23.9	30.1	3.0	7.4	15.2
9	Children aged 6-23 months received Dairy products (milk, yoghurt, cheese) in the last 24 hours (%)	25.6	63.2	31.6	31.3	26.7	9.1	44.4	30.1
10	Children aged 6-23 months received Flesh foods (meat, fish, poultry and liver/organ meats) in the last 24 hours (%)	18.9	21.1	36.8	25.4	41.2	6.1	7.4	22.5
11	Children aged 6-23 months received Eggs in the last 24 hours (%)	13.3	47.4	42.1	29.9	43.0	9.1	18.5	25.5
12	Children aged 6-23 months received Vitamin A-rich fruits and vegetables in the last 24 hours (%)	45.6	57.9	36.8	41.8	42.3	21.2	51.9	42.1
13	Children for whom complementary feeding started before 6 months of age (%)	26.7	25.5	15.9	20.2	11.4	2.4	22.2	19.7
14	Children for whom complementary feeding started at 6 months of age (%)	19.3	26.4	50.8	57.1	78.4	79.2	44.0	45.8
15	Children for whom complementary feeding started after 6 months of age (%)	46.1	32.7	19.0	18.5	6.8	6.4	25.6	26.3

74.5% of children under the age of six months are exclusively breastfed. The percentage varies by district and is lowest in Darrang (68.1%), followed by Udalguri (69.2%). Complementary feeding was started at six months of age for only 45.8% of the children; for the rest, complementary feeding started either before (19.7%) or after (26.3%). Delayed start of complementary feeding was highest in Barpeta (46.1%), followed by Bongaigaon (32.7%). Early complementary feeding initiation was also highest in Barpeta (26.7%) and Bongaigaon (25.5%). On the other hand, complementary feeding was started for 79.2% of the children in Kokrajhar, the highest in the region. Goalpara (78.4%) also has a high percentage of children for whom complementary feeding started on time.

The results show that only 25.8% of children aged 6-23 months receive a minimum acceptable diet in the survey area. It is surprisingly the lowest in Kokrajhar (9.1%). The minimum acceptable diet is limited mainly by the low percentage of children with minimum diet diversity (28.8%). Children receiving a minimum acceptable diet are highest in Goalpara (43.3%), followed by Darrang (36.8%) and Bongaigaon (36.8%). Children receiving a minimum diet diversity is also highest in these districts. 64.6% of children in the same age group receive the minimum meal frequency. This is highest in Goalpara (86.7%), followed by Bongaigaon (73.7%) and Barpeta (71.1%).

Based on a 24-hour recall, grains, roots, and tubers (72.2%) are the main food groups used for complementary feeding, followed by fruits, vegetables (42.1%), and dairy products (30.1%). On the other hand, legumes and nuts (15.2%) are the least used food groups, followed by eggs (25.5%) and flesh foods (22.5%).

Appendix 19 shows the Z-score distribution based on different breastfeeding and complementary feeding practices. Breastfed children within one hour of birth are fewer in all categories of anthropometric failure except severely wasted. Children for whom breastfeeding continued after six months of age are also fewer in all categories of anthropometric failure. Children for whom complementary feeding started at exactly six months of age are fewer in stunted, underweight, severely underweight, wasted, and severely wasted categories compared to those for whom

complementary feeding started before or after six months. Children who receive the minimum acceptable diet are fewer in stunted, severely stunted, underweight, and wasted categories than their counterparts. Children with minimum dietary diversity and minimum diet frequency in complementary feeding are fewer in all categories of anthropometric failure except for severely wasted.

5.5.3.7 Diet Patterns and Expenditure on Food Categories

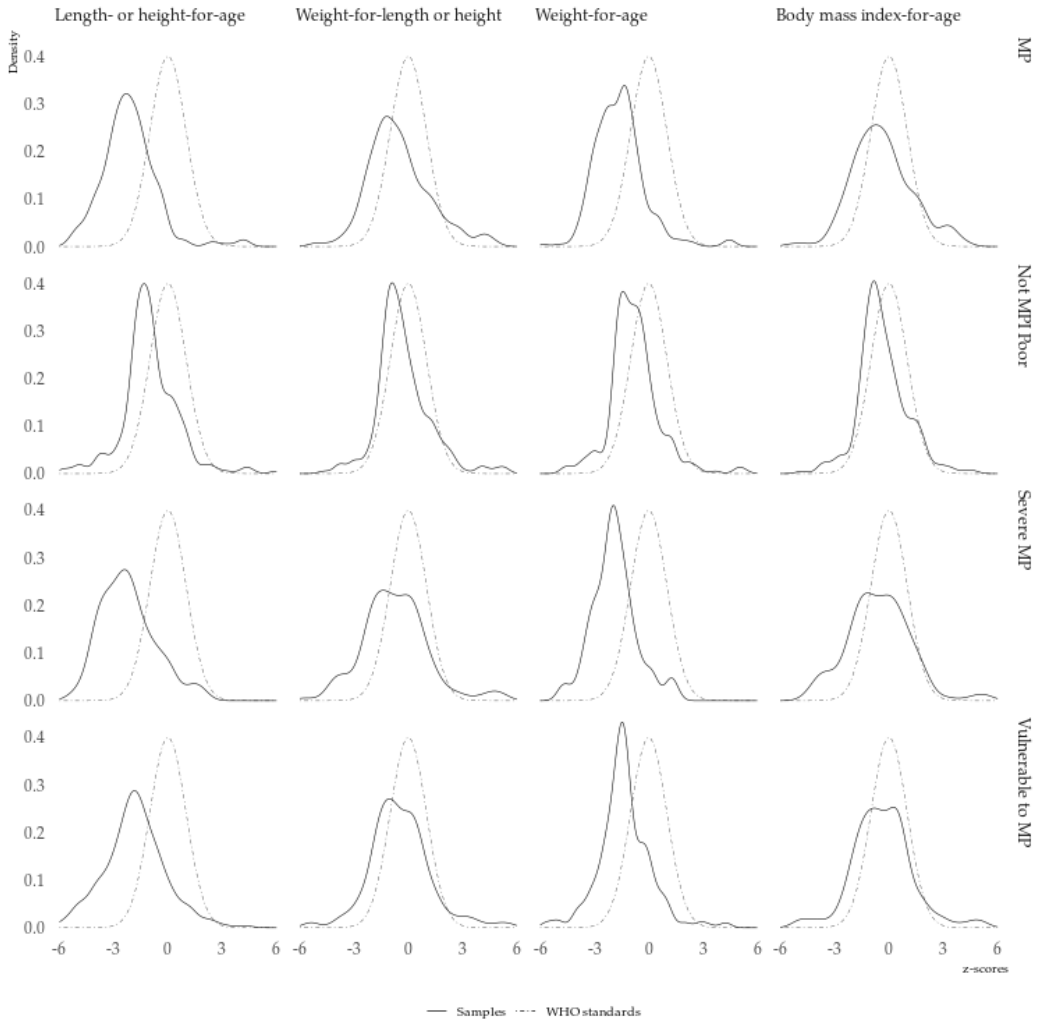
Per capita expenditure on food categories, expenditure on food categories as a percentage of total food expenditure, and quantity consumed as a percentage of total food consumption are estimated for the survey districts. Appendix 20 compiles expenditure on food categories as a percentage of total food expenditure. Appendix 21 shows the quantity consumed of each food group as a percentage of total food consumption. Most districts have the highest expenditure on edible oils, meat, poultry, and fish. However, meat, poultry, and fish are among the food groups with the lowest quantity consumed as a percentage of total food consumption, along with eggs.

While considering the quantity of different food groups consumed as a percentage of the total food consumption of the household, roots and tubers are most consumed, contributing between 16-18 percent of the total quantity consumed, followed by the food group comprising of sugars, salt, and packaged foods, which contribute 13-17 percent. Cereals contribute between 10-15 percent of the total consumption, vegetables between 11-13 percent, pulses and legumes between 7-13 percent, edible oils between 7-9 percent, and fruits between 5-9 percent. The least consumed groups are eggs, meat, milk, fish, and leafy vegetables. These are consumed less than five percent of the total consumption. This pattern is more or less similar across the districts. There is a significant difference in the order of food groups and high variation among districts between per capita expenditure and consumption quantity.

The largest expenditure is on edible oils in most districts, contributing between 14-24 percent of the total food expenditure. Meat and poultry come in second with a 9-19% contribution, followed by fish with a 9-18% contribution and pulses and legumes with a 9-16% contribution. We can also

see that spending on roots and tubers, the most consumed food group, ranks fifth with a range of 7-11 percent. The smallest expenditure remains on eggs, with less than 0.3 percent of the total expenditure. Milk and milk products contribute only 3-6 percent of the total expenditure, vegetables 4-5 percent, and cereals 5-8 percent.

Figure 11 Z-Score Distribution based on Multidimensional Poverty in Lower Assam



5.6 Chapter Summary and Conclusions

5.6.1 Summary of Secondary Data Analysis

This chapter used secondary data from NFHS-4 and NFHS-5 for Assam to understand the nutritional status of children under five years of age in districts of Assam. The status of different traditional indicators of anthropometric failure, their severity cut-offs, and the composite index of anthropometric failure and its subcategories were estimated. Changes in these indicators between the two rounds of the survey and the performance of districts were analysed. A special focus was given to the aspirational districts of Assam. Primary data collected through a survey conducted in seven selected districts of Assam was used to estimate the indicators and determinants of undernutrition and the coverage of various nutrition interventions. Multi-dimensional poverty and diet patterns in the survey districts are also analysed.

Analysis of NFHS5 data shows that Assam has a higher incidence of anthropometric failure in all categories than the national average. Between 2016 and 2020, while all the considered indicators decreased at the national level, all indicators showed an increase except for stunting in Assam. The Barak Valley Region (BVR) district of Karimganj shows alarmingly high levels of wasting, severe wasting, severe underweight, CIAF, and triple anthropometric failure, standing out among other districts with a high prevalence of anthropometric failure in Assam. Though Karimganj managed to bring down stunting rates by more than ten percentage points between the latest two rounds of NFHS, it witnessed the highest increase in wasting, severe wasting, underweight, severe underweight, CIAF, and triple failure in Assam.

The Bodoland Territorial Region (BTR) district of Bongaigaon has high stunting, severe stunting, underweight, and triple anthropometric failure. However, it managed to reduce wasting and severe wasting between 2016 and 2020. Baksa, another BTR district, has high stunting rates and the highest increase in stunting and severe stunting between NFHS4 and NFHS5, making it the only aspirational district to be so. Baksa is also the aspirational district with the highest increase in

wasting. The other two districts in the BTR region, Udalguri and Kokrajhar, show high variation in the incidence of triple failure, with Udalguri having the lowest incidence of triple anthropometric failure and Kokrajhar having a high incidence of triple anthropometric failure.

Kamrup and Kamrup Metro are the better-performing districts with a low incidence of stunting, wasting, CIAF, and children with triple anthropometric failure. Kamrup also has the lowest incidence of underweight, severe stunting, severe wasting, and severe underweight and has also managed to significantly reduce stunting, wasting, underweight, severe underweight, CIAF, and triple failure during the period between 2016 and 2020.

Most aspirational districts have stunting rates higher than the state average; however, stunting rates decreased in all but one, namely Baksa, between 2016 and 2020. The aspirational district of Dhubri has high stunting, severe stunting, severe underweight, and CIAF rates but shows a decrease in wasting, severe wasting, and CIAF between the latest rounds of NFHS. Barpeta district shows the highest reduction in stunting rates among aspiration districts, and it also significantly reduced underweight and CIAF rates. In Hailakandi, the incidence of underweight is significantly high, and the prevalence of severe stunting has increased considerably. Darrang witnessed a decrease in stunting, underweight, severe underweight, and triple failure but has the highest incidence of wasting among aspirational districts. Karimganj, Cachar, and Biswanath districts are non-aspirational districts with higher wasting rates than any aspirational district.

5.6.2 Summary of Primary Data Analysis

Among the survey districts, Barpeta has the highest prevalence of stunting, underweight, CIAF, severe stunting, severe wasting, and triple anthropometric failure. The district also has a high prevalence of wasting, a high number of mothers reporting child death, and the highest prevalence of recent illnesses such as diarrhoea and ARI. The district fared poorly in most basic, underlying, and immediate determinants of the nutritional status of children. It has the highest percentage of multidimensionally poor households, the highest intensity of multidimensional poverty, and the

largest number of severely multidimensionally poor households. It also has the lowest literacy rates among the survey districts, the lowest percentage of households using improved sanitation facilities, and the highest incidence of delayed and early starts of complementary feeding. Breastfed children within one hour of birth are also low in the district; however, the percentage of children receiving a minimum meal frequency is high compared to other districts surveyed. Coverage of nutrition monitoring and surveillance interventions and most maternity and delivery care interventions are also really low in Barpeta.

Goalpara district, next to Barpeta, has the highest incidence of wasting and the highest percentage of children with triple anthropometric failure among the survey districts. Golapara also has a high prevalence of stunting, severe stunting, underweight, severe underweight, and CIAF. The district fared poorly in many basic determinants of nutrition and has a high incidence of multidimensional poverty and a high intensity of poverty. It also has low literacy rates and the highest percentage of households without electricity. However, coverage of interventions is comparatively better than in other districts, and IYCF practises also show a positive status. Goalpara has the highest percentage of mothers protected against neonatal tetanus and the highest percentage of deliveries assisted by a doctor among the survey districts. Goalpara has the highest proportion of children receiving a minimum acceptable diet and a minimum meal frequency. The percentage of children for whom complementary feeding started on time is also high in Golapara.

Dhubri is one of the districts with high stunting, severe stunting, underweight, and CIAF. The number of mothers reporting child deaths is also high in Dhubri. The percentage of literate women and households using clean cooking fuel is the lowest in Dhubri. The district also has a high incidence of multidimensional poverty and a low percentage of children breastfed within one hour of birth. A high percentage of institutional deliveries is observed in Dhubri compared to other survey districts, despite it being the district with the lowest coverage of awareness creation

interventions regarding the importance of institutional deliveries. Dhubri also has the highest percentage of children receiving vitamin A supplements.

Darrang is the district with the highest incidence of children born with low birth weight, the prevalence of severely underweight children, and mothers with below-normal BMI. It also has high wasting, severe wasting, underweight, and CIAF rates. Darrang has high coverage of most maternal and child health interventions and the highest percentage of institutional deliveries among the survey districts. Darrang is the district with the highest literacy rates among women but has the lowest percentage of women participating in household decision-making. The percentage of children receiving a minimum acceptable diet is on the higher side in Darrang, but it has a low percentage of children breastfed within one hour of birth and exclusively breastfed children.

A comparatively better-performing district, Udalguri has the lowest incidence of severe wasting and children with triple anthropometric failure. It also has low underweight, severe underweight, CIAF, and a high number of mothers reporting child death. However, the prevalence of low birthweight is high in the district. Udalguri also has the lowest percentages of children receiving supplementary take-home rations, fully immunised children, institutional deliveries, and deliveries assisted by a doctor. It also has the highest percentage of overweight mothers and a low percentage of exclusively breastfed children. Udalguri has the lowest incidence of underage marriage among the survey districts.

Another better-performing district, Kokrajhar, has the lowest stunting, severe stunting, wasting, and severe underweight rates among the survey districts. Kokrajhar also has a low underweight, CIAF, and triple anthropometric failure rate; however, the number of mothers reporting child death is the highest in the district. The intensity of multidimensional poverty is the lowest in Kokrajhar, and it has the highest percentage of children receiving supplementary rake home ration. The highest percentage of mothers participating in household decision-making is in Kokrajhar, and mothers with below normal BMI are also low, but mothers who consumed IFA for 100 days

during pregnancy are low, and mothers owning a house or land are the lowest in the district. Kokrajhar has the highest percentage of children for whom complementary feeding started on time but has the lowest percentage of children receiving a minimum acceptable diet.

One of the best-performing districts, Bongaigaon, has low stunting, severe stunting, wasting, severe wasting, underweight, severe underweight, CIAF, and triple failure rates. The survey sample shows zero mothers reporting child deaths in Bongaigaon. According to the survey sample data, different basic, underlying, and immediate determinants of nutrition provide an enabling backdrop for Bongaigaon's performance. Bongaigaon has the lowest percentage of multidimensionally poor households, the lowest percentage of mothers with below-normal BMI, the highest literacy rates among women, and the highest percentage of mothers owning a house or land. It has the highest percentage of fully immunised children and mothers who consumed IFA for more than 100 days during pregnancy among the survey districts. Children receiving a minimum acceptable diet were also high in Bongaigaon; however, the timely start of complementary feeding was low.

Z-score distribution patterns from primary data show that stunting and wasting are highest among the children in the age group 6 to 11 months, severe stunting and severe wasting are highest among children in the age group 12 to 23 months, and underweight and severe underweight are highest among children in the age group 48-59 months. In general, boys are more stunted, severely stunted, wasted, severely wasted, underweight, and severely underweight than girls, but girls in the age group 12-23 have the highest prevalence of wasting. Z-score distribution based on MPI points to a clear and strong influence of multidimensional poverty on nutritional status outcomes and its severity cut-offs. Children who are breastfed within one hour of birth, children for whom breastfeeding continued after six months of age, children for whom complementary feeding started at exactly six months of age, and children who receive the minimum acceptable diet are all fewer in most categories of anthropometric failure.

Based on a 24-hour recall, grains, roots, and tubers are the main food groups used for complementary feeding, followed by fruits, vegetables, and dairy products. On the other hand, legumes and nuts are the least used food groups, followed by eggs and flesh foods.

While considering total household food consumption, most districts have the highest expenditure on edible oils, meat and poultry, and fish consumption. However, meat, poultry, and fish are among the food groups with the lowest quantity consumed as a percentage of total food consumption, along with eggs. While considering the quantity of different food groups, roots and tubers are most consumed, followed by the food group of sugars salt and packaged foods, cereals, vegetables, pulses and legumes, edible oils, and fruits. The least consumed groups are eggs, meat, milk, fish, and leafy vegetables. There is a significant difference in the order of food groups and high variation among districts between per capita expenditure and consumption quantity. The expenditure on roots and tubers, the highest quantity consumed food group, is in fifth place, but the smallest expenditure remains on eggs, the lowest quantity consumed food group.

Chapter 6. Village-level Health Systems and Nutrition Interventions in Assam; A Case Study of Dhubri District

6.1 Introduction

The main objective of this chapter is to understand the health system at the village level in Assam, with a specific focus on nutrition interventions. The chapter explores actors and institutions involved in nutrition interventions, the influence of governing and regulatory framework of the interventions, the influence of the social construct nature of the health system on nutrition intervention, the pathways through which nutrition-specific interventions reach women and children, and the micro, and meso-level factors influencing the coverage of selected nutrition interventions.

Recent developments in Health Policy and Systems Research (HPSR) focus on contextual factors and the social construct nature of Health Systems at different levels, from national to local, to reshape the systems to achieve public health targets. Many specific questions driven research have gathered evidence on pathways and linkages within health systems that influence and contribute to system functions related to public health, such as research on governance architecture, locus of decision making, factors contributing to access to health service delivery, values and norms influencing health system actors and their interpretation of interventions and policies and so on. However, research focusing exclusively on nutrition interventions with this alternative approach to health systems is limited. Information on the characteristics and functioning of health systems as a social construct at the local level, such as at the village and Gram Panchayat level, is also absent in the Indian context. Against this backdrop, this chapter which aims to gather knowledge on local health systems with a specific focus on nutrition interventions, becomes significant.

We also look at the policies, laws, regulations, and guidelines that govern nutrition interventions and how they are implemented and enforced in the village-level health system. A study of the social

construct nature of the health system seeks to explore how cultural beliefs, social norms, and other contextual factors shape the implementation and uptake of nutrition interventions. We also look at individual-level factors, such as knowledge, attitudes, and practices, as well as organizational and policy-level factors, such as resource availability, institutional capacity, and political will, that may affect the coverage of nutrition at the village level. At first a landscape of actors and institutions involved in implementing nutrition interventions at the village level in the study area is presented, followed by a discussion of the themes that emerged from qualitative data analysis. The last section analyses the interlinkages and overarching themes and summarises the chapter.

6.2 Actors and Institutions

The following layout (Figure 12) is conceptualised using policy documents and existing literature. Accredited Social Health Activists (ASHAs), Auxiliary Nurse Midwife (ANMs), and Anganwadi Workers (AWWs) are the first contacts of the beneficiaries to the formal nutrition intervention landscape. ANMs and ASHAs work in coordination with each other, and their activities are coordinated at the sub-PHC/ Family Health Centre (FHC) level, PHC level, and also at the Anganwadi Centre (AWC) level. Elected Representatives (ERs) at the ward level also play a crucial role at the frontline as the connection between the PRI at the Gram Panchayat level and as a member of Anganwadi Level Monitoring and Support Committees (ALMSCs).

Figure 13 shows the structure of ALMSCs. Peer group members (pregnant and lactating women) and selected community members (science teachers, retired government officers, community leaders, and representatives from community organisations) are also part of ALMSC which discusses issues at the Anganwadi level. Figure 14 shows the Village Health Sanitation and Nutrition Committees (VHSNCs) structure. VHSNCs comprise members of ALMSCs, Village Sarpanch, ICDS-Supervisor, Village secretary, and representatives from Community-Based Organisations (CBOs). National Health Mission (NHM) uses up to 5 percent of its budget in each

state to support NGOs in various activities such as training, evaluations, and filling service delivery gaps. Representatives from these NGOs in each relevant setting are also part of the VHSNCs. Their position and role vary and cannot be accommodated in a general layout diagram.

Figure 12 Layout of Formal System of Intervention at the Village Level

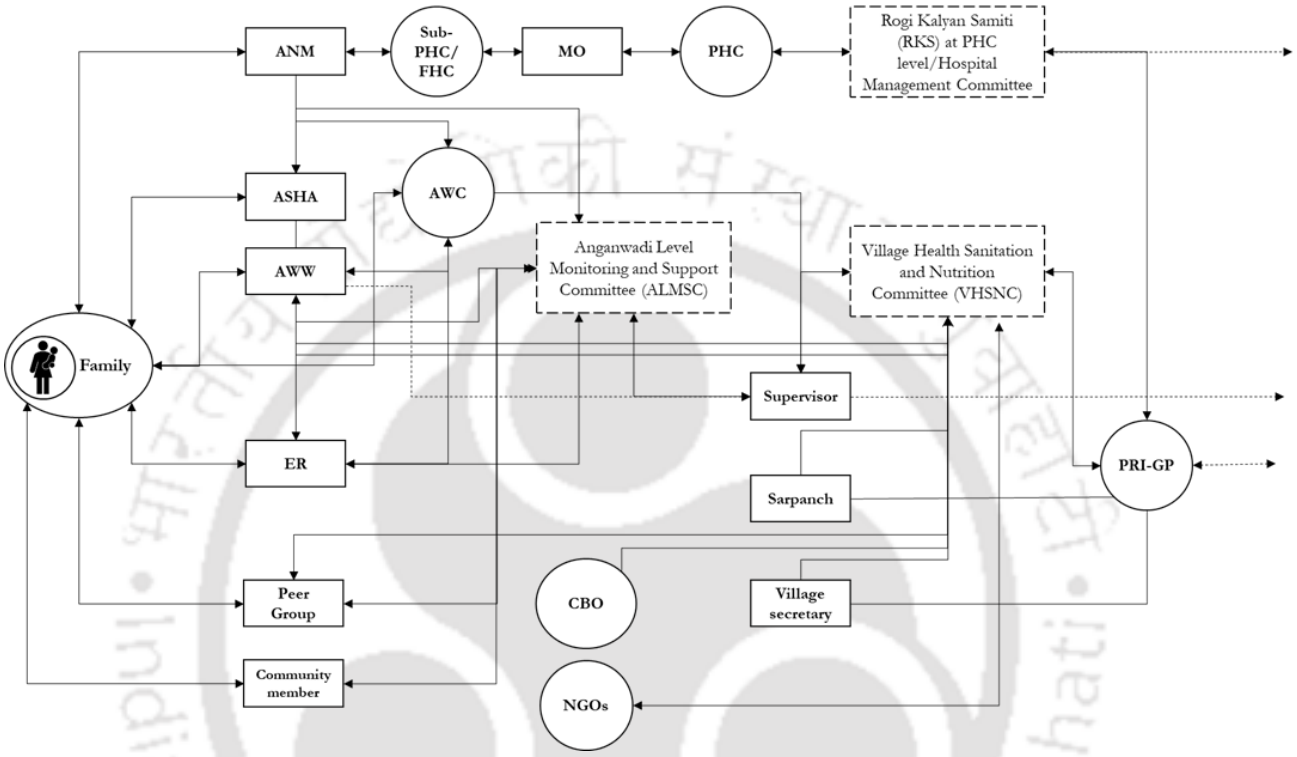


Figure 13 Layout of Anganwadi Level Monitoring and Support Committee (ALMSCs)

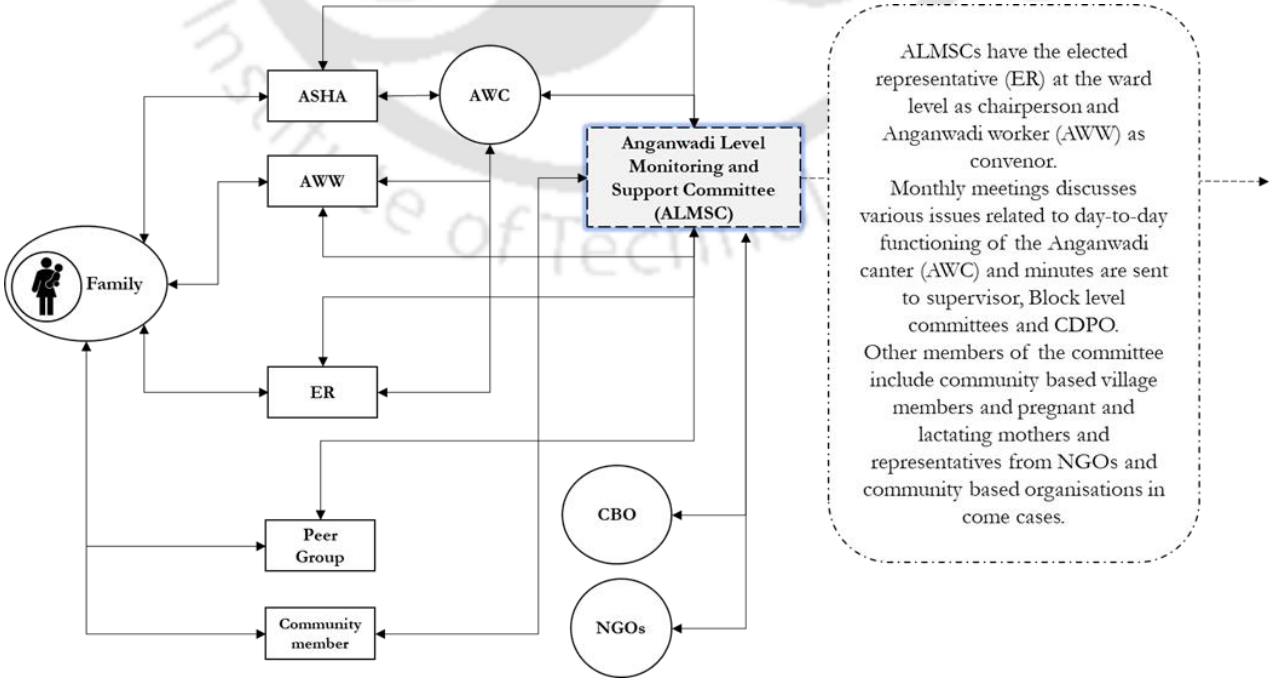
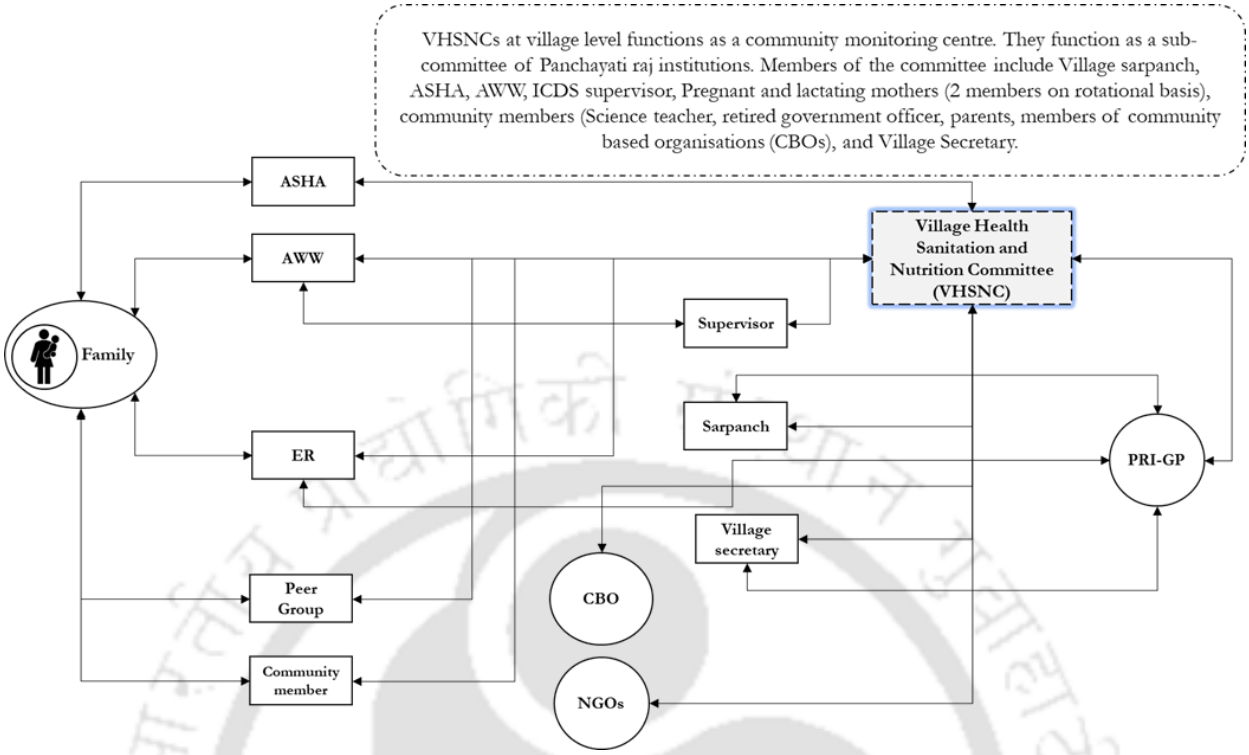


Figure 14 Layout of Village Health Sanitation and Nutrition Committees (VHSNCs)



ALMSCs and VHSNCs are crucial in implementing nutrition interventions and function as nodes of interconnections. The qualitative data revealed a more complex layout with more actors, linkages and interconnections.

6.3 Themes from Qualitative Data Analysis

6.3.1 Frontline Workers

6.3.1.1 Involvement of family members of frontline workers in interventions

The participation of children and spouses of the workers is active in service-delivery. The relationship of frontline families with the community is also influenced by the interventions. The transportation and delivery of goods are where family members are primarily involved. In this context, husbands often interact with the community and serve as the primary contact point.

> *"My husband goes and collects the goods most of the time, or else, both of us go together. If my son is there, he comes sometimes. . . he also helps with the phone most of the time."* (AWW)

*". . . they call him only. He (husband) knows more than I do. So, I ask him to deal with most things. He also knows how to deal with an issue. In meetings also, he accompanies me." (*AWW)

*". . . my son, daughter, everyone in the family is involved actually. I keep asking them for some kind of help. Sometimes they say no, but I have to keep asking, there is no other way." (*AWW)

In one case, the son of a deceased Anganwadi helper continues to assist in running the AWC without any payment because the community assumes it is his responsibility.

"It is the right thing to do, right? I only suggested he help with the work until we get another helper. There is so much work, so the AWW cannot do everything alone. It is his duty to his mother and the community. He also finds satisfaction in doing this work. It is like a prayer to his mother." (Elected representative, AMC member)

6.3.1.2 Challenges at the family level of frontline workers

The workers also feel that their children do not receive enough attention and time, creating conflicts within their families. Furthermore, some workers realize their child's nutrition levels are low. The low salary adds to family issues, and in some cases, workers have to lock their children at home to attend work, causing conflicts. Consequently, some children are sent to hostels.

"I have a daughter who is currently 8 years and 6 months old, but I have not been able to give her enough attention to her studies due to my busy schedule. Additionally, my house is far from my workplace, making it difficult to balance my responsibilities. Furthermore, my husband has begun to complain about my low salary despite the amount of work I am doing." (AWW)

"Although I may not be able to give my family enough time, it is important that I provide them with necessary things such as food, right? While I ensure that other children have a nutritious diet, my child's nutrition levels are low." (AWW)

"I have only one daughter; my husband passed away three years ago. I go to work, leaving my daughter at home. She often has to eat cold food and sometimes gets emotional. As no one else is at home, I lock her inside, scared for her safety. Even then, she scored 85% in her exams. I had to send her to a hostel. It is not easy to keep her with me as it affects my work, but I have to fulfil my duties. My daughter understands that I work for social welfare and is proud of me, but she is malnourished and cries a lot. People often compliment her, saying she is good and has learned from her mother. I believe that it is not necessary to become a doctor or engineer; one should only strive to be a good person." (Supervisor)

6.3.1.3 Delays in salary payment

Anganwadi workers face considerable delays in salary payments. However, AWWs continue their work, hoping to receive their salary payments at once. Also, they perceive delays as a part of the government's bureaucratic procedures and are willing to wait patiently. The hope of better opportunities also keeps them motivated. They believe that their work experience and skills will open up new opportunities for them in the future, such as a supervisor post.

> *"I have not received my salary for the last six months. When it comes, it comes together but even then, not for all the pending months. It is the same everywhere. We keep discussing it among ourselves (other AWWs), and everyone has the same issue. Supervisor says it is a delay with the higher authorities."* (AWW)

> *"I believe my salary will increase, allowing me to support my family better. I have been working hard since 2007, and if people become more cooperative, I can guide them well. My ultimate wish is for my family to be well cared for while doing the work I love."* (AWW)

Some Anganwadi workers feel that more than the money they receive, they value the pleasure and satisfaction they derive from watching children play and catering to the community's needs. They view their work as a responsibility and are willing to make personal sacrifices.

> *"I feel good watching boys and girls play. I missed them a lot during the lockdown. That is why I do this work in the first place, right? Is it for money? What money do we receive? I must be spending more than what I receive for working here. I work because of the nature of work."* (AWW)

6.3.1.4 Work burden on frontline health workers

The frontline health workers provide a wide range of services under different departments and schemes. Every new scheme envisaged requires the frontline workers to play a role, causing an ever-increasing list of tasks that need to be carried out with limited resources and time.

> *"The challenge I face is that I have to do the work of two to three different departments. It is very difficult to manage all these responsibilities. I have to do the work of BLOs, ICDS, and also Poshan Tracker."* (AWW)

"Are we machines? These workers are not machines. They receive orders from different departments and are expected to carry out various tasks. For instance, the department might instruct them to carry out a particular task, and the BLO might tell them to send something in the morning. The workers may also be asked to attend a meeting in Salmara in two days. Ten workers are needed to complete the work. Here, one worker is a part of so many departments. They work in the ICDS office, which is their primary responsibility. They are also attached to the BLO, and they must also work for the Poshan Abhiyan department. Additionally, they need to attend the CDPO's office and complete tasks assigned by the DSW. Before they finish one task, another call comes in for vaccine duty from the Asha or ANM. The problem is that one person, in a single day, may be asked to work for four different departments." (AWW)

They often work long hours, which may include travelling long distances on foot or by other means of transportation. Their duties include providing maternal and child health care services, such as antenatal and postnatal care, delivery services, and newborn care. They also provide immunization services, administering vaccines and monitoring vaccination coverage, family planning services, counselling on contraception methods and providing access to contraceptive products. They also play a crucial role in disease prevention and control, identifying and treating communicable and non-communicable diseases, and providing health education and promotion. They provide health promotion and education services and information on hygiene, nutrition, and lifestyle practices promoting good health.

Additionally, they provide referral and follow-up services, referring patients to higher-level health facilities when necessary and monitoring their health status. Additionally, they are expected to provide monitoring and reporting services, collect and reporting health data, and conduct surveillance activities to monitor disease outbreaks. ASHAs are imposed with more than 70 duties to perform for a nominal amount as incentives. During the COVID-19 pandemic, frontline health workers in India also provided critical response services, including contact tracing, testing, and vaccination services.

A lack of coordination among departments in assigning tasks to frontline workers is adding to the challenges faced by the workers. There lacks a clear demarcation of duties and responsibilities, causing confusion and conflicts.

> *"There are random requests from the office to do something. They say you do it with AWW, you go with this person or someone else but get us this report by tomorrow. Every month there is a new duty, during covid there was so much work. Nobody understands the kind of work we do and the number of tasks we have"* (ASHA)

Even the supervisors are burdened with work they cannot finish within the stipulated time.

> *"We work for 25 days a month, with Sundays off. If there are no other holidays, we have to work every day. We have to be in the office two days a week, which accounts for 8-9 days a month. The rest of the time, around 15 days, we are required to be on the field, but that is not enough as there is a need for five supervisors, whereas currently, there are only two. This means that only two supervisors are managing 136 centres. Even if we visit one centre every day, it will take more than 40 days."* (Supervisor)

6.3.1.5 Evolution and Growth of Frontline Workers

There are instances where Anganwadi Helpers continue their education while at the job and become Anganwadi Workers. Some supervisors were Anganwadi Workers and then later promoted to their current position. The frontline workers cite their passion for the job, the satisfaction derived from the work, and the respect they gain in the community as reasons for sticking to the job despite its hardships and also for trying to move up the hierarchy.

> *"I was a helper till 2009; then I became a worker. . . I finished my 10th standard while working as a helper only. I like the work and interacting with the kids and their mothers. They also give love and respect to me. I feel good."* (AWW)

Workers who were initially not fond of the nature of work also evolved to like the work and appreciate it. In that sense, they overcome their conditioning.

> *"To be honest, I had always wanted to become a teacher, but somehow ended up in this department. At first, I did not feel great about it, and when interacting with poor people in villages, I started to feel a sense of disgust. Later on, when I became a mother, I realized the potential of this department and how much*

we can accomplish if we are willing. With the right mindset, we can achieve significant developments." (Supervisor)

6.3.1.6 Shortage of frontline workers adds to the work burden

The absence or lack of frontline health workers, such as helpers and ANMs, has significant implications for the workload of other available workers, particularly Anganwadi workers (AWWs). With the shortage of helpers, AWWs often have to perform additional tasks such as cooking, cleaning, and maintaining the AWCs. The lack of ASHAs and ANMs responsible for providing critical maternal and child health services puts additional pressure on AWWs to deliver these services, despite their limited training and expertise.

> *"There is no ASHA in this area. We never had one. I do not know why, maybe because this is like an island, and there is no connectivity that no one wants to work here. I am only keeping track of everything. For delivery-related work also, I am managing everything from transportation to arranging money. However, most of them are home delivery only. It is impossible to reach the hospital from here once the pain starts."* (AWW)

6.3.1.7 Accountability

When the AWW or ASHA reports something to the higher authority, there is a need for feedback and updates back to the AWW. Unfortunately, in most cases, the officials do not provide the necessary feedback, leading to frustration and mistrust. When officials visit the AWCs, they often take pictures and promise to act on the issues the AWW highlighted. However, when these promises do not materialise, the frontline workers are again put in a difficult spot, as they have to answer to the community. The lack of feedback and updates from higher officials can also lead to assumptions of corruption, malpractice, and indifference.

> *". . . they say click pictures and send, or they will come and click pictures and go, but nothing happens after that. I keep requesting and giving reports. Once the contractor came and clicked pictures and went. Then when I asked CDPO mam she asks, 'hasn't the contractor come?' Yes, he came and clicked pictures, and now the centre is repaired. (jokingly)" (*AWW)

"These days I cannot ask parents to come for meetings or something like that; they are tired of coming, waiting, and listening to the same thing. Every time someone comes, they promise many things. Now you have come and are asking so many questions, but what use? It is difficult for me to convince the people" (AWW)

6.3.2 Geographical and Seasonal Influences

6.3.2.1 Seasonal nature of service delivery

The influence of season is a critical factor that impacts nutrition interventions. During the monsoon and flood seasons, the interventions are often interrupted, significantly impacting the beneficiaries and frontline workers. Additional resources, such as boat rent and fuel, are required to support the functioning of the interventions. However, these resources may not always be available, leading to a disruption in services. During the dry seasons, strong winds gush away the tin roofs of the AWCs. The repair work required is not done on time, disrupting the services provided to the beneficiaries. During the flood season, however, additional services and information are given to the beneficiaries out of the frontline workers' goodwill and due to the demand from the beneficiaries.

"This year's flood has completely destroyed the AWC. The floor is ruined, and there are big holes. Kids run around and hurt their legs. So, mothers are not sending them here anymore. . . while coming, you saw the river, right? But that was not the river, it was somewhere else, the river took away land and reached till here. Many centres fell under the river" (Elected representative)

". . . during the dry season, there will be strong winds gushing this month, and it will come to a point where the houses will be destroyed, and this house will be uprooted. Last time it happened, it was blown away, and I clicked a picture and sent it to the supervisor and the department. The tins were in the paddy field in that condition. We submitted the report, but still, nothing came. So, we managed some funds through AMC and procured it." (AWW)

6.3.2.2 Geographical influences

The effective delivery of services is influenced by various geographical factors that are often ignored while planning and implementing the program. One significant factor is the location of

the AWC. For example, a railway line near AWC makes it difficult for children from the other side of the track to come to the AWC and for the AWW to visit houses on the other side.

> *". . you can see this railway track, right? There is no opening for one kilometre, so we have to go under the fencing, across the track to drop the kid at the centre. There is no toilet in the centre, so whenever the child has to use it the worker calls me and I have to go pick her back to home. It is not like one mother can go and bring all the kids, so all mothers have to go"* (Beneficiary)

Another important geographical factor that impacts the delivery of ICDS services is the changing geography of flood-prone areas. In such areas, rivers shift and change their course, taking away land and infrastructure, including AWCs. This creates a significant challenge for investing in infrastructure for the AWCs, and the service delivery is severely affected in such areas. The shifting river course result in the displacement of communities, making it challenging to reach out to them.

> *"There are 13 houses in this habitation, and to reach the centre, one must cross the river, which is impossible to cross during the rainy season. Moreover, the riverbank in this area is eroding, making it difficult to move from one house to another, and it poses a risk to the children who need to come to the centre. The speed of the water in the river is quite fast, which makes it necessary for parents to carry their children in their embrace while crossing the river."* (AMC member, beneficiary)

6.3.3 Issue Related to Connectivity

6.3.3.1 Delivery of Goods

Delivery of goods is a crucial aspect of nutrition interventions. The challenges in this aspect arise mainly because many of the AWCs are located in remote, poorly connected, and flood-affected areas, making timely delivery of goods difficult. Additionally, the current approach to delivering goods to these AWCs utilizes a one-size-fits-all method, which is ineffective and fails to capture hidden costs and time needed for delivery. There is a need to develop customized approaches that are more efficient and effective for each AWC.

> *"To bring the materials to the centre, first I have to take a bike to the ghat, take a boat, and then take a rikshaw and then again a boat to reach the office. Only a small amount is given for transportation, like*

80 rupees or so. I spent at least 600 to bring it here. Many workers face the same problem. So, for small things we can't go because the cost is higher than the value of the goods itself" (AWW)

At the same time, the absence of a standardized approach to delivering goods to the AWCs results in an ad hoc approach in which Anganwadi workers, their families, and community members devise unique methods for delivering the goods. This approach is unsustainable and necessitates a more systematic approach.

"There is no single mechanism. They inform from office when the goods come, and we have to somehow get it to the centre. Whoever can help helps. Most of the time AWW only goes with her husband or son. Once, I also went. Sometimes we pool in money for rikshaw and arrange the driver to get the goods to the centre." (AMC member)

6.3.4 Travel Cost and Time

The lack of road connectivity is a significant challenge that affects the work of Anganwadi workers (AWWs) and supervisors' visits. The challenges increase particularly during the monsoon season. In some cases, the costs associated with reaching the AWC consume a considerable portion of the worker's salary. Even in cases where the distance is relatively short, the need to cross the river multiple times causes a financial burden on the workers. Similar challenges also affect the work of supervisors and Asha workers.

"Visiting houses are not easy in this area. The entire area gets flooded and I have to walk longer roots through higher grounds and cross streams. Sometimes I have to take boats. Even when the flood water recedes the slit makes it hard for us to walk. But we get the same financial incentives only even if we have to work double" (ASHA)

"My salary alone is not enough to support my family, and I also have to spend 6,000 per month on ferry fares to cross the river. . . I leave home in the morning, and the whole day passes by just like that. By the time I return home after crossing the river, it's already 3 pm. The river crossing alone takes almost an hour, and if I miss one boat, I have to wait for another hour to catch the next one." (AWW)

6.3.5 Distribution of Vaccines, Ration and other Goods

6.3.5.1 Gaps in immunization supply

There are gaps in the supply of vaccines to AWCs, resulting in children missing out on immunization. One common observation is that vaccines fail to reach AWCs for unknown reasons. The AWWs said they often do not receive the required supply of vaccines on time, leaving them to deal disappointment and frustration of parents who have brought their children to the AWC for vaccinations. The AWWs may be blamed for the lack of vaccines, even though they have no control over the supply chain. ANMs responsible for distributing vaccines to AWCs also do not receive the required supply of vaccines from the higher-level health facilities on time though the AWWs often blame them for the vaccine shortage and delay.

> *"One of the problems I am facing is that the ANM (Auxiliary Nurse Midwife) doesn't administer vaccines at my centre. Although my centre is quite large, the ANM only provides vaccinations at the sub-centre located in the Senibari area. I have made numerous attempts to bring the vaccines to my centre, but I have been informed that the beneficiaries need to be brought to Senabari instead. However, when I did so on one occasion, there were not enough vaccines available, and I had to face the beneficiaries' questions"* (AWW)

6.3.5.2 Inadequate allocation of ration and other goods

The distribution of rations and other goods emerged as the most significant issue leading to conflicts between frontline workers and the community. This has had a negative impact on trust between the two parties, as beneficiaries have reported a lack of transparency in the distribution process, while workers have cited a lack of consistency in the arrival of goods as the root of the issue. Families of frontline workers are also involved in distribution activities, creating additional complications. The COVID-19 pandemic has further compounded the distribution challenges since the pandemic demanded doorstep deliveries of rations. Inadequate and partial distribution intensifies tensions.

"When the ration comes, it comes for four to five months and then it stops for the next four or five months. Same with my salary also. I haven't got paid in the last three years. Many people think it is because I am not putting effort that the ration is not coming. But I do everything I can. It is the same with many centres. Only in main centres with many children, they give ration in time" – AWW

"The ration that we receive is not enough for our children. We have around 80 children, but the ration that comes is only enough for around 30-40 children. While some centres receive less, others receive more, and sometimes the ration is distributed equally despite the number of children. Ideally, it should be distributed according to the number of children in each centre, but unfortunately, the rations are insufficient for all the students." (Elected representative)

According to the supervisors, distribution is being carried out according to the number of beneficiaries, so it is adequate if the AWW provides the correct information about beneficiaries.

"There is no shortage of ration. Ration comes according to the number of beneficiaries. For children under 3 this much ration is allotted, for children above 3 this much money is allotted to procure materials and distribute, for pregnant ladies this much. It is all according to rules. So how can there be shortage if the number is given correctly?" (Supervisor)

6.3.5.3 Inadequate allocation of additional ration for malnourished children

Another aspect of the ration distribution system concerns the allocation of rations to malnourished children. According to Anganwadi Workers (AWWs), whenever they report a malnourished child to the department, only the ration for the malnourished child is increased, while the total ration for the AWC is not. As a result, workers must take from the rations of other children to provide for the malnourished child, which has led to further discord.

"If child is underweight, they ask us to give the child 120 grams of Sattu instead of 100 grams. But they don't increase the total allocation for the AWC. It means I have to take it from another children's ration, right? Otherwise I will run out of the ration faster than usual and again the blame will be on me" (AWW)

6.3.5.4 Delays in payment

Delays in payments for the procurement of goods have created several issues at the AWC. This delay makes it difficult for the AWW to procure goods necessary for the ICDS program, such as

food supplies, cooking equipment, and educational materials. As instructed by their supervisors, Anganwadi workers have had to borrow materials from nearby shops to keep the meal distribution going. However, when payment delays happened, the workers could not repay the borrowed amounts in time, leading to strained relationships with the shop owners. The shops stopped providing materials to the workers. A coupon system was in place for some periods where the AWW could procure materials using coupons distributed to them, and the shop owners were reimbursed against the coupons. Delays in payments towards the coupons also made shop owners reluctant to accept them.

> *"The supervisors asked us to arrange ration from certain shops using coupons. But payment against these coupons also gets delayed a lot, and shop owners don't want to give items anymore. They accuse me of bringing inconvenience to them and causing monetary loss. So, I do not approach them anymore"* – AWW

6.3.5.5 Excess allocation of resources

In some instances, AWCs have reported receiving excess materials. This happens mainly at places where a disproportionate number of AWCs exist to the population they serve. In some areas, three AWCs exist instead of one, despite serving the same population. One Anganwadi worker from an AWC with excess materials reported that she distributed the extra materials among the poorest households in the area, using her discretion to determine who would receive them. While this approach may seem well-intentioned, it is not an equitable or systematic way of ensuring that those most in need receive the resources necessary for their well-being.

> *". . . they (beneficiaries) seem happy with the ration they receive, and there are no complaints from them. In fact, there are times when there is an excess of ration available. In such situations, the excess is distributed among the poorest people. This ensures that the ration is not wasted and instead goes to those who need it the most. . . there are three centres in close proximity, so the number of beneficiaries in each centre is relatively low."* (AWW)

6.3.5.6 Food items distributed and promoted

The distribution of food items is observed to be non-uniform and not always reflective of the most value-for-money or locally produced options. In most cases, AWW procures and distributes relatively expensive and non-locally produced fruits, such as apples and grapes, once or twice a year, while more nutritious and cheaper options which can be provided more often are not provided. Such an approach to procuring and distributing food items increases the scheme's cost, making it non-sustainable. Even during the celebration of Poshan month, expensive fruits and dry fruits are presented as more nutritious options without giving much focus to the locally available items.

> *". . . apple, dates, egg are all provided by baidaw (referring to AWW as elder sister) time to time. We know it is good for the baby. But it is very difficult to make them eat. They like biscuits. Also, we can't buy apple every day. We are farmers, how will we do that?"* (Beneficiary)

6.3.6 The Day-to-Day Functioning of AWCs

6.3.6.1 AWW's time away from the AWC

The functioning of AWCs is often hindered by the absence of Anganwadi workers, who are required to be away from the AWC for various purposes. This challenge is particularly pronounced in mini-AWCs where there are no helpers. Sometimes, community members or school teachers assist in caring for the children during the Anganwadi worker's absence. To address this issue, there is a need to explore alternative strategies that can mitigate the impact of the absence of Anganwadi workers. These strategies could include establishing a pool of trained helpers who can take over in the worker's absence and identifying community volunteers who can provide support.

> *"In addition to the helper, my neighbours also lend a helping hand. They assist me by looking after the boys and girls at the centre whenever I am unable to be present there. I inform them of my inability to stay at the centre, and they kindly offer to help me out."* (AWW)

6.3.6.2 Lack of materials and equipment

The AWCs face various operational challenges due to insufficient materials and equipment. The delays in providing copies of books have resulted in some workers creating copies independently based on the ones provided. They often resort to erasing and rewriting of the records. Additionally, there is a lack of sufficient growth charts, which are being replaced with photocopies made by the AWW.

> *"One of our major problems is the department copies. The department gave me one in 2015 and another in 2019. For conducting surveys, I need three copies, but I have to make two of them myself. One copy holds 100 houses, and I have 235 houses, so I need three copies. I also need a survey copy and a measuring copy. In 2015, they gave us only 11 copies, and since then, they haven't given us a single copy. I have to update the copy I have every year. I also didn't receive the MPR. I had to make a copy of the previous year's MPR and work with that. Additionally, I need a growth chart, and one page is required for each kid for one year, which means five pages for one child. They only gave us the chart in 2015, and I haven't received a new one since. I have been facing difficulties doing this work"* (AWW)

> *"Yes, the centre needs many essential things. We didn't receive tables, chairs, and other necessary items. I complained about it, but nothing has been done. I have talked to the CDPO as well, but still, nothing has happened. I told them that we cannot keep using the same copies for years. We can only do it once on one page, and for five or six years, how can we use the same copy?* (AMC member, Elected Representative)

6.3.6.3 Data uploads to MIS

The mobile phones given to Anganwadi workers for data updates are problematic since a stable internet connection is necessary. An unstable internet connection causes data loss, causing the AWW to upload the data multiple times, leading to time loss. The requirement of OTP for Poshan-related work adds to the issues in areas without network, leading to further time loss. The process is made cumbersome by issues such as phone hang-ups and server downtimes. Borrowing phones and sharing weighing machines are standard practices among frontline workers to measure and track the anthropometric details of children and upload them.

"The phone that was given to me is in bad condition, and the net doesn't stay. The SIM that was given to me also has some issue. . . It's very challenging because I have to do one work 4-5 times due to the poor network connection." (AWW)

6.3.6.4 Engagement for the children

AWWs find keeping children engaged during Anganwadi sessions a challenging task. Many AWCs have limited space, which restricts the movement of children and limits the scope of activities that can be done. Children are naturally playful and curious and find sitting in one place for a long time difficult. The equipment and toys in AWCs are not always stimulating or engaging enough for the children. In some cases, children have exposure to digital media like YouTube and mobile games; for such children, the demands for entertainment and learning are different and higher due to their exposure to such media.

"How we learnt twinkle twinkle little stars is not how the children knows it. They watch it in YouTube in a different way and they want to listen to that only. They come and ask me to play videos on mobile phone. (AWW)

6.3.7 Infrastructure

6.3.7.1 AWC buildings

The absence of buildings for AWCs has emerged as a pressing issue from the interviews. In many cases, AWWs are forced to use their own homes as AWCs. This led to an additional burden on the worker's family and trust issues with the community regarding the use of resources. Neighbouring houses are sometimes used for cooking, as gas connections are given without proper housing or access to water. The lack of walls, washroom facilities, and ventilation also limits the functioning of the AWCs, often resulting in children being sent back home.

"Most of the centres don't have a building. So, the centres are run from the AWWs house only, sometimes from the courtyard. Also, there is no latrine facility. So, if a kid needs to use the toilet I call their mother and she has to come and take them home. Many parents think that it is useless to send the children to the centres" – AWW

There are also issues with the construction and planning of AWCs, with some AWCs being constructed on flood-prone land and others lacking doors, windows, and proper walls. Fans are not provided for use in the summer months, and most AWCs lack proper ventilation. The lack of proper housing often results in materials being stolen or destroyed. AWWs are forced to carry important documents with them, which is observed to create mistrust in the community.

> *"The situation in the centre is such that I cannot keep many things here, such as chairs and tables. Even carpets cannot be left here because the house is in a state of disrepair and kids who play nearby enter the building and destroy everything. I can't keep the documents also here. It is difficult for me to bring them home from such a far distance also."* (AWW)

6.3.7.2 Maintenance

Maintenance of AWCs is delayed. The role played by contractors in charge of the maintenance of AWCs also came up as a recurring theme. Reports of needed repairs or maintenance must pass through multiple channels, including the AWW, supervisor, CDPO, and DSWO, before reaching the contractor, who further delays repairs, according to the AWW and supervisors. In some instances, local governments have repaired AWCs. There are also instances where school classrooms have been used when the AWCs start to leak during rainy weather.

> *"The current condition of the anganwadi centres is poor. Out of 76 centres, most of them are damaged. This year, only 6 centres have been repaired. We have repeatedly complained to the CDPO about the incomplete work, and they regularly take damage reports from our side. . .I explain that I have complained to the officers, but it is ultimately up to them whether they take action or not. People understand that I am not responsible for undone work."* (Supervisor)

6.3.7.3 Lack of harmonisation in the allotment of resources

There is also a lack of harmonisation in the allotment of resources for the infrastructure development of AWCs. For example, funds for water and sanitation facilities are allotted to AWCs functioning in rented buildings making the funds unusable. In some other cases, funds for building AWC are allotted without allotting funds for procuring the land needed for the building. There is

a need for better planning and construction of AWCs, taking into account the needs of the AWWs and the community. Mechanisms for faster and more efficient maintenance and repairs should also be implemented.

> *"The government has allotted water connection and gas connection, but we can't use it since there is no building for the AWC. This is a rented building and the owner doesn't want to install the water tank. So, he is opposing."* (AMC member, Elected Representative)

> *"They have allotted money for the building but not for the land. Also, the land is expensive here, nobody will give up their land for free. So the money is stuck. The centre next to this also face the same challenge. They are allotted money to buy the land but it is too less to buy land here."* (AWW)

6.3.7.4 Inclusiveness

Even the AWCs with proper buildings lack basic infrastructure, such as ramps for wheelchairs, making it difficult for PwDs to access the services provided by the AWCs. The provision of ramps, handrails, and accessible toilets is not given in AWCs. ICDS workers and helpers are also not trained in disability sensitivity and awareness to ensure that PwDs are treated respectfully and provided with appropriate support.

> *"At present, our centre is not designed scientifically. It lacks a ramp for handicap children, which is necessary for their movement. We often need to lift their wheelchairs and hold their hands and legs to bring them to the centre, which is not an ideal situation."* (AWW)

6.3.7.5 Child friendliness of AWCs

It is observed that AWCs are not designed child-friendly, which affects the quality of services provided. AWCs need to be designed with child-friendly infrastructure to create a stimulating and engaging environment for children.

> *". . . the newly constructed centres are very beautiful, I have seen. They have printed the walls with pictures and alphabets. Also, the scales for measuring heights. Children would want to attend those centres because they are attractive and goes with child's nature. Here I don't even have walls. I can't even let the children play outside because there is a road nearby and I might not be able to keep an eye on all the children at once. The location isn't safe for children"* (AWW)

6.3.8 Community Participation

6.3.8.1 Varying perceptions about AWC

AWCs are perceived differently by individuals depending on their needs and expectations. For some, AWCs are perceived as educational institutions, as they provide preschool education to children and teach them how to behave in society. For others, AWCs are seen as a ration distribution centres, as they distribute food and supplements to mothers and children in the community. AWCs are also perceived as a daycare centres, where mothers can leave their children while they go to work. AWCs are also seen as a government office, where the community can approach government officials and seek assistance on various issues. AWCs serve as a point of contact for ASHAs and the health system, where they can refer patients and provide essential health services. Moreover, AWCs are the face of the government in the community in many instances, and as such, they are seen as government representatives.

6.3.8.2 Undesirable outcomes of community participation

There are some undesirable outcomes of community participation that we came across during the study; in many cases, AWWs face pressure from the AMC to prioritize education over maternal and child health intervention. This is an example of community perceptions and beliefs can influence the delivery of health services.

> *"At times the committee members pressurise me to teach the children more. They say the children are not able to say the letters, etc. They want me to sit in the AWC all the time and teach the children like a tuition teacher. But for ICDS scheme, education is only secondary, the primary focus is one nutrition and health."* (AWW)

This pressure comes from the perception among some community members that the Anganwadi is primarily an educational institution and also them realising the importance of education for the social upliftment of their children.

> *". . . first of all, we need more educational activities, we need development in this char areas. Before only five people were there in this village who could read, now there are 50-60. Now the kids can learn alphabets in Anganwadi. We didn't have that. Maybe in town you had that. I know there is health department also associated with the AWC but the main focus should be in studies."* (AMC member, Elected Representative)

AWWs being held accountable by the community for issues beyond their control, such as infrastructure maintenance and system delays, is a common challenge faced by health workers. Sometimes, money has even been taken from AWWs' salaries for infrastructure maintenance. In some instances, the community members forced AWW to build an AWC on her own land.

> *". . . we complained many times but nothing happened. You see, the children come to the centre in the morning. We can't make they sit outside under the sun and rain, right? So, we took some money from the worker and built the house. This house is sanctioned by the worker. The land is also hers. We (committee) pressurised her for that as we can't teach the children outside."* (AMC member, Elected Representative)

6.3.8.3 Anganwadi Management Committee

The committee size varies from 3 to 13. In most cases, mothers from the community are members who attend AMC meetings the least. The committee members have taken the initiative to support the Anganwadi Workers (AWWs), including providing space and transportation.

> *"We have a committee of 10 members who help us. While I cannot speak for other centres, in my centre, you have seen how our community people are helping. We have helpers and workers who ensure that the kids arrive at the centre on time and receive the education they need."* (AMC member, Elected representative)

> *"When we encounter problems at the centre, we inform the committee. Their responsibility is to ensure that the centre is managed properly, the classes are held regularly, and the government-provided food is good and sufficient. If there are any issues, we inform the committee who then informs the workers that the centre is not running well. When the food arrives or the committee visits, they conduct a meeting and inform the beneficiaries of any decisions made during the meeting."* (Beneficiary)

The committee also instructs the AWWs and intervenes if the work is deemed unsatisfactory or the AWC is not functioning correctly. Additionally, the committee is present while distributing ration and other goods.

The presence of the Anganwadi Management Committee (AMC) members' children attending the AWC has been identified as a positive factor contributing to their sense of responsibility towards the AWC.

> *". . . they (committee members) are very active. They come for everything and help us. They even repaired the road leading to the centre through panchayat. They have their own children studying here, so why not?"* (ASHA)

One observation is that in some instances, AMCs are involved only in accounting and financial matters related to the AWC. Their role is limited to financial checks, and community participation and initiatives are often ignored.

Some committee members sometimes join frontline workers in creating awareness for pregnant women. However, they may speak out of their knowledge, and traditional non-scientific information may get passed along, which leads to misinformation. The power dynamics within the committee limit the AWW or ASHA from interfering or correcting the committee member. This highlights the need for awareness creation and training for committee members on the importance of evidence-based information and scientific knowledge.

> *"They (committee members) help in distribution of the goods and sometimes awareness creation. They come for mothers' meetings and help in taking class for them but sometimes they also don't know what to say, we have training but they don't. . . he started saying pregnant ladies should not eat too much meat and egg, the supervisor was also there so she later said pregnant ladies can eat meat and eggs and that it is just a misconception that should not. If supervisor was not there then I couldn't have said anything"* (AWW)

6.3.8.4 Role of local governments

The role of local governments in their implementation and functioning has been observed to be minimal. The local government's contribution is primarily limited to repairing the AWCs in some

cases. However, even with such limited involvement, the repair work takes longer than the department route.

> *"I think only one out of the six centres were repaired by the panchayat. Rest was done by the department only. Panchayat takes more time than the department. . . the member attends the meeting but other than that not much help. It is actually not their duty."* (Supervisor)

> *"For this centre we are planning to make a building soon. I have spoken to the panchayat president about this and they have agreed. But we also don't have many funds. We can buy some books and toys but not more than that. It is actually the worker and the department who should do everything else. We are here to make sure it is working."* (AMC member, Elected Representative)

6.3.8.5 Additional resource mobilisation

The Anganwadi Workers (AWWs) and Anganwadi Management Committee (AMC) have demonstrated the ability to mobilize additional resources to support the AWCs through community participation. This includes contributions towards constructing AWC buildings, installing fences and pillars, and other related activities. These contributions take the form of both monetary donations and labour sharing.

> *". . . the society have done more. They put the pillars up, they put the bamboo, they put the fencing also for the centre. It took weeks but every Sunday they have come together and did all these. Even now also they help me with the work every day. Cooking, looking after the children, and cleaning."* (AWW)

6.3.8.6 Participation

The platforms for community participation disproportionately represent mothers from comparatively well-off families than those working in the fields and going for other manual labour. These limitations include factors such as meeting times, location, and accessibility. This lack of participation limits their ability to voice concerns and contribute to decision-making.

> *". . . yes, they call us for meetings but I can't go. I go to the field early in the morning and come in the evening. If I don't go then everything is doomed, so I have to go to the field. Other mothers go to the meeting and they complain that I don't go despite being a member. How can I go? . . . they can go because they don't have to work. Both their husbands are salaried. They aren't poor."* (Beneficiary)

6.3.9 Challenges at the Policy Level

6.3.9.1 Improper categorization of AWCs

The categorization of AWCs into mini and full centres has been identified as an issue affecting these AWCs' functioning. This is because the categorization is often done in an improper manner, resulting in inconsistencies in the number of beneficiaries between AWCs. In many cases, mini-AWCs have as many beneficiaries as full AWCs, while in other cases, full AWCs have fewer beneficiaries than a mini AWCs. Furthermore, there have been instances where three AWCs exist in close proximity to each other, which can result in a duplication of efforts and resources. Additionally, there have been cases where one beneficiary is listed as being served by two different AWCs. Such inconsistencies in the categorization of AWCs and the associated allocation of resources can create confusion and inefficiencies in the delivery of services.

> *"I informed the department about the high population in our village and the need for 2-3 more centres. Currently, we only have one centre. The population in our village is 15,033, with 122 children in our immediate area."*
>
> *"Is the ration adequate?"*
>
> *"No, actually during the lockdown, we received dry food that needs to be distributed that was enough. But during other times we have severe shortage"* (AWW)

6.3.9.2 Absence of clear guidelines

The absence of clear guidelines and manuals is a common problem frontline workers face. This is partly because the tasks and responsibilities of these workers are constantly changing, and there is no standardized set of procedures to guide their work. Due to the absence of a list of the highest priority works, the workers struggle to prioritize their tasks, leading to inefficiencies and missed opportunities to provide essential services.

> *"We have a list of tasks to do, and documents to maintain, and we are trained on how to do that. But there are so many other works that needs to be done. The CDPO and Supervisor asks us to do it and we*

do it accordingly. There are no rules as such. Whatever they say we do. But even they don't say how exactly to do it, we just do it." (AWW)

"When I have doubts I ask other workers first, only if they don't know about it, I ask the supervisor. Even if she doesn't know she will ask higher authorities and let us know. I ask in the WhatsApp group. Most of the times the doubts are same so only one has to ask." (AWW)

Another issue faced by frontline workers is multiple reporting. ASHAs, for example, are part of multiple interventions by multiple departments and have to report to different people such as ICDS supervisors, Block Level Officer (BLO), Child Development Project Officer (CDPO), Poshan Abhiyan team, and the Department of Social Welfare (DSW) in addition to their usual line of reporting. This creates confusion, work burden and duplication of efforts.

The order-based approach to work is also a common practice among frontline workers. This means that they only perform tasks when given clear instructions or orders, leading to a hesitation to work without orders and instructions. This approach limits their initiative and application of learnings from experience.

"Whatever the higher authority say is urgent needs to be done first. Sometimes in the middle of something urgent, an even more important thing comes up, then we have to drop everything in the middle and do that. I have to manage everything. If while doing some data collection a call from pregnant lady's family comes then I have to give that priority." (ASHA)

6.3.9.3 Lack of feedback mechanisms from frontline workers

There is a lack of a feedback loop for continuous monitoring, evaluation, and refinement of program interventions based on the feedback received from front-line workers and beneficiaries. There are instances where AWWs observe gaps in the nutritional status of children from certain communities or working in specific industries but are not able to address these gaps effectively. For instance, in the following anecdote, AWW observes that children of brick factory workers have poor nutritional status, but due to a lack of effective outreach or specific interventions, these children do not receive adequate support.

"for children whose mothers work in brick factories, there is a gap in the services provided. It is possible to bridge this gap if the VHSND goes to the brick factory and provides the necessary vaccines, etc. They are clearly malnourished also. However, so far, nobody has taken the initiative to do so." (AWW)

In the absence of a feedback loop, the ICDS program may continue to operate based on assumptions and without adequate inputs from the ground. This can result in sub-optimal outcomes, where certain beneficiaries are left behind, and the program's overall effectiveness is compromised. Therefore, it is essential that the ICDS system establishes a feedback loop that allows for continuous monitoring, evaluation, and refinement of interventions based on the feedback received from front-line workers and beneficiaries.

6.3.10 Nutrition Surveillance and Monitoring

6.3.10.1 Anthropometric indicators

Monitoring children's anthropometric measures, such as height, weight, and MUAC, is crucial for nutrition monitoring and surveillance. Both height and weight information are required to know if the child is stunted, wasted, or underweight. However, in several instances, weighing children is not performed, and instead, only their height is measured to know if the child is stunted. This omission is mainly due to the unavailability of weighing machines. Height scales are provided, although this procedure could have been accomplished with a tape or wall measurement.

"The weight-taking machines that were provided are not working. How will I take the weight of the children? I borrow the machine from them because I have to measure the weight of the children. . . I have contacts with many other workers. I borrow machines from them, I tell them to work for three days, and I'll work for two days" (AWW)

"The weighing machine broke down many months back. I raised a request to the CDPO through Supervisor but no action is taken so far. So, I just measure the height of the children and report it. Even if I weigh the children regularly it won't make any difference." (AWW)

6.3.10.2 Mother and Child Protection (MCP) card

MCP card contains information about the mother's health status, the child's birth weight, immunization schedule, and other important health-related information. The card is used by health workers to track the health and development of mothers and children and to provide appropriate care and support. The MCP cards are often seen only as an identity document of the child needed for accessing government benefits rather than for monitoring the health and development of the mother and child. The cards are often kept with the AWWs or ASHAs, and not with the mothers.

6.3.11 Initiatives and Bypasses by Actors

Front-line workers sometimes utilize personal funds to fulfil specific needs or undertake initiatives to address certain requirements. There are instances where supervisors and Child Development Project Officers (CDPOs) contributed funds towards procuring doors, tiles, tin roofs, and other essentials for AWCs. There have been instances where Anganwadi Workers have dismantled storage room walls to provide adequate seating space for children, as they recognized that the storage room was unnecessary.

> *"There is a lot of help that comes from within the department. For example, the CDPO has contributed door for some centres. Supervisors have pooled in money to buy study materials for some centres which are really backward. We are doing everything step by step. Everyone wants to see good things happening in the society"* (Supervisor)

> *". . . there was a storeroom in the centre that took so much space. But I don't need a wall for the storeroom, and without that there will be more space for the children to sit. So I just brought it down. The shelves remain but the wall is gone."* (AWW)

6.3.12 Celebration of Poshan Month and VHSND

We observe that the celebration of Poshan day contributed to a narrow focus on specific food items, ignoring the importance of an affordable, diverse and balanced diet. Further, promoting good nutrition practices during the celebration does seem to not reach the vulnerable populations and those living in remote areas.

". . . maybe once in month we can give the child apples and oranges. We are poor, how will we give it every day?" (Beneficiary)

"Even if it is expensive, they(mothers) know it is beneficial for the child. We give everything, apple, dates, grapes, eggs, everything. . . yes papaya also but somethings are more nutritious." (AWW)

It also seems to have created unrealistic expectations among the public, which lead to disappointment and a lack of trust in the program as the sudden influx of resources and attention during celebrations do not continue throughout the year.

"What we get it sattu and rice few times a year from the centre, but at the meeting they advise us to eat all good food and feed the children also good food. It is not possible. It is easy not possible, things are very expensive. They should give us some oil also. Even the AWW agrees that we can't give children this type of food every day." (Beneficiary)

6.3.13 Role of NGOs

Involving locally based NGOs and Community-Based Organizations in interventions was aimed at supporting CHWs. However, there seems to be a need for streamlining and harmonising responsibilities. There were instances of a lack of a proper mechanism to facilitate NGO involvement, which undermined the efficiency of frontline functionaries.

"The NGO is supposed to distribute the ration to us. But they don't bring it to the centre. We have to go to their office and collect it. It is a long journey; I have to take a boat and then a tempo to reach there and come back. Who will pay for it? So, it takes time for me to arrange the money and take help from someone to carry the materials to the centre. Sometimes by the time I reach there the quality of the material deteriorates because of improper packing and storage. But everyone blames me only" -AWW

6.3.14 Coordination at the Grassroots

6.3.14.1 WhatsApp groups

WhatsApp has allowed ASHAs and AWWs to form groups and coordinate their activities. They use the app to share information and updates on patients. The app has made it easy for them to stay connected and work collaboratively, ensuring everyone is on the same page. ASHAs and AWWs have used WhatsApp to connect with beneficiaries also. They share their phone numbers

with patients or their family members, who can contact them directly if they need advice or assistance. This has been particularly helpful during the pandemic. AWWs have also used WhatsApp to provide nutrition counselling and education to mothers. They share audio and video messages about healthy eating habits, breastfeeding, and hygiene practices.

6.3.14.2 Informal discussions at the CDPO office and VHSND

The office of CDPO is a critical centre for coordinating the activities of ASHAs and AWWs. Informal discussions at the office provide a platform for health workers to share their experiences and learn from each other. Health workers discuss their challenges and seek advice from their colleagues and supervisors. These discussions help in developing effective strategies to overcome the barriers.

> *". . . when we (supervisors) sit at the CDPO office we discuss and share everything. Two days a week we sit in the office. There we get to know about stories from the field, jokes, and all. This is helpful for us actually; it helps with the work and improves our experience. We decide on things and do planning also together."* (Supervisors)

Informal discussions during VHSND provide an additional opportunity to interact with community members and learn about their healthcare needs. Discussions at VHSND help strengthen the relationships between health workers and the community.

6.3.14.3 Joint outreach and counselling

ASHAs and AWWs conduct joint outreach and counselling sessions to raise awareness about the importance of nutrition and health. This collaboration helps reach more people and contributes to effectively coordinating activities at the frontline.

6.3.14.4 Joint monitoring and reporting:

ASHAs and AWWs jointly monitor and report on the progress of nutrition and healthcare interventions. This helps to identify gaps in the interventions and the community's needs.

6.3.14.5 Referral and follow-up

ASHAs and AWWs refer beneficiaries to each other for care and follow-up. This coordination ensures that patients receive appropriate care and follow-up, leading to improved health outcomes and portraying both workers as part of the same system to the community.

6.3.15 Interpersonal Relationships

6.3.15.1 The relationship between the community and the CHWs

Issues related to payment delays seemed to be causing much mistrust between the community and the CHWs. As a general trend, we observed dissatisfaction towards the activities of AWCs from the beneficiaries caused by irregularities in supply.

We came across instances where the AWWs and ASHAs were trying to overcome supply limitations through initiative and innovation but failing due to a lack of community participation and support. These instances seem to demotivate them from taking more initiative to overcome the barriers.

> *"They have given us a stove and gas connection, but there is no safe place in the centre to keep it and cook meal for the children. So, I have taken help from the nearby house and keep the cylinder and stove in their house premises and cook food. Some local politicians are making an issue out of this. They accuse me of taking money from the household for letting them use the gas cylinder. This is not true"* (AWW)

6.3.15.2 The relationship between the functionaries

Worsening interpersonal relationship between ASHAs and AWWs causes issues in cooperation and coordination. A partial cause of this friction between the workers could be the overburden of work imposed on ASHAs.

> *"They (AWWs) don't really have much work unlike us. We have a lot of tasks to complete for a minimum pay. It will be nice if the work is more equally distributed between AWWs and ASHAs. These days they are not even measuring the children or weighing them. We have to do that also"* (ASHA)

*"There is so many different works to do. There are many trainings to attend also. We can't go to the training and come back same day because the boat ride itself is 4 hours one side. So, we stay in the lodge. Despite all these works we don't get paid regularly like AWWs. They are permanent employees but we are not. I have not received my dues of at least 3 years" (*ASHA)

6.3.15.3 The relationship between the functionaries and the government.

The feeling of being overburdened with work and pending payments are at the root of the worsening relationship between the CHWs and the government.

"The Sadou Asom Asha Karmi Santha (SAAKS) has been staging different types of protests demanding payment of dues and issuing of appointment letters. The demands and protests have become stronger during the pandemic as the workload of ASHAs increased multitude without a significant increase in incentives or proper measures for protection. It is reported that as many as 30,000 CHWs are engaged in the effort to combat the pandemic in the State. They collect information on people with coronavirus symptoms and also collect information on people coming back from outside the state. On an average, they visited 300 households every day. There are reports from different parts of the state about hostility towards CHWs during contact tracing and door-to-door data gathering. The first phase of vaccine drive against Covid-19 was also boycotted by a large section of ASHA workers in Assam as a form of protest against poor remuneration for the risks they have been exposed to. The state also has more people working outside the state who returned during and after the lockdown, making the contact tracing work more cumbersome." (KI)

6.3.16 Resistance from the Community towards Interventions

6.3.16.1 Resistance at the family level

Frontline workers observe instances where beneficiary families resist interventions, making it difficult for the program to achieve its objectives. In many households, mothers-in-law wield significant influence and control over household decisions and resist outside interventions, believing they know what is best for their grandchildren. This makes it challenging for workers to engage with beneficiary families and implement the program's interventions effectively.

. . .The main challenge I face is with the mother-in-law. They often want to give unsolicited advice to their daughter-in-law. They would say things like "don't do this" or "don't do that" and compare their experiences during their own pregnancies, saying things like "we didn't do this when we were pregnant."

They question why their daughter-in-law needs to take certain medicines or vaccines, and even suggest not taking them at all. (AWW)

To address such issues, supervisors often visit beneficiary families' homes to explain the program's interventions and address any concerns or issues they may have. Family meetings are also conducted with all family members to explain the benefits of interventions and address any concerns or questions they may have.

6.3.16.2 Resistance against vaccine

In some communities, there is a common notion that vaccines, particularly those given to adults, cause infertility. This belief has led to vaccine hesitancy and resistance towards vaccination programs in some parts.

"Many husbands don't want their wives and children to take vaccines. Especially teenage girls. They think it will cause infertility. We explain to them well about the benefits and the agree. Sometimes ICDS supervisor, ASHA, AWW, schoolteacher also helps with making them understand in meetings and otherwise. Here, people were more receptive to covid vaccine because we have explained the about vaccines before." (ANM)

6.3.16.3 Community restrictions

A few instances of community restrictions impacting the functioning of AWCs are observed. In one such instance, the community near the Masjid has placed restrictions on singing and dancing in the AWC.

'The office informed me that my centre will be repaired, giving me hope. However, I mentioned that I will not keep the centre in its current location, next to the masjid. There are restrictions when it comes to activities such as dancing and singing. . . there is a school field located nearby that would be a better fit for my centre. The presence of the school would allow me to conduct my work more effectively also." (AWW)

6.3.16.4 Challenges in explaining population-level interventions

Explaining population-level interventions to individuals are observed to be challenging. Beneficiaries often have difficulty understanding why population-level interventions are necessary

and question why everyone needs to follow the same guidelines or take the same intervention. Individuals feel that it is unnecessary to take a particular intervention if they perceive that they are not directly affected. A common question from the beneficiaries, as reported by the AWWs, is why all pregnant women need to take IFA even if they are perfectly healthy and follow a balanced diet. Another question that individuals may ask is, "Why can't the government identify the beneficiaries and not waste resources?".

6.3.17 Cultural Factors Affecting Interventions

6.3.17.1 Misconceptions regarding pregnancy

We observed several misconceptions regarding maternal and child health that create barriers to nutrition intervention uptake. Some of the misconceptions include eating certain foods, such as dark-coloured fruits or vegetables, during pregnancy will cause a dark complexion for the baby, eating some other fruits, vegetables, and eggs will cause miscarriage, sleeping in the afternoon while pregnant will cause health issues to the child and even miscarriage.

> *"There is a misconception among some people that pregnant women should not take a nap in the afternoon as it may cause water to block. However, this is not true. Water block occurs due to a lack of iron in the diet which leads to anaemia, not because of sleep. I have explained to them that taking a nap for at least 1 to 2 hours after a meal is beneficial for pregnant women. It can help them feel more relaxed and refreshed."* (AWW)

6.3.17.2 Misconceptions regarding diet and feeding practices

Some observed misconceptions include starting complementary feeding at five months of age, waiting for teeth to emerge before starting complementary feeding and discarding colostrum, the first milk produced by a lactating mother.

> *"During pregnancy, some women avoid certain types of food such as eggs due to misconceptions that they may cause harm to the unborn child. I try explaining that consuming eggs does not pose any risks to pregnant women or their babies. In fact, eggs are a good source of nutrition for both."* (AWW)

"Some mothers refuse to give complementary food to their babies even after they turn 6 months old. They believe that they should wait until the baby grows teeth. However, this practice has decreased significantly in recent times" (AWW)

". . they used to throw away the thick milk, called colostrum, that is produced during the first breastfeed. But in reality, colostrum provides a lot of immunization and helps the baby build up their ability to fight diseases. Therefore, we explain to them the importance of not throwing away the colostrum and to feed their child as soon as possible after a normal delivery, preferably within an hour or half an hour of recovering." (AWW)

6.3.18 Awareness Creation

6.3.18.1 Target Groups

The awareness creation activities were traditionally focused on women and children as they are considered the most vulnerable to malnutrition and related health issues. However, the target group of such interventions now includes men and other family members. Frontline workers observe that in most houses, men are the decision-makers, and their involvement in nutrition and health programs significantly impacts the overall health and well-being of the family. They also recognize the family as a unit where the health of each member is interconnected and interdependent.

". . .their mothers-in-law come too. Because mothers-in-law talk about what they used to do when they had to feed a child or what they used to do in the past. So, they also need to come. Also, we invite teenage girls because they will become mothers in the future and can benefit from the program." (AWW)

"Before, we didn't talk to males. But think about this, if a woman gets pregnant, who will arrange everything? the husband, in-laws, or other family members will do it, right? So, we explain to the family members what should be eaten and done during this time." (AWW)

6.3.18.2 Gaps in communication

There is often a communication gap between frontline workers and beneficiaries during awareness creation. Many frontline workers perceive that uneducated community members will not comprehend the information provided no matter how often they are told. At the same time,

beneficiaries say they understand the instructions but do not adhere to them due to differing expectations or a form of showing dissatisfaction.

> *"I have a problem convincing people. If someone could come and help explain my ideas to them, that would be great. I wish they could understand what I am saying, as it would make my work much easier. Unfortunately, they struggle to comprehend many things, including language and even simple rules."* (AWW)

6.3.18.3 Focus on hygiene

Hygiene and sanitation are critical components of public health interventions and are often emphasised in the health promotion literature. However, beneficiaries feel that there is an increased focus on promoting hygiene. It is observed that hygiene promotion efforts tend to be stigmatizing since they are not approached sensitively and respectfully. It is also noted that the emphasis on hygiene solely focuses on the beneficiaries' behaviour rather than seeing it as a shared responsibility between beneficiaries, health workers, and policymakers.

> *"I have explained to them many times, instructing them to ensure their children look presentable and clean before sending them to the centre. I have even contacted mothers directly to explain, I emphasize the importance of ensuring boys and girls are clothed, clean, and hygienic before sending them to the centre. Unfortunately, some children arrive at the centre not meeting these standards, which is disappointing. I have expressed that it's important for mothers to take care of their children, that if mother is not nice, then how will the children be?"* (AWW)

6.3.18.4 Child marriage

Frontline workers play a crucial role in awareness creation. The current approach to underage marriage prevention by frontline workers is mainly focused on reproductive health, emphasizing that early marriage and childbirth can lead to complications during pregnancy and childbirth and long-term health issues such as anaemia and malnutrition. While raising awareness about the health consequences of underage marriage is essential, a child rights-based approach focusing on how underage marriage can result in the child dropping out of school, limiting their opportunities for education and development is absent.

6.3.19 Childcare Challenges at the Family Level

6.3.19.1 Time

The lack of time to feed the child is a significant challenge for many mothers, particularly those from poor households working in the fields. Many mothers do not have access to support systems such as childcare facilities or family members to assist them in feeding their children, leaving them to manage this responsibility on their own. As a result, many mothers cannot provide their children with the time and attention required for optimal nutrition.

> *"The child doesn't eat. To feed one bite, I have to walk around for half an hour. So, whatever I can feed within my available time, I do."* (Mother)

> *". . . they (children) don't eat anything other than biscuits. I have to put in so much effort to make them eat a little bit of rice and lentils. I am running behind them and making them eat while I do other work also. It is very difficult."* (Mother)

Breastfed children are often taken to the field where mothers work, exposing the child to various pollutants, including dust, chemicals, and other harmful substances. Exposure to these pollutants can increase the risk of respiratory infections, allergies, and other health problems. Also, taking a breastfed child to the field does not ensure adequate breastfeeding because work makes it challenging for the mother to breastfeed frequently.

> *"Many mothers have to take the baby to the filed as they have no one staying back at home during the day. Even breastfed children are also taken the fields. They run around and play at times. Small children sleep in cloth cradle or bedsheets under trees. This way mothers can breastfeed them and keep an eye on them."* (AWW)

6.3.19.2 Lack of control over diet and feeding

Mothers from poor households leave their children at home or with the community when they go to work, making monitoring their child's diet and nutrition challenging. Mothers come back home after work and feed their children, but they often may not fully understand what their child has eaten throughout the day. While some husbands take on this responsibility to some extent, they

are observed to be not 'successful' in feeding the child adequately. Also, husbands are said not to have the same level of knowledge or awareness about their child's dietary needs as the mother.

> *"I have no idea what all they eat. They eat everything that is fed to them by whoever is around. All the children are left together and they roam around within the village. Someone or the other feed them. I come back home in the evening and then make them proper meals. Sometimes they eat it, sometimes they don't want to eat it as they are full."* (Mother)

6.3.19.3 Neglected children

AWWs observe neglected children in the community but feel helpless due to the lack of mechanisms to address such issues. Neglect of basic needs such as food, clothing, and health aspects, including hygiene practices, which have detrimental effects on children's physical and mental health, are observed. AWWs feel that adequate resources, coordination with other departments, and higher authorities' intervention are needed to address this issue.

> *"There are children who are not being taken care of in the community. The parents don't look after them or give them bath or even proper food. I spoke to the supervisor and the CDPO also that the department should do something about it. Actually, the government should do something about it. They (children) are almost like they are orphans."* (AWW)

6.4 Chapter Summary and Conclusions

The findings of this study reveal a complex system that consists of various elements which have both direct and indirect impacts on the successful execution of evidence-based nutrition interventions. Moreover, the study highlights challenges present at different levels of the system and the interconnections between various factors. A diagram (Figure 15) is presented to represent a simplified version of the intricate relationships between the identified themes. The interconnections are further discussed under overarching themes, although not all connections are depicted in the diagram. The subsequent section provides a comprehensive explanation of these connections.

Coordination at the Grassroots: The successful implementation of joint outreach and counselling, monitoring and reporting, as well as referral and follow-up activities at the community level requires effective coordination. Such coordination is facilitated by building strong interpersonal relationships among frontline workers. Informal communication platforms such as WhatsApp groups and other informal discussion avenues also strengthen these relationships. The existence of positive interpersonal relationships between frontline workers further reinforces the effectiveness of the coordination of interventions at the community level.

Performance of frontline workers: The performance of frontline workers is influenced by several factors, including the quality of interpersonal relationships between the workers and the community, the relationships between frontline workers, coordination efforts at the community level, and the workers' relationship with department officials. Platforms for community participation and outreach activities are crucial in enabling and influencing the relationship between the community and the frontline worker. There is a positive feedback loop between the performance of frontline workers and their relationships with the community.

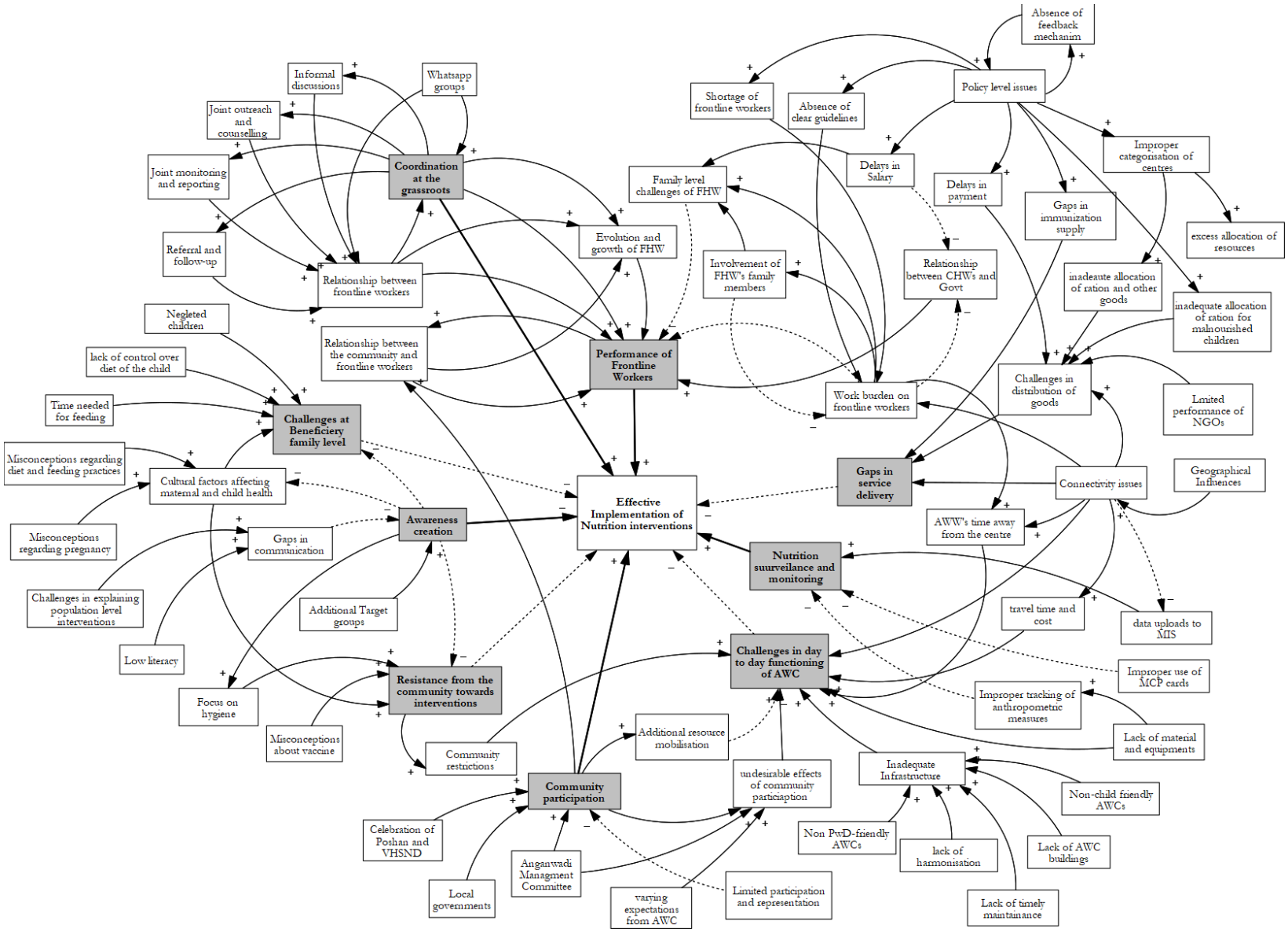
However, delays in salary disbursement, high work burden, and involvement of family members of frontline workers in implementing interventions pose significant challenges at the family level that can limit their performance. Nonetheless, frontline workers are observed to be evolving with support from their peers and the community, and this evolution positively impacts their performance.

High work burden is a crucial factor affecting the performance of frontline workers, and policy-level issues such as a shortage of frontline workers and the absence of clear guidelines contribute to this burden. These issues also deteriorate the relationship between frontline workers and their employers. The absence of a feedback mechanism from frontline workers exacerbates policy-level issues.

Challenges at the family level of the beneficiary: The implementation of nutrition interventions faces various challenges at the family level of beneficiaries, including cultural factors, misconceptions, superstitions, and manifestations of poverty. Some significant challenges include parents lacking time to feed their children, parents, without control over their children's diets and feeding practices, and instances of parental neglect. Misconceptions regarding diet, feeding practices, and pregnancy in the household also contribute to these challenges.

Awareness creation activities in various forms have been effective in reducing these challenges at the family level, especially through additional target groups consisting of spouses and in-laws of the mother.

Figure 15 Interlinkages of Themes



Awareness creation: Awareness creation activities play a crucial role in addressing various types of resistance from the community towards interventions and challenges at the family level of beneficiaries. However, these activities are limited by communication gaps caused by low literacy rates in the region and difficulties in explaining population-level interventions to the beneficiaries.

Resistance from the community towards interventions: Resistance from the community towards interventions poses a significant barrier to their implementation and effectiveness. Such resistance mainly stems from various misconceptions, particularly misconceptions related to vaccines. Moreover, a high focus on personal hygiene during awareness creation activities has also contributed to the resistance against interventions.

Challenges in day-to-day functioning of AWCs: The day-to-day functioning of AWCs is fraught with numerous complex and interconnected challenges. These challenges include connectivity issues worsened by seasonal floods and winds, high work burden and connectivity issues leading to the absence of AWWs from the AWC, lack of material and equipment, inadequate infrastructure, undesirable effects of community participation, and community restrictions.

Inadequate infrastructure of AWCs is characterised by a lack of buildings for the AWCs, delayed maintenance, inconsistent allocation of resources, and a lack of child-friendly and PwD-friendly AWCs. These issues have their root in policy-level problems. Furthermore, some undesirable effects of community participation, stemming from misconceptions about the objectives of interventions and varying expectations, have also emerged as challenges to the functioning of AWCs. Additional resource mobilisation through community participation and initiatives by health system actors have helped alleviate some of the challenges in the day-to-day functioning of AWCs.

Nutrition Surveillance and Monitoring: Effective nutrition surveillance and monitoring are essential components of evidence-based nutrition interventions. However, this study has identified that the lack of materials and equipment and improper use of MCP cards have resulted in inadequate tracking of anthropometric measures and overall nutrition surveillance and monitoring. While the

use of technology, such as mobile phones, has helped improve the situation, it is limited by connectivity issues.

Community participation: Community participation is a vital component of the effective implementation of evidence-based nutrition interventions, and it can occur through various channels such as Anganwadi Management Committees (AMCs), Panchayati Raj Institutions (PRIs), and Village Health Sanitation and Nutrition Days (VHSND) celebrations. However, this study found that community participation through AMCs is limited and underrepresented, which poses a challenge to the effectiveness of the interventions.

Gaps in service delivery: Gaps in service delivery, particularly in immunization and distribution of ration and other goods, have been identified as significant challenges in evidence-based nutrition interventions. Policy-level issues, including payment delays, gaps in vaccine supply chain, and inadequate ration allocation for malnourished children, often cause these gaps. Improper categorization of AWCs as mini-AWCs or full AWCs, and inadequate allocation of resources based on this categorization, also contribute to the challenges.

Chapter 7. Conclusion

7.1 Discussion

The findings of Chapter 4 provide an in-depth analysis of the prevalence, determinants, and distribution of undernutrition in India. The indicators vary significantly among the states, with almost 50% of children under five years of age showing at least one form of anthropometric failure in many states. The prevalence of Severe and Acute Malnutrition (SAM) also shows high inter-state variability. The district-level estimations of indicators show high inter-district variance, with high prevalence districts clustering around the drought-prone areas of the country. Changes in indicators between 2006 and 2020 are observed to be not uniform and inadequate to achieve national nutrition targets. The results of regression analyses reveal that poverty and income are the most impactful determinants of undernutrition. Timely start of breastfeeding, a diverse diet and minimum diet frequency are important immediate determinants of the nutritional status of children, and different essential nutrition interventions implemented through the Integrated Child Development Services (ICDS) programme and National Health Mission significantly influence nutritional outputs. Clean drinking water and sanitation are also important factors in the fight against undernutrition, especially in curbing wasting. The results suggest the areas that need policy focus in the fight against undernutrition, and further qualitative and mixed-method studies are needed to explore the pathways of nutrition intervention implementation and other factors that could have contributed to the result.

The findings of secondary data analysis in Chapter 5 reveal that Assam has a higher incidence of anthropometric failure in all categories than the national average. While all the indicators decreased nationally between 2016 and 2020, all indicators showed an increase except for stunting in Assam. The Barak Valley Region (BVR) district of Karimganj and the Bodoland Territorial Region (BTR) district of Bongaigaon have high anthropometric failure levels. However, Kamrup and Kamrup

Metro are the better-performing districts. Analysis of the performance of aspirational districts in Assam highlights that most have stunting rates higher than the state average, but stunting rates decreased in all but one district between 2016 and 2020.

The primary data collection survey conducted in seven select districts of Assam found that Barpeta district had the highest prevalence of stunting, underweight, CIAF, severe stunting, severe wasting, triple anthropometric failure, and a high incidence of wasting, recent illnesses, and child deaths. The district also fared poorly in most basic, underlying, and immediate determinants of the nutritional status of children, such as multidimensional poverty, low literacy rates, poor sanitation facilities, and delayed or early start of complementary feeding. Goalpara district had the highest incidence of wasting and triple anthropometric failure and a high prevalence of stunting, severe stunting, underweight, and severe underweight. Dhubri district had high stunting, severe stunting, underweight, and CIAF rates, as well as a high incidence of child deaths and low literacy rates. Darrang district had the highest incidence of low birth weight, severely underweight children, mothers with below-normal BMI, and high wasting, severe wasting, underweight, and CIAF rates. Udalguri district had the lowest incidence of severe wasting and children with triple anthropometric failure, but high prevalence of low birthweight, overweight mothers, and a low percentage of exclusively breastfed children. Kokrajhar district had the lowest stunting, severe stunting, wasting, and severe underweight rates, but high prevalence of child deaths, low rates of mothers who consumed IFA during pregnancy, and low percentages of children receiving a minimum acceptable diet. Bongaigaon district was one of the best-performing districts, with low rates of stunting, severe stunting, wasting, severe wasting, underweight, severe underweight, CIAF, and triple failure, and zero mothers reporting child deaths. The district had enabling determinants of nutrition, such as low multidimensional poverty, high literacy rates among women, and high immunisation rates.

The findings of the survey also indicate that stunting and wasting are highest among children in the age group of 6 to 11 months, severe stunting and severe wasting are highest among children

in the age group of 12 to 23 months, and underweight and severe underweight are highest among children in the age group of 48 to 59 months. Boys are generally more affected by malnutrition than girls, but girls in the age group of 12 to 23 months have the highest prevalence of wasting. There is a clear and strong influence of multidimensional poverty on nutritional status outcomes. Children who receive adequate breastfeeding, complementary feeding, and a minimum acceptable diet are less likely to experience anthropometric failure. Grains, roots, and tubers are the most commonly used food groups for complementary feeding, while legumes, nuts, eggs, and flesh foods are the least used. Most districts have the highest expenditure on edible oils, meat and poultry, and fish consumption, but the food groups with the lowest quantity consumed as a percentage of total food consumption are meat, poultry, fish, eggs, and leafy vegetables. There is a significant difference in the order of food groups and high variation among districts between per capita expenditure and consumption quantity. The expenditure on roots and tubers, the highest quantity consumed food group, is in fifth place, while the smallest expenditure remains on eggs, the lowest quantity consumed food group.

The findings of qualitative data analysis shed light on a complex system that consists of various elements which have both direct and indirect impacts on the successful execution of evidence-based nutrition interventions. The study highlights challenges present at different levels of the system and the interconnections between various factors. We see that coordination at the grassroots level, which is crucial for the successful implementation of joint outreach and counselling, monitoring and reporting, and referral and follow-up activities at the community level is facilitated by building strong interpersonal relationships among frontline workers and through informal communication platforms. The performance of frontline workers is influenced by several factors, including the quality of interpersonal relationships between the workers and the community, the relationships between frontline workers, and the workers' relationship with department officials. Delays in salary disbursement, high work burden, and involvement of family

members of frontline workers in implementing interventions pose significant challenges at the family level of the frontline workers. Challenges at the family level of beneficiaries include cultural factors, misconceptions, superstitions, and manifestations of poverty. Awareness creation activities have been effective in reducing these challenges, especially through additional target groups consisting of spouses and in-laws of the mother. Resistance from the community towards interventions poses a significant barrier to their implementation and effectiveness. The day-to-day functioning of AWCs is fraught with numerous complex and interconnected challenges, including connectivity issues, high work burden, lack of material and equipment, inadequate infrastructure, undesirable effects of community participation, and community restrictions. Despite being essential components of evidence-based nutrition interventions, effective nutrition surveillance and monitoring are limited by the lack of materials and equipment and improper use of MCP cards. Community participation through AMCs is limited and underrepresented, which poses a challenge to the effectiveness of the interventions. Gaps in service delivery, particularly in immunisation and distribution of ration and other goods, have been identified as significant challenges in evidence-based nutrition interventions.

7.2 Conclusion

The implications of findings of this study are multifaceted and have significant implications for public health policy and interventions aimed at improving nutritional outcomes in India. The high variability of undernutrition indicators across states and districts highlights the need for targeted and context-specific interventions, with a particular focus on drought-prone areas. Poverty and income inequality remain the most impactful determinants of undernutrition underscoring the need for addressing these basic determinants as the key strategy to combat undernutrition. The identification of timely start of breastfeeding, diverse diet, minimum diet frequency, and essential nutrition interventions implemented through the ICDS program and National Health Mission as important immediate determinants of nutritional status highlight the need for effective

implementation of these interventions and scaled-up coverage. The importance of clean drinking water and sanitation in curbing wasting underscores the need for integrated interventions that address multiple determinants of undernutrition.

The higher incidence of anthropometric failure in Assam compared to the national average indicates the need for identifying contextual factors that are contributing to the problem and forming targeted interventions. The fact that all indicators increased except for stunting in Assam, while they decreased nationally, highlights the urgent need for specific interventions in the state. The identification of districts with high levels of anthropometric failures, such as Karimganj and Bongaigaon, provides policymakers with a target for intervention. Conversely, the better performance of districts such as Kamrup and Kamrup Metro can serve as models for other districts. The primary data collection survey in seven select districts highlights the need for differentiated strategies depending on the specific characteristics of each district. For instance, Barpeta district needs urgent intervention due to its high prevalence of stunting, underweight, and other forms of anthropometric failure. The poor underlying and immediate determinants of the nutritional status of children in the district, such as low literacy rates, poor sanitation facilities, and delayed or early start of complementary feeding, indicate the need for a multi-sectoral approach to address the issue. The finding that Udalguri district has a lower incidence of severe wasting and children with triple anthropometric failure but high prevalence of low birthweight and overweight mothers indicates the need for differentiated strategies for different forms of anthropometric failure. The best-performing districts, such as Bongaigaon, may be able to provide valuable lessons on improving children's nutritional status.

The findings of the qualitative data analysis give insights into the complex system of actors, institutions, and relationships that shape the landscape of nutrition interventions at the village level. The findings also underscore the importance of building strong interpersonal relationships among frontline workers and the community, ensuring timely salary disbursement, addressing the high work burden of frontline workers, and engaging with family members of frontline workers

and beneficiaries to reduce cultural barriers and misconceptions. Resistance from the community towards interventions needs to be addressed, and effective nutrition surveillance and monitoring must be put in place to track the progress of the interventions. The challenges at the grassroots level, including the functioning of AWCs, connectivity issues, inadequate infrastructure, and community restrictions, need to be addressed to ensure the successful implementation of a joint outreach and counselling, monitoring and reporting, and referral and follow-up activities. The findings also highlight the need for increased community participation through AMCs, and addressing gaps in service delivery, particularly in immunization and distribution of ration and other goods. Addressing these challenges will require collaboration and coordination across different levels of the system, including frontline workers, community members, department officials, and policymakers.

References

1. Adam, T., & de Savigny, D. (2012). Systems thinking for strengthening health systems in LMICs: need for a paradigm shift. Health policy and planning, 27(suppl_4), iv1-iv3.

2. Adu-Afarwuah, S., Lartey, A., & Dewey, K. G. (2017). Meeting nutritional needs in the first 1000 days: a place for small-quantity lipid-based nutrient supplements. Annals of the New York Academy of Sciences, 1392(1), 18-29.

3. Ahmed, T., Hossain, M., & Sanin, K. I. (2012). Global burden of maternal and child undernutrition and micronutrient deficiencies. Annals of Nutrition and Metabolism, 61(Suppl. 1), 8-17.

4. Alderman, H. H., Elder, L. K., Goyal, A., Herforth, A. W., Hoberg, Y. T., Marini, A., ... & Zaman, H. (2013). Improving nutrition through multisectoral approaches (No. 75102, pp. 1-178). The World Bank.

5. Alderman, H., & Garcia, M. (1994). Food security and health security: Explaining the levels of nutritional status in Pakistan. Economic Development and Cultural Change, 42(3), 485-507.

6. Alkire, S., & Kanagaratnam, U. (2021). Revisions of the global multidimensional poverty index: indicator options and their empirical assessment. Oxford Development Studies, 49(2), 169-183.

7. Anand, S., & Ravallion, M. (1993). Human development in poor countries: on the role of private incomes and public services. Journal of economic perspectives, 7(1), 133-150.

8. Arnold, F., Parasuraman, S., Arokiasamy, P., & Kothari, M. (2009). Nutrition in India. National Family Health Survey (NFHS-3). International Institute for Population Sciences, Deonar, Mumbai, India, Aug.

9. Avula, R., Kadiyala, S., Singh, K., & Menon, P. (2015). A review of evidence-based interventions in Indian nutrition programs.

10. Bagchi, K. 1981. "Nutrition Programmes in India: Retrospect and Prospect." Health and Population: Perspectives and Issues 4 (4): 223–242.

11. Baidal, J. A. W., Locks, L. M., Cheng, E. R., Blake-Lamb, T. L., Perkins, M. E., & Taveras, E. M. (2016). Risk factors for childhood obesity in the first 1,000 days: a systematic review. American journal of preventive medicine, 50(6), 761-779.

12. Behrman, J. R., & Deolalikar, A. B. (1987). Will developing country nutrition improve with income? A case study for rural South India. Journal of political Economy, 95(3), 492-507.

13. Behrman, J. R., & Wolfe, B. L. (1984). More evidence on nutrition demand: Income seems overrated and women's schooling underemphasised. Journal of development economics, 14(1), 105-128.

14. Bennett, L. (1988). The role of women in income production and intra-household allocation of resources as a determinant of child nutrition and health. Food and nutrition Bulletin, 10(3), 1-9.

15. Bennett, S., Agyepong, I. A., Sheikh, K., Hanson, K., Ssengooba, F., & Gilson, L. (2011). Building the field of health policy and systems research: an agenda for action. PLoS Med, 8(8), e1001081.

16. Bharali, N., Singh, K. N., & Mondal, N. (2019). Composite Index of Anthropometric Failure (CIAF) among Sonowal Kachari tribal preschool children of flood effected region of Assam, India. Anthropological Review, 82(2), 163-176.

17. Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., ... & Maternal and Child Nutrition Study Group. (2013). Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?. The lancet, 382(9890), 452-477.

18. Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De Onis, M., Ezzati, M., ... & Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. The lancet, 371(9608), 243-260.

19. Bliss, C., & Stern, N. (1978). Productivity, wages and nutrition: Part I: the theory. Journal of Development Economics, 5(4), 331-362.

20. Bora, K., & Bora, T. (2022). Observations on the Distribution of Under-Five Children with Severe Acute Malnutrition in Assam. Indian Journal of Pediatrics, 89(12), 1265-1265.

21. Bose, V., Batra-Dua, S., Menon, S., Mathur, S., Sharma, G., & Chauhan, K. (2014). A landscape analysis of nutrition initiatives in Madhya Pradesh: Policies, actors, and networks (Vol. 4). Intl Food Policy Res Inst.

22. Bouis, H. E., & Haddad, L. J. (1990). Effects of agricultural commercialization on land tenure, household resource allocation, and nutrition in the Philippines. Food and Nutrition Bulletin, 12(4), 1-2.

23. Chakrabarty, M. (2016). Climate change and food security in India. Observer Research Foundation (ORF): New Delhi, India, (157).

24. Chambers, R., & Von Medeazza, G. (2013). Sanitation and stunting in India: undernutrition's blind spot. Economic and Political Weekly, 15-18.

25. Chandrasekhar, S., Aguayo, V. M., Krishna, V., & Nair, R. (2017). Household food insecurity and children's dietary diversity and nutrition in India. Evidence from the comprehensive nutrition survey in Maharashtra. Maternal & child nutrition, 13, e12447.

26. Chatterjee, M., & Lambert, J. (1989). Women and nutrition: reflections from India and Pakistan. Food and nutrition bulletin, 11(4), 1-16.

27. Chattopadhyay, A., & Datta, A. (2020). Does cereal, protein and micronutrient availability hold the key to the malnutrition conundrum? An exploratory analysis of cereal cultivation and wasting patterns of India.

28. Chaudhary, D. 2011. "Reducing Malnutrition—An Analysis of Integrated Child Development Services (ICDS) Scheme." In Public Health Nutrition in Developing Countries, edited by Sheila C. Vir. Cambridge, UK: Woodhead Publishing India.

29. Chen, L. C., Huq, E., & d'Souza, S. (1981). Sex bias in the family allocation of food and health care in rural Bangladesh. Population and development review, 55-70.

30. Chopra, J. G., Camacho, R., Kevany, J., & Thomson, A. M. (1970). Maternal nutrition and family planning. The American journal of clinical nutrition, 23(8), 1043-1058.

31. Choudhury, M., Randhawa, S., Mohanty, R., & Mahanta, L. B. (2022). How does flooding affect the nutritional status of children in floodplain regions? A cross-sectional study from Assam, India. Proceedings of the Indian National Science Academy, 1-13.

32. Chowdhury, S., Kasemi, N., Singh, A., Chakrabarty, M., & Singh, S. (2023). Decomposing the gap in undernutrition among under-five children between EAG and non-EAG states of India. Children and Youth Services Review, 145, 106796.

33. Christian, P., Abbi, R., Gujral, S., & Gopaldas, T. (1988). Socioeconomic determinants of child nutritional status in rural and tribal India. Ecology of food and nutrition, 23(1), 31-38

34. Corsi, D. J., Mejía-Guevara, I., & Subramanian, S. V. (2016). Risk factors for chronic undernutrition among children in India: Estimating relative importance, population attributable risk and fractions. Social Science & Medicine, 157, 165-185.

35. Cowling, K., Dandona, R., & Dandona, L. (2014). Social determinants of health in India: progress and inequities across states. International journal for equity in health, 13, 1-12.

36. Das, N. K., Barbhuiya, A. F., & Sarma, R. (2020). Nutritional status of the rabha tribal children of Udalguri district of Assam, India. Eur J Mol Clin Med, 7, 4794-802.

37. Das, S., & Sahoo, H. (2011). An investigation into factors affecting child undernutrition in Madhya Pradesh. The Anthropologist, 13(3), 227-233.

38. Dewey, K. G. (1979). Agricultural development, diet and nutrition.

39. Dhamija, G., Ojha, M., & Roychowdhury, P. (2022). Hunger and health: Reexamining the impact of household food insecurity on child malnutrition in India. The Journal of Development Studies, 58(6), 1181-1210.

40. Dimitrova, A., & Bora, J. K. (2020). Monsoon weather and early childhood health in India. PloS one, 15(4), e0231479.

41. Fiorentini, C. (2010). Economic and cultural determinants of child malnutrition in India: unravelling the" South Asian Enigma" (Doctoral dissertation, Georgetown University).

42. Gaiha, R., Jha, R., & Kulkarni, V. S. (2014). Diets, undernutrition, and disease: The Indian experience. Oxford University Press.

43. Gaiha, Raghav, Raghbendra Jha, and Vani S. Kulkarni. "Child undernutrition in India." Available at SSRN 1734591 (2010).

44. Garrett, J., Bassett, L., & Levinson, F. J. (2011). Multisectoral Approaches to Nutrition: Rationale and Historical Perspectives. Working Multi-sectorally in Nutrition, Principles, Practices and Case Studies, International Food Policy Research Institute, Washington DC.

45. Gilson, L., Hanson, K., Sheikh, K., Agyepong, I. A., Ssengooba, F., & Bennett, S. (2011). Building the field of health policy and systems research: social science matters. PLoS Med, 8(8), e1001079.

46. Gopalan, C. (1985). Maternal health, fertility control and child nutrition. NFI bulletin, 6(1), 1-4.

47. Gopalan, C. 2010. "My Life in Nutrition" [commentary]. World Nutrition 1 (4): 185–203.

48. Grosse, R. N., & Auffrey, C. (1989). Literacy and health status in developing countries. Annual review of public health, 10(1), 281-297.

49. Gulati, A., Kumar, A. G., Shreedhar, G., & Nandakumar, T. (2012). Agriculture and malnutrition in India. Food and nutrition bulletin, 33(1), 74-86.

50. Heaver, R., & Mundial, B. (1990). Improving family planning, health, and nutrition outreach in India. Banco Mundial.

51. Herman, D. R., Baer, M. T., Adams, E., Cunningham-Sabo, L., Duran, N., Johnson, D. B., & Yakes, E. (2014). Life course perspective: Evidence for the role of nutrition. Maternal and child health journal, 18(2), 450-461.

52. Horton, R. (2008). Maternal and child undernutrition: an urgent opportunity. The Lancet, 371(9608), 179.

53. Horton, S. (1986). Child nutrition and family size in the Philippines. Journal of Development economics, 23(1), 161-176.

54. https://data.unicef.org/country/ind/ accessed on 20-09-2020

55. Huffman, S. L. (1984). Determinants of breastfeeding in developing countries: overview and policy implications. Studies in family planning, 15(4), 170-183.

56. IAP (Indian Academy of Pediatrics). 2007. "IAP Guidelines 2006 on Management of Acute Diarrhea." Indian Pediatrics 44 (May 17): 380–389.

57. Imai, K. S., Annim, S. K., Kulkarni, V. S., & Gaiha, R. (2014). Women's empowerment and prevalence of stunted and underweight children in rural India. World Development, 62, 88-105.

58. India–MHRD (Ministry of Human Resource Development). 1993. National Nutrition Policy. New Delhi.

59. India–MoWCD (Ministry of Women and Child Development). 1995. National Plan of Action on Nutrution. New Delhi.

60. India–MoWCD (Ministry of Women and Child Development). 2005. National Plan of Action for Children, 2005. New Delhi

61. India–PC (Planning Commission). 1969. Fourth Five Year Plan 1969–1974. New Delhi.

62. India–PC (Planning Commission). 1998. Ninth Five Year Plan 1998–2002. New Delhi

63. India–PC (Planning Commission). 2002. Tenth Five Year Plan 2002–2007. New Delhi.

64. India–PC (Planning Commission). 2007. Eleventh Five Year Plan 2007–2012. New Delhi.

65. India. 1974. National Policy for Children. New Delhi.

66. International Institute for Population Sciences (IIPS) and ICF. 2022. National Family Health Survey (NFHS-4), 2019-20: India. Mumbai: IIPS.

67. International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.

68. Islam, S., Mahanta, T. G., Sarma, R., & Hiranya, S. (2014). Nutritional status of under 5 children belonging to tribal population living in riverine (Char) areas of Dibrugarh district, Assam. Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine, 39(3), 169.

69. Jayachandran, J., & Jarvis, G. K. (1986). Socioeconomic development, medical care, and nutrition as determinants of infant mortality in less-developed countries. Social biology, 33(3-4), 301-315.

70. Jith, J. R., & Bedamatta, R. (2021). Child undernutrition in the states of india: an analysis based on change in composite index of anthropometric failure from 2006 to 2016. Review of Development and Change, 26(1), 104-126.

71. Johri, M., Sylvestre, M. P., Koné, G. K., Chandra, D., & Subramanian, S. V. (2019). Effects of improved drinking water quality on early childhood growth in rural Uttar Pradesh, India: A propensity-score analysis. Plos one, 14(1), e0209054.

72. Kapil, U. (2002). Integrated Child Development Services (ICDS) scheme: a program for holistic development of children in India. The Indian Journal of Pediatrics, 69(7), 597-601.

73. Katoch, O. R. (2022). Determinants of malnutrition among children: A systematic review. Nutrition, 96, 111565.

74. Katoch, O. R., & Sharma, A. (2016). Socioeconomic factors, living conditions and child undernutrition among school-going children in Rural Areas of district Doda, Jammu & Kashmir, India: A Preliminary Study. Indian Journal of Nutrition, 3(1), 1-7.

75. Katoch, O. R., Sharma, A., & Nawaz, A. (2017). Determinants of malnutrition (stunting) among rural farming households: evidences from rural areas of District Doda, Jammu & Kashmir. Asian Journal of Research in Social Sciences and Humanities, 7(7), 166-176.

76. Khan, J., & Mohanty, S. K. (2018). Spatial heterogeneity and correlates of child malnutrition in districts of India. BMC public health, 18(1), 1-13.

77. Kim, R., Bijral, A. S., Xu, Y., Zhang, X., Blossom, J. C., Swaminathan, A., ... & Subramanian, S. V. (2021). Precision mapping child undernutrition for nearly 600,000

inhabited census villages in India. Proceedings of the National Academy of Sciences, 118(18), e2025865118.

78. Kim, S. S., Avula, R., Ved, R., Kohli, N., Singh, K., van den Bold, M., ... & Menon, P. (2017). Understanding the role of intersectoral convergence in the delivery of essential maternal and child nutrition interventions in Odisha, India: a qualitative study. BMC Public Health, 17(1), 161.

79. Kochupurackal, S. U., Channa Basappa, Y., Vazhamplackal, S. J., & Srinivas, P. N. (2021). An intersectional analysis of the composite index of anthropometric failures in India. International Journal for Equity in Health, 20, 1-11.

80. Leslie, J. (1988). Women's work and child nutrition in the Third World. World development, 16(11), 1341-1362.

81. Mahapatra, B., Walia, M., Rao, C. A. R., Raju, B. M. K., & Saggurti, N. (2021). Vulnerability of agriculture to climate change increases the risk of child malnutrition: Evidence from a large-scale observational study in India. PloS one, 16(6), e0253637.

82. Mandal, M., Ghosh, D., Karmakar, M., Mandi, S., Modak, P., Ghosh, B., & Mandal, D. (2023). Rural child health in India: the persistent nature of deprivation, undernutrition and the 2030 Agenda. Environment, Development and Sustainability, 1-24.

83. Martorell, R., Leslie, J., & Moock, P. R. (1984). Characteristics and determinants of child nutritional status in Nepal. The American journal of clinical nutrition, 39(1), 74-86.

84. Mazumdar, S. (2010). Determinants of inequality in child malnutrition in India: the poverty-undernutrition linkage. Asian Population Studies, 6(3), 307-333.

85. McDonald, C. M., Olofin, I., Flaxman, S., Fawzi, W. W., Spiegelman, D., Caulfield, L. E., ... & Nutrition Impact Model Study. (2013). The effect of multiple anthropometric deficits on child mortality: meta-analysis of individual data in 10 prospective studies from developing countries. The American journal of clinical nutrition, 97(4), 896-901.

86. Meshram, I. I., Balakrishna, N., Arlappa, N., Rao, K. M., Laxmaiah, A., & Brahmam, G. N. V. (2014). Prevalence of undernutrition, its determinants, and seasonal variation among tribal preschool children of Odisha state, India. Asia Pacific Journal of Public Health, 26(5), 470-480.

87. Meshram, I. I., Rao, K. M., Balakrishna, N., Harikumar, R., Arlappa, N., Sreeramakrishna, K., & Laxmaiah, A. (2019). Infant and young child feeding practices, sociodemographic factors and their association with nutritional status of children aged< 3 years in India: Findings of the National Nutrition Monitoring Bureau survey, 2011–2012. Public health nutrition, 22(1), 104-114.

88. Mitchell, P. J., Cooper, C., Dawson-Hughes, B., Gordon, C. M., & Rizzoli, R. (2015). Life-course approach to nutrition. Osteoporosis International, 26(12), 2723-2742.

89. Mohanty, S. K. (2011). Multidimensional poverty and child survival in India. Plos one, 6(10), e26857.

90. Muttarak, R., & Dimitrova, A. (2019). Climate change and seasonal floods: potential long-term nutritional consequences for children in Kerala, India. BMJ Global Health, 4(2), e001215.

91. Myrdal, G., & Barber, W. J. (1968). Asian drama: An inquiry into the poverty of nations. Pantheon.

92. Nabarro, D. (1984). Social, economic, health, and environmental determinants of nutritional status. Food and nutrition bulletin, 6(1), 1-16.

93. Nandy, S., & Svedberg, P. (2012). The Composite Index of Anthropometric Failure (CIAF): An alternative indicator for undernutrition in young children. In Handbook of Anthropometry (pp. 127–137). Springer

94. Nandy, S., Irving, M., Gordon, D., Subramanian, S. V., & Smith, G. D. (2005). Poverty, child undernutrition and morbidity: new evidence from India. Bulletin of the World Health Organization, 83, 210-216.

95. Nayak, B. S., Unnikrishnan, B., George, A., Mundkur, S. C., & Guddattu, V. (2018). Risk factors for malnutrition among preschool children in rural Karnataka: a case-control study. BMC public health, 18, 1-8.

96. Nie, P., Rammohan, A., Gwozdz, W., & Sousa-Poza, A. (2016). Developments in undernutrition in Indian children under five: a decompositional analysis. Available at SSRN 2769201.

97. NITI Aayog (2020). http://niti.gov.in/poshan-abhiyaan#:~:text=The Prime Minister's Overarching Scheme,pregnant women and lactating mothers.&text=Intensified health and nutrition services for the first 1000 days

98. Patel, A., Badhoniya, N., Khadse, S., Senarath, U., Agho, K. E., Dibley, M. J., & South Asia Infant Feeding Research Network (SAIFRN)*. (2010). Infant and young child feeding indicators and determinants of poor feeding practices in India: secondary data analysis of National Family Health Survey 2005–06. Food and nutrition bulletin, 31(2), 314-333.

99. Pathak, P. K., & Singh, A. (2011). Trends in malnutrition among children in India: growing inequalities across different economic groups. Social science & medicine, 73(4), 576-585.

100. Pelletier, D. L., Frongillo, E. A., Gervais, S., Hoey, L., Menon, P., Ngo, T., ... & Ahmed, T. (2012). Nutrition agenda setting, policy formulation and implementation: lessons from the Mainstreaming Nutrition Initiative. Health Policy and Planning, 27(1), 19-31.

101. Pomati, M., Nandy, S. Assessing Progress towards SDG2: Trends and Patterns of Multiple Malnutrition in Young Children under 5 in West and Central Africa. Child Ind Res 13, 1847–1873 (2020). https://doi.org/10.1007/s12187-019-09671-1

102. Popkin, B. M. (1980). Time allocation of the mother and child nutrition. Ecology of food and nutrition, 9(1), 1-13.

103. R. Longhurst and P. Payne, "Seasonal Aspects of Nutrition" (paper presented at IDS/ROSS Conference: Seasonal Dimensions to Rural Poverty, IDS, Sussex, UK, 3-6 July 1978.

104. Rajaram, R., Perkins, J. M., Joe, W., & Subramanian, S. V. (2017). Individual and community levels of maternal autonomy and child undernutrition in India. International journal of public health, 62, 327-335.

105. Rajpal, S., Joe, W., Kim, R., Kumar, A., & Subramanian, S. V. (2020). Child undernutrition and convergence of multisectoral interventions in India: an econometric analysis of National Family Health Survey 2015–16. Frontiers in Public Health, 8, 129.

106. Rajpal, S., Kim, J., Joe, W., Kim, R., & Subramanian, S. V. (2021). Small area variation in child undernutrition across 640 districts and 543 parliamentary constituencies in India. Scientific Reports, 11(1), 1-9

107. Ramji, S. (2009). Impact of infant & young child feeding & caring practices on nutritional status & health. Indian Journal of Medical Research, 130(5), 624-626.

108. Rodriguez-Llanes, J. M., Ranjan-Dash, S., Mukhopadhyay, A., & Guha-Sapir, D. (2016). Flood-exposure is associated with higher prevalence of child undernutrition in rural eastern India. International Journal of Environmental Research and Public Health, 13(2), 210.

109. Ruel, M. T., & Menon, P. (2002). Child feeding practices are associated with child nutritional status in Latin America: innovative uses of the demographic and health surveys. The Journal of nutrition, 132(6), 1180-1187.

110. Ruel, M. T., Alderman, H., & Maternal and Child Nutrition Study Group. (2013). Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition?. The lancet, 382(9891), 536-551.

111. Ruel, M. T., Levin, C. E., Armar-Klemesu, M., Maxwell, D., & Morris, S. S. (1999). Good care practices can mitigate the negative effects of poverty and low maternal schooling on children's nutritional status: evidence from Accra. World Development, 27(11),

112. Rutter, H., Savona, N., Glonti, K., Bibby, J., Cummins, S., Finegood, D. T., ... & Petticrew, M. (2017). The need for a complex systems model of evidence for public health. The Lancet, 390(10112), 2602-2604.

113. Sahu, S. K., Kumar, S. G., Bhat, B. V., Premarajan, K. C., Sarkar, S., Roy, G., & Joseph, N. (2015). Malnutrition among under-five children in India and strategies for control. Journal of natural science, biology, and medicine, 6(1), 18.

114. Saxena, N. C. (2018). Hunger, under-nutrition and food security in India. In Poverty, Chronic Poverty and Poverty Dynamics: Policy Imperatives (pp. 55-92). Singapore: Springer Singapore.

115. Schwarzenberg, S. J., & Georgieff, M. K. (2018). Advocacy for improving nutrition in the first 1000 days to support childhood development and adult health. Pediatrics, 141(2), e20173716.

116. Sethuraman, K., Lansdown, R., & Sullivan, K. (2006). Women's empowerment and domestic violence: the role of sociocultural determinants in maternal and child undernutrition in tribal and rural communities in South India. Food and nutrition bulletin, 27(2), 128-143.

117. Sharma, A. J., & Subramanyam, M. A. (2021). Intersectional role of paternal gender-equitable attitudes and maternal empowerment in child undernutrition: A cross-sectional national study from India. BMJ open, 11(8), e047276.

118. Sheikh, K., Gilson, L., Agyepong, I. A., Hanson, K., Ssengooba, F., & Bennett, S. (2011). Building the field of health policy and systems research: framing the questions. PLoS Med, 8(8), e1001073.

119. Shekar, M., Kakietek, J., Dayton Eberwein, J., & Walters, D. (2017). An investment framework for nutrition: reaching the global targets for stunting, anemia, breastfeeding, and wasting. The World Bank.

120. Shroff, M., Griffiths, P., Adair, L., Suchindran, C., & Bentley, M. (2009). Maternal autonomy is inversely related to child stunting in Andhra Pradesh, India. Maternal & child nutrition, 5(1), 64-74.

121. Singh, K. J., Chiero, V., Kriina, M., Alee, N. T., & Chauhan, K. (2022). Identifying the trend of persistent cluster of stunting, wasting, and underweight among children under five years in northeastern states of India. Clinical Epidemiology and Global Health, 18, 101158.

122. Singh, S. K., Srivastava, S., & Chauhan, S. (2020). Inequality in child undernutrition among urban population in India: a decomposition analysis. BMC public health, 20(1), 1-15.

123. Stiller, C. K., Golembiewski, S. K. E., Golembiewski, M., Mondal, S., Biesalski, H. K., & Scherbaum, V. (2020). Maternal nutritional status and child feeding practices: a retrospective study in Santal communities, Birbhum District, West Bengal, India. International Breastfeeding Journal, 15(1), 1-24.

124. Story, W. T., & Carpiano, R. M. (2017). Household social capital and socioeconomic inequalities in child undernutrition in rural India. Social Science & Medicine, 181, 112-121.

125. Strauss, J., & Thomas, D. (1995). Household resources: Empirical modelling of household and family decisions. Handbook of development economics, 3.

126. Striessnig, E., & Bora, J. K. (2020). Under-five child growth and nutrition status: spatial clustering of Indian districts. Spatial Demography, 8, 63-84.

127. Subbarao, K. (1990). Improving nutrition in India. Policies and programs and their impact. World Bank Discussion Papers, (49).

128. Subramanyam, M. A., Kawachi, I., Berkman, L. F., & Subramanian, S. V. (2010). Socioeconomic inequalities in childhood undernutrition in India: analyzing trends between 1992 and 2005. PloS one, 5(6), e11392

129. Sudfeld, C. R., McCoy, D. C., Danaei, G., Fink, G., Ezzati, M., Andrews, K. G., & Fawzi, W. W. (2015). Linear growth and child development in low-and middle-income countries: a meta-analysis. Pediatrics, 135(5), e1266-e1275.

130. Svedberg, P. (2000). Poverty and undernutrition: theory, measurement, and policy. Clarendon Press.

131. Svedberg, P. (2011). How many people are malnourished?. Annual review of nutrition, 31, 263-283.

132. UNICEF, Division of Data Research and Policy (2019). UNICEF Global Databases: Overlapping Stunting, Wasting and Overweight, January 2019, New York.

133. UNICEF. (1990). A UNICEF Policy Review: Strategy for Improved Nutrition of Children and Women in Developing Countries, Report.

134. Ved, R., Sheikh, K., George, A. S., & Raman, V. R. (2018). Village Health Sanitation and Nutrition Committees: reflections on strengthening community health governance at scale in India. BMJ global health, 3(Suppl 3), e000681.

135. Victora, C. G., Adair, L., Fall, C., Hallal, P. C., Martorell, R., Richter, L., ... & Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: consequences for adult health and human capital. The lancet, 371(9609), 340-357.

136. Vijayaraghavan, K. (2018). National control programme against nutritional blindness due to vitamin A deficiency: Current status & future strategy. The Indian journal of medical research, 148(5), 496.

137. Vikram, K. (2018). Social capital and child nutrition in India: The moderating role of development. Health & place, 50, 42-51.

138. Vir, S., Sreenath, K. C., Bose, V., Chauhan, K., Mathur, S., & Menon, S. (2014). National policies and strategic plans to tackle undernutrition in India: A review.

139. Waber, D. P., Vuori-Christiansen, L., Ortiz, N., Clement, J. R., Christiansen, N. E., Mora, J. O., ... & Herrera, M. G. (1981). Nutritional supplementation, maternal education, and cognitive development of infants at risk of malnutrition. The American journal of clinical nutrition, 34(4), 807-813.

140. Wethington, E. (2005). An overview of the life course perspective: implications for health and nutrition. Journal of nutrition education and behavior, 37(3), 115-120.

141. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr Suppl. 2006;450:76-85. doi:10.1111/j.1651-2227.2006.tb02378

142. Wolfe, B. L., & Behrman, J. R. (1983). Is income overrated in determining adequate nutrition? Economic Development and Cultural Change, 31(3), 525-549.

143. World Health Organization. Expert Committee on Nutrition and Physical Status: uses and interpretation of anthropometry. Geneva: World Health Organization; 1995.

144. Yesmin, F., & Baruah, R. (2014). A comparative study on gender disparity in nutritional status in children under five years in rural and urban communities of Assam, India. Indian Journal of Community Health, 26(Supp 2), 353-358.

Appendices

Appendix 1 List of Dependent Variables and Definitions

Number	Dependent Variable	Definition
1	**HAZ**	Height/Age standard deviation
2	**WAZ**	Weight/Age standard deviation
3	**HWZ**	Weight/Height standard deviation
4	**Severely Stunted**	Children with Height/Age below -3 standard deviations, based on the WHO standard
5	**Severely Wasted**	Children with Weight/Height below -3 standard deviations, based on the WHO standard
6	**Severely Underweight**	Children with Weight/Age below -3 standard deviations, based on the WHO standard
7	**CIAF- Group B**	Children under 5 years who are Wasted Only
8	**CIAF- Group C**	Children under 5 years who are Wasted and Underweight (Double Failure)
9	**CIAF- Group D**	Children under 5 years who are Stunted, Wasted and Underweight (Triple Failure)
10	**CIAF- Group E**	Children under 5 years who are Stunted and Underweight (Double Failure)
11	**CIAF- Group F**	Children under 5 years who are Stunted Only
12	**CIAF- Group Y**	Children under 5 years who are Underweight Only

Appendix 2 List of Domains, Independent Variables, and Codes

No.	Domain	Independent Variable	Code
1	**Breastfeeding and Complementary Feeding**	Children under age 2 years breastfed within one hour of birth	breastfed_within1
2		Children under age 6 months exclusively breastfed	breastfed_upto6
3		Children age 6-23 months receiving minimum acceptable diet*	min_diet
4	**Selected Interventions**	Children whose height and weight are measured at regular interval	monitor_HW
5		Eligible children who are fully immunised (BCG, measles, and 3 doses each of polio and DPT)	immunised
6		Children who received a vitamin A dose in the last 6 months	vitaminA
7	**Child Health and Recent Illness**	Prevalence of diarrhoea (reported) in the last 2 weeks preceding the survey	diarrhoea
8		Prevalence of symptoms of acute respiratory infection (ARI) in the last 2 weeks preceding the survey	ARI
9		Anaemic Child	anemic_child

10	**Antenatal Care**	Mothers who had at least 4 antenatal check-ups	ANC_4
11		Mothers received STR	STR_mother
12		Mothers who consumed iron folic acid for 100 days or more when they were pregnant	IFA_100
13		Registered pregnancies for which the mother received Mother and Child Protection (MCP) card	MCP_card
14		Mothers who received financial assistance under any scheme for births delivered in an institution	financial
15		Health workers ever talked to Mothers about Nutrition	nutrition_aware
16		Mothers whose last birth was protected against neonatal tetanus	tetanus
17	**Maternal Indicators**	Mothers Education	edu_mother
18		Women married before the age of 18 years	underage
19		Age at first birth	age_firstbirth
20		Anaemic Mother	anemic_mother
21		Mothers whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2)14	low_BMI
22		Mothers who are overweight or obese (BMI ≥ 25.0 kg/m2)14	high_BMI
23		Mothers Height	height_mother
24	**Women's Empowerment**	Mother usually participates in household decisions**	decision-making
25		Mother owning a house and/or land alone	owns_landhouse
26		Freedom of movement***	movement
27	**Household Profile**	Households with an improved drinking water source	improved_drinking
28		Households using improved sanitation facility	improved_sanitation
29		Households using clean fuel for cooking	clean_cooking
30		Households with electricity	electricity
31		Family Size	size_family
32	**Socio-economic Indicators**	Wealth	wealth
33		Rural/Urban	rural_urban
34		Religion	religion
35		Social Group (SC/ST/OBC)	group_social

36		Whether covered by insurance	insurance
37	**Birth Related**	Institutional births	institutional
38		Sex of the child	sex_child
39		Birth order of the child	order_birth
40		Low Birthweight	low_birthweight

Appendix 3 Estimation of Minimum Acceptable Diet

A child in the age group 6-23 months is considered to be having minimum dietary diversity if she is fed,

1) Milk or milk products two or more times during the day or night preceding the survey or are breastfeeding, and
2) A minimum dietary diversity of 4 out of 7 food groups fed during the day or night preceding the survey:
    a) Grains, roots and tubers
    b) Legumes and nuts
    c) Dairy products (milk, yoghurt, cheese)
    d) Flesh foods (meat, fish, poultry and liver/organ meats)
    e) Eggs
    f) Vitamin A rich fruits and vegetables
    g) Other fruits and vegetables

A child in the age group 6-23 months is considered to be receiving a minimum acceptable meal frequency if she is fed a minimum meal frequency of,

a) 2 or more solid or semi-solid feeds for breastfeeding children aged 6-8 months, or 3 or more solid or semi-solid feeds for breastfeeding children aged 9-23 months, or
b) 4 or more solid or semi-solid or milk feeds for non-breastfeeding children aged 6-23 months.

A minimum acceptable diet is calculated disaggregated by whether the child is being breastfed or not as follows,

a) Breastfed children – minimum dietary diversity and minimum meal frequency as above

b) Non-breastfed children – minimum dietary diversity but excluding the dairy products category (4 out of 6 groups) and minimum meal frequency and 2 or more milk feeds

The variable score for the independent variable representing the decision-making power of the mother is calculated based on the following information,

a) Decision-making on how to spend respondent's earnings
b) Decision-making on respondent healthcare
c) Decision-making on large household purchases
d) Decision-making on what to do with the money the husband earns
e) Decision-making on visits to family or relatives

The variable score for the independent variable representing the freedom of movement of the mother is calculated based on the following information,

a) Whether the mother is allowed to go to the market alone
b) Whether the mother is allowed to go to the health facility alone
c) Whether the mother is allowed to go to places outside this village alone.

Appendix 4 Dimensions and Indicators used for Calculation of Multi-Dimensional Poverty Index (MPI)

Dimension	Indicator	Deprivation
Health	Nutrition	Mothers were considered undernourished if their body mass index (BMI) was below normal 18.5 kg/m2. Children under the age of five years were considered undernourished if their z-score for either height-for-age (stunting) or weight-for-age(underweight) was below minus two standard deviations from the population's median. Households were considered nutrition deprived if the mother or the child was undernourished.
	Child Mortality	The household was considered deprived if mothers reported child mortality
Education	Years of schooling	The household was considered deprived if no member above 12 years of age completed six years of schooling
	School attendance	The household was considered deprived if any school-going age child was not attending school
Standard of living	Electricity	Deprived if the household has no electricity
	Sanitation	Deprived if the household does not have access to improved sanitation facilities or has access to improved but shared sanitation facilities only. Improved sanitation includes flush toilets or latrines or ventilated improved pits, or composting toilet
	Drinking water	Deprived if the household does not have access to an improved source of drinking water. A source is considered improved if the source is piped water, a public tap, a borehole or pump, a protected well, a protected spring or rainwater
	Housing	Deprived if the house's floor, walls or roof is made of inadequate materials. Mud, clay, earth, sand or dung for flooring; cane, palm, trunks, sod, mud, dirt, grass, reeds, thatch, bamboo, sticks, carton, plastic or polythene sheeting, loosely packed stones, uncovered adobe, raw or reused wood, plywood, unburnt brick, canvas or tent for walls and roofing are considered inadequate.
	Cooking fuel	Deprived if the household uses non-clean cooking fuels such as dung, wood, charcoal or coal.
	Assets	Deprived if the household does not own a car or a truck and does not own more than one of the assets; radio, television, computer, animal cart, bicycle, motorbike or refrigerator

Appendix 5 State-wise anthropometric failure among children under five years of age, Stunting, Wasting, Underweight and CIAF, 2006-2021

	State	*Stunting (%)*			*Wasting (%)*			*Underweight (%)*			*CIAF (%)*		
		NFHS3	NFHS4	NFHS5	NFHS3	NFHS4	NFHS5	NFHS3	NFHS4	NFHS5	NFHS3	NFHS4	NFHS5
1	Andaman	-	26.30	22.77	-	15.92	16.43	-	20.76	22.54	-	40.14	38.03
2	Andhra Pradesh	38.34	32.05	28.90	11.46	17.01	14.30	28.49	32.05	26.50	48.19	47.21	41.55
3	Arunachal Pradesh	42.74	29.86	25.60	14.67	16.77	12.13	31.45	18.46	11.70	54.02	45.24	36.76
4	Assam	44.97	35.99	34.50	13.64	16.02	20.01	35.39	28.40	29.06	55.52	49.72	51.86
5	Bihar	54.10	48.41	39.54	26.90	21.47	21.85	54.45	44.63	37.09	69.30	63.98	56.97
6	Chandigarh	-	29.89	22.49	-	10.92	8.28	-	25.29	18.93	-	40.80	28.40
7	Chhattisgarh	52.31	38.38	33.30	19.88	24.25	17.48	46.04	39.15	29.48	63.98	59.42	48.56
8	Dadra & Nagar Haveli, Damn Diu	-	35.38	34.32	-	24.20	19.71	-	33.30	32.04	-	55.69	49.06
9	Delhi	44.72	29.96	27.04	15.78	17.99	9.57	28.81	26.38	17.98	56.65	45.15	36.06
10	Goa	25.65	20.11	25.21	14.38	20.37	17.56	25.65	23.02	20.40	38.08	42.06	40.23
11	Gujarat	51.51	39.85	37.25	18.64	28.07	24.73	44.73	41.37	36.77	64.48	60.91	57.10
12	Haryana	45.75	34.08	25.07	19.53	21.66	10.07	39.87	30.20	18.73	57.87	53.38	35.00
13	Himachal Pradesh	36.26	25.54	30.50	18.71	14.38	15.02	34.04	20.83	22.07	50.06	39.45	43.93
14	J&K	35.29	28.42	24.86	14.50	11.45	17.77	25.35	16.76	17.18	46.86	38.94	41.55
15	Jharkhand	48.04	44.90	37.69	31.67	29.64	20.57	54.98	48.07	35.32	68.02	66.42	54.14
16	Karnataka	43.89	37.89	33.29	17.86	24.95	17.11	37.84	36.03	28.01	56.87	57.72	48.27
17	Kerala	24.55	19.60	22.46	15.74	16.11	14.49	22.66	16.60	17.48	39.51	35.21	36.49
18	Ladakh	-	-	28.94	-	0.00	16.38	-	-	16.60	-	-	43.62
19	Lakshadweep	-	26.33	29.27	-	13.52	17.89	-	22.42	22.36	-	39.15	44.72
20	Madhya Pradesh	46.12	42.19	32.76	34.37	26.26	16.65	55.83	43.55	28.86	69.29	62.38	47.09
21	Maharashtra	43.91	36.06	33.50	16.38	25.18	23.51	35.90	37.30	32.75	56.27	56.57	52.98
22	Manipur	34.60	30.00	23.67	8.92	7.02	9.67	21.70	13.96	11.77	42.97	36.55	33.18
23	Meghalaya	55.25	43.84	44.48	30.14	15.62	11.17	48.10	29.17	24.60	71.54	57.68	53.71
24	Mizoram	40.24	29.84	29.94	8.81	7.91	9.11	20.19	13.69	12.35	48.10	37.50	38.49

25	Nagaland	37.18	28.99	32.95	12.67	11.58	16.47	24.09	16.94	25.22	47.46	38.98	46.86
26	Odisha	43.79	34.83	31.21	18.82	21.73	17.57	39.54	35.76	28.65	57.25	52.52	46.42
27	Puducherry	-	26.46	26.91	-	17.25	10.52	-	21.16	17.49	-	42.65	37.70
28	Punjab	36.54	25.39	22.72	8.91	15.47	9.43	24.71	21.30	15.33	42.98	38.96	31.76
29	Rajasthan	43.54	38.81	30.41	20.54	23.83	16.61	39.85	37.21	24.81	57.69	57.62	45.01
30	Sikkim	37.14	29.40	21.39	10.82	15.37	9.45	20.41	14.81	8.02	46.73	44.99	30.30
31	Tamilnadu	30.07	27.06	24.15	21.66	20.23	13.41	29.60	24.71	18.73	48.40	45.00	36.57
32	Telangana	-	29.62	30.97	-	19.32	19.54	-	30.11	28.57	-	45.74	48.37
33	Tripura	35.83	25.17	31.39	24.86	17.76	18.09	38.94	25.17	22.97	53.02	41.84	48.02
34	Uttarakhand	44.20	33.05	25.56	18.63	19.97	11.02	37.66	26.62	16.36	56.10	50.13	35.57
35	Uttar Pradesh	54.35	45.91	36.46	14.03	17.80	15.62	39.94	38.91	27.56	63.81	59.60	49.69
36	West Bengal	40.88	33.80	32.87	16.52	20.85	19.84	34.96	33.33	30.01	53.25	50.89	49.57
37	**India**	**43.67**	**38.36**	**32.84**	**18.14**	**20.41**	**16.97**	**37.15**	**34.50**	**26.93**	**56.53**	**54.79**	**47.40**

Source: Author's calculations using NFHS 3, 4- & 5-unit level data

Appendix 6 Compilation of States by sub-categories of CIAF, 2006 to 2021, in percent

		CIAF Subcategory																	
		Group B (%)			*Group C* (%)			*Group D* (%)			*Group E* (%)			*Group F* (%)			*Group Y* (%)		
	NFHS Round →	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5
	States/UT																		
1	Andaman*	-	6.40	6.34	-	5.88	6.81	-	3.63	3.29	-	9.69	10.33	-	12.98	9.15	-	1.56	2.11
2	Andhra Pradesh*	3.45	5.04	4.02	4.45	6.93	5.71	3.45	5.04	4.58	18.75	16.89	13.29	16.03	10.12	11.04	16.03	3.19	2.93
3	Arunachal Pradesh	4.23	8.54	6.53	5.64	5.97	3.84	4.80	2.26	1.76	19.61	9.37	5.32	18.19	18.23	18.53	18.19	0.86	0.78
4	Assam	3.25	5.41	7.34	4.79	6.23	7.87	5.60	4.38	4.80	22.32	15.70	14.25	16.72	15.91	15.46	16.72	2.09	2.15
5	Bihar	4.45	5.16	6.33	8.25	7.80	8.80	14.10	8.51	6.72	29.40	25.71	19.27	10.15	14.19	13.55	10.15	2.60	2.30
6	Chandigarh*	-	2.30	0.59	-	5.17	4.14	-	3.45	3.55	-	13.22	10.06	-	13.22	8.88	0.00	3.45	1.18

7	Chhattisgarh	3.53	6.97	5.63	6.27	10.96	7.05	10.09	6.32	4.81	27.67	18.77	15.04	14.19	13.29	13.45	14.19	3.10	2.59
8	Dadra & Nagar Haveli Damn & Diu*	-	9.28	5.90	-	9.40	6.43	-	5.53	7.37	-	16.74	15.82	-	13.11	11.13	-	1.63	2.41
9	Delhi	4.94	7.34	3.83	5.76	5.94	3.65	4.94	4.72	2.09	16.87	13.80	10.69	22.50	11.44	14.26	22.50	1.92	1.55
10	Goa	3.37	10.32	8.22	6.48	7.67	4.53	4.53	2.38	4.82	11.92	8.99	8.78	8.94	8.73	11.61	8.94	3.97	2.27
11	Gujarat	4.13	7.77	7.49	5.45	10.88	9.72	8.92	9.42	7.52	26.97	18.67	16.89	15.55	11.76	12.84	15.55	2.41	2.64
12	Haryana	3.44	7.78	3.91	6.78	9.18	3.90	9.31	4.70	2.25	21.79	13.98	10.46	14.38	15.40	12.35	14.38	2.34	2.12
13	Himachal Pradesh	5.15	6.02	5.46	6.20	5.58	6.15	7.25	2.77	3.42	18.25	10.18	10.67	10.53	12.59	16.41	10.53	2.30	1.83
14	J&K	5.68	5.65	9.31	4.56	3.81	6.26	4.16	1.99	2.21	15.21	9.91	7.58	15.52	16.52	15.07	15.52	1.06	1.13
15	Jharkhand	5.66	6.80	5.38	10.78	11.57	8.81	15.08	11.26	6.38	25.57	22.10	17.88	7.32	11.54	13.44	7.32	3.14	2.25
16	Karnataka	4.05	8.26	6.46	6.39	9.04	6.24	7.35	7.66	4.41	21.36	16.80	15.08	14.56	13.43	13.80	14.56	2.54	2.28
17	Kerala	6.03	7.87	6.59	5.69	6.22	5.44	3.79	2.01	2.45	9.93	6.85	7.59	10.60	10.74	12.42	10.60	1.52	1.99
18	Ladakh*	-	-	7.87	-	-	5.74	-	-	2.77	-	-	7.02	-	-	19.15	-	-	1.06
19	Lakshadweep*	-	4.27	3.66	-	6.05	10.16	-	3.20	4.07	-	10.68	6.50	-	12.46	18.70	-	2.49	1.63
20	Madhya Pradesh	6.09	6.74	5.02	13.23	10.53	6.93	14.79	8.98	4.70	23.96	21.12	14.85	7.06	12.09	13.21	7.06	2.91	2.38
21	Maharashtra	3.72	7.63	7.47	5.82	9.91	9.44	6.80	7.63	6.61	20.32	16.78	14.12	16.43	11.64	12.77	16.43	2.97	2.58
22	Manipur	3.61	3.18	5.51	3.12	2.40	3.10	2.08	1.45	1.06	14.98	9.15	6.71	17.18	19.41	15.90	17.18	0.97	0.90
23	Meghalaya	3.96	6.20	4.45	10.20	6.28	3.79	15.98	3.14	2.93	19.79	18.39	16.89	19.33	22.31	24.66	19.33	1.36	0.99
24	Mizoram	3.79	3.67	5.18	2.57	2.92	2.55	2.44	1.32	1.38	13.69	8.38	7.60	24.12	20.14	20.95	24.12	1.07	0.82
25	Nagaland	5.02	4.86	6.70	4.12	4.10	5.84	3.53	2.61	3.93	15.30	9.20	14.08	18.29	17.18	14.94	18.29	1.02	1.37
26	Odisha	4.71	5.38	5.24	6.14	9.22	7.24	7.91	7.13	5.09	22.61	16.31	13.59	12.94	11.38	12.53	12.94	3.09	2.72
27	Puducherry*	-	7.41	5.87	-	7.41	3.42	-	2.43	1.23	-	9.95	11.34	-	14.07	14.34	-	1.38	1.50
28	Punjab	2.12	5.25	3.94	2.65	6.60	3.69	4.06	3.62	1.80	16.33	9.36	8.43	16.06	12.41	12.49	16.06	1.73	1.41
29	Rajasthan	4.93	6.66	6.34	7.51	9.74	6.56	8.10	7.43	3.70	22.54	17.63	12.85	12.68	13.75	13.86	12.68	2.41	1.69
30	Sikkim	4.08	9.35	5.53	3.88	4.34	2.67	2.86	1.67	1.25	12.04	6.90	3.39	22.04	20.82	16.76	22.04	1.89	0.71
31	Tamilnadu	7.20	8.18	5.06	8.96	7.86	5.55	5.36	4.20	2.79	13.17	10.75	8.59	11.47	12.11	12.77	11.47	1.90	1.80
32	Telangana*	-	6.65	7.18	-	6.65	7.50	-	6.01	4.85	-	14.64	13.51	-	8.97	12.61	-	2.81	2.71

33	Tripura	4.75	6.23	7.59	9.69	7.91	7.17	10.24	3.62	3.33	16.09	11.11	10.60	8.78	10.44	17.46	8.78	2.53	1.87
34	Uttarakhand	3.71	7.61	4.78	6.24	8.17	3.91	8.68	4.19	2.32	20.59	12.96	8.81	14.63	15.90	14.43	14.63	1.30	1.31
35	Uttar Pradesh	3.34	4.36	5.30	4.46	6.88	6.10	6.15	6.56	4.22	27.69	23.02	15.40	20.19	16.33	16.84	20.19	2.45	1.83
36	West Bengal	4.44	5.01	6.14	5.82	9.19	7.99	6.07	6.65	5.71	21.01	14.59	13.75	13.61	12.56	13.41	13.61	2.89	2.56
	India	**4.32**	**6.04**	**5.89**	**6.31**	**8.03**	**6.66**	**7.42**	**6.34**	**4.43**	**21.16**	**17.77**	**13.82**	**14.82**	**14.25**	**14.58**	**14.82**	**2.36**	**2.02**

Source: Author's calculations using NFHS 3, 4- & 5-unit level data

Note: *Classification: Wasting only(**B**), Wasted and underweight(**C**), Stunted, wasted, and Underweight (**D**), Stunted and underweight(**E**), Stunting only(**F**), underweight only (**Y**)*

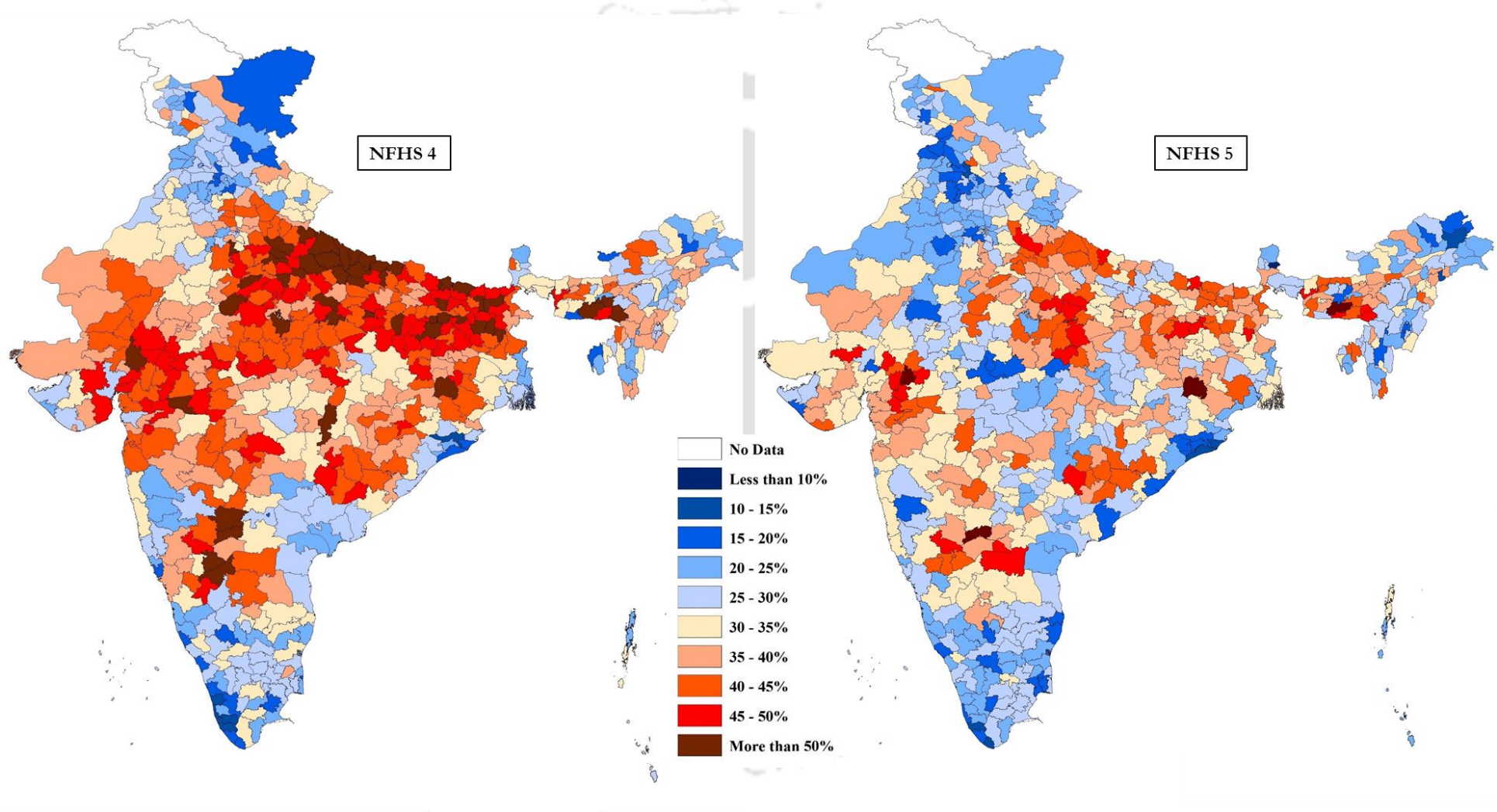
Appendix 7 State-wise indicators of severe and multiple anthropometric failures among children under five years of age, 2006-2021

		Severe Stunting (%)			**Severe Wasting (%)**			**Severe Underweight (%)**			**Wasted & Underweight (%)**			**Stunted Wasted & Underweight (%)**			**Stunted & Underweight (%)**		
	NFHS round →	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5
1	Andaman	-	7.79	9.15	-	6.75	6.34	-	4.84	6.57	-	5.88	6.81	-	3.63	3.29	-	9.69	10.33
2	Andhra Pradesh	15.75	10.73	10.21	3.17	4.50	5.29	8.51	7.08	7.09	4.45	6.93	5.71	3.45	5.04	4.58	18.75	16.89	13.29
3	Arunachal Pradesh	21.30	12.78	11.04	5.92	7.95	5.89	10.72	5.51	3.49	5.64	5.97	3.84	4.80	2.26	1.76	19.61	9.37	5.32
4	Assam	20.13	13.79	15.03	4.06	5.76	8.49	11.12	7.75	8.52	4.79	6.23	7.87	5.60	4.38	4.80	22.32	15.70	14.25
5	Bihar	27.50	23.18	18.45	8.15	7.41	8.70	23.10	15.63	11.78	8.25	7.80	8.80	14.10	8.51	6.72	29.40	25.71	19.27
6	Chandigarh	-	6.90	6.51	-	4.02	1.78	-	6.32	5.33	-	5.17	4.14	-	3.45	3.55	-	13.22	10.06
7	Chhattisgarh	24.14	16.70	14.01	5.62	9.02	6.80	15.85	11.96	8.22	6.27	10.96	7.05	10.09	6.32	4.81	27.67	18.77	15.04
8	Dadra & Nagar Haveli Damn & Diu	-	15.55	12.20	-	9.97	4.29	-	9.45	9.38	-	9.40	6.43	-	5.53	7.37	-	16.74	15.82
9	Delhi	23.18	9.08	10.04	6.86	6.64	4.08	10.15	6.90	4.19	5.76	5.94	3.65	4.94	4.72	2.09	16.87	13.80	10.69
10	Goa	9.97	7.67	7.08	5.18	8.47	6.52	6.87	4.76	4.82	6.48	7.67	4.53	4.53	2.38	4.82	11.92	8.99	8.78
11	Gujarat	25.50	17.23	17.09	5.90	10.38	10.57	16.29	14.11	12.08	5.45	10.88	9.72	8.92	9.42	7.52	26.97	18.67	16.89

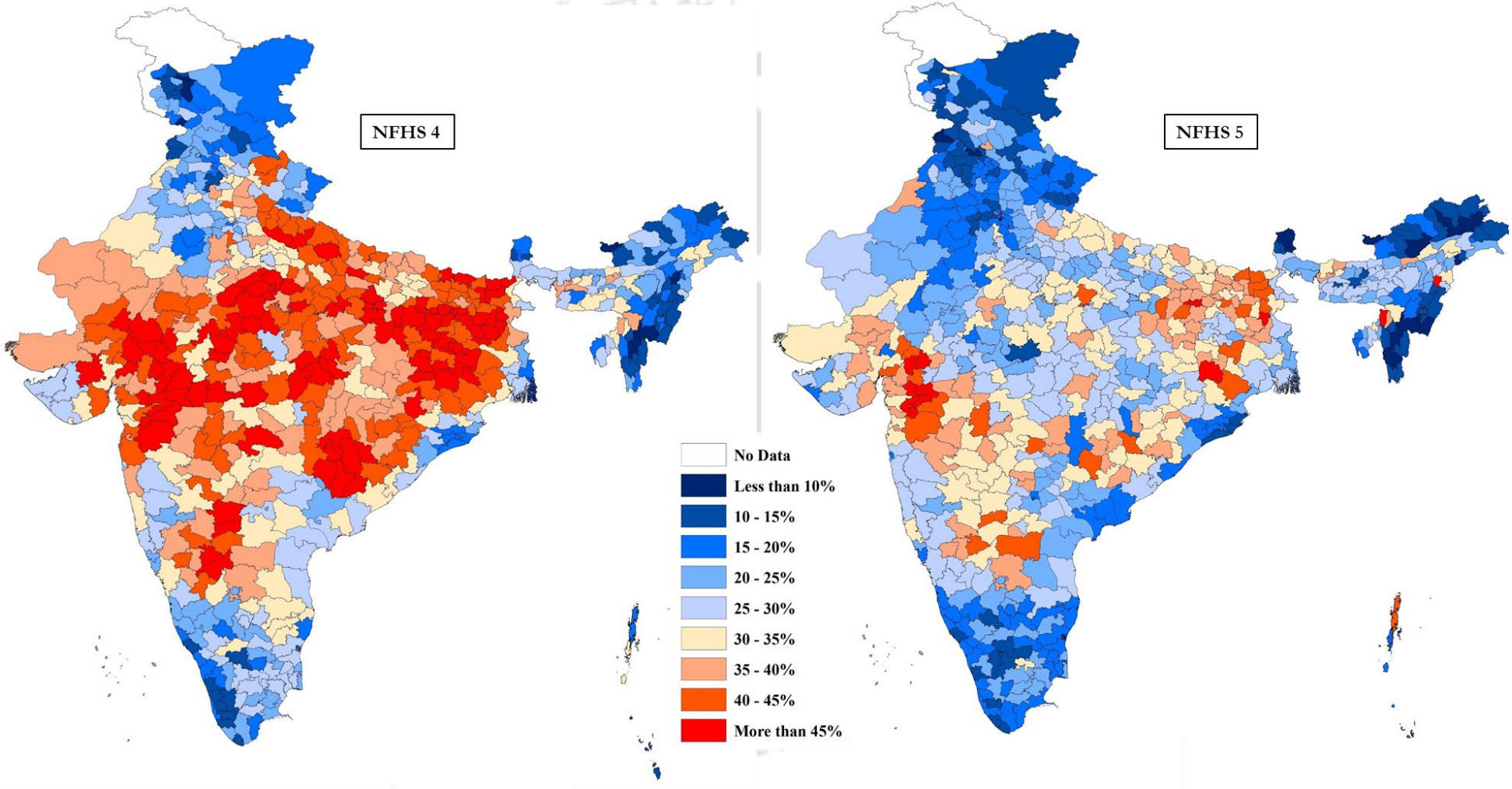
12	Haryana	19.35	14.33	9.70	5.06	9.11	3.62	14.38	8.38	4.49	6.78	9.18	3.90	9.31	4.70	2.25	21.79	13.98	10.46
13	Himachal Pradesh	15.32	8.12	12.91	5.03	4.63	5.94	10.76	4.48	5.05	6.20	5.58	6.15	7.25	2.77	3.42	18.25	10.18	10.67
14	J&K	15.01	11.57	10.46	4.16	4.95	8.69	8.11	4.44	4.95	4.56	3.81	6.26	4.16	1.99	2.21	15.21	9.91	7.58
15	Jharkhand	25.11	19.61	16.69	11.39	11.69	8.03	24.51	17.33	11.18	10.78	11.57	8.81	15.08	11.26	6.38	25.57	22.10	17.88
16	Karnataka	20.88	17.06	14.00	5.98	9.94	6.85	12.98	12.30	7.39	6.39	9.04	6.24	7.35	7.66	4.41	21.36	16.80	15.08
17	Kerala	6.25	6.53	7.13	4.24	6.80	5.25	4.46	3.98	3.83	5.69	6.22	5.44	3.79	2.01	2.45	9.93	6.85	7.59
18	Ladakh	-	-	13.62	-	-	8.51	-	-	5.32	-	-	5.74	-	-	2.77	-	-	7.02
19	Lakshadweep	-	5.69	7.32	-	3.20	9.35	-	4.98	6.91	-	6.05	10.16	-	3.20	4.07	-	10.68	6.50
20	Madhya Pradesh	22.94	18.87	12.94	12.56	9.41	5.80	24.35	14.67	8.37	13.23	10.53	6.93	14.79	8.98	4.70	23.96	21.12	14.85
21	Maharashtra	17.28	13.97	13.76	4.83	9.29	10.06	10.92	11.15	10.39	5.82	9.91	9.44	6.80	7.63	6.61	20.32	16.78	14.12
22	Manipur	12.10	9.06	7.42	2.08	2.36	3.90	4.46	2.38	2.03	3.12	2.40	3.10	2.08	1.45	1.06	14.98	9.15	6.71
23	Meghalaya	29.22	19.12	20.70	19.48	7.35	4.25	27.40	7.40	6.44	10.20	6.28	3.79	15.98	3.14	2.93	19.79	18.39	16.89
24	Mizoram	18.16	9.63	13.09	3.52	2.83	4.75	5.01	2.65	2.94	2.57	2.92	2.55	2.44	1.32	1.38	13.69	8.38	7.60
25	Nagaland	17.57	10.59	13.67	4.78	4.44	6.36	6.58	4.44	6.49	4.12	4.10	5.84	3.53	2.61	3.93	15.30	9.20	14.08
26	Odisha	19.15	12.75	11.29	5.03	6.50	5.92	12.94	9.95	7.12	6.14	9.22	7.24	7.91	7.13	5.09	22.61	16.31	13.59
27	Puducherry	-	9.84	10.25	-	6.98	3.01	-	5.50	2.46	-	7.41	3.42	-	2.43	1.23	-	9.95	11.34
28	Punjab	17.30	7.96	8.41	2.12	5.54	3.16	7.68	5.60	3.53	2.65	6.60	3.69	4.06	3.62	1.80	16.33	9.36	8.43
29	Rajasthan	22.59	17.00	12.34	7.34	8.90	7.58	15.26	12.52	7.25	7.51	9.74	6.56	8.10	7.43	3.70	22.54	17.63	12.85
30	Sikkim	16.94	12.92	10.70	4.08	6.68	5.17	5.71	3.34	2.50	3.88	4.34	2.67	2.86	1.67	1.25	12.04	6.90	3.39
31	Tamilnadu	10.25	10.61	8.72	8.69	7.90	4.96	6.52	6.73	4.39	8.96	7.86	5.55	5.36	4.20	2.79	13.17	10.75	8.59
32	Telangana	-	9.71	12.49	-	4.88	7.40	-	8.58	7.73	-	6.65	7.50	-	6.01	4.85	-	14.64	13.51
33	Tripura	14.63	8.42	15.12	8.78	7.07	7.69	15.54	5.81	5.87	9.69	7.91	7.17	10.24	3.62	3.33	16.09	11.11	10.60
34	Uttarakhand	23.02	13.64	10.21	5.17	9.47	4.31	15.32	7.57	4.22	6.24	8.17	3.91	8.68	4.19	2.32	20.59	12.96	8.81
35	Uttar Pradesh	30.52	20.79	16.49	4.90	5.92	6.75	14.98	12.15	8.36	4.46	6.88	6.10	6.15	6.56	4.22	27.69	23.02	15.40
36	West Bengal	16.17	11.41	13.53	4.49	6.76	6.97	10.21	9.36	8.65	5.82	9.19	7.99	6.07	6.65	5.71	21.01	14.59	13.75
	India	**20.57**	**16.26**	**13.94**	**6.05**	**7.46**	**6.85**	**13.21**	**10.76**	**7.79**	**6.31**	**8.03**	**6.66**	**7.42**	**6.34**	**4.43**	**21.16**	**17.77**	**13.82**

Source: Author's calculations using NFHS 3, 4- & 5-unit level data

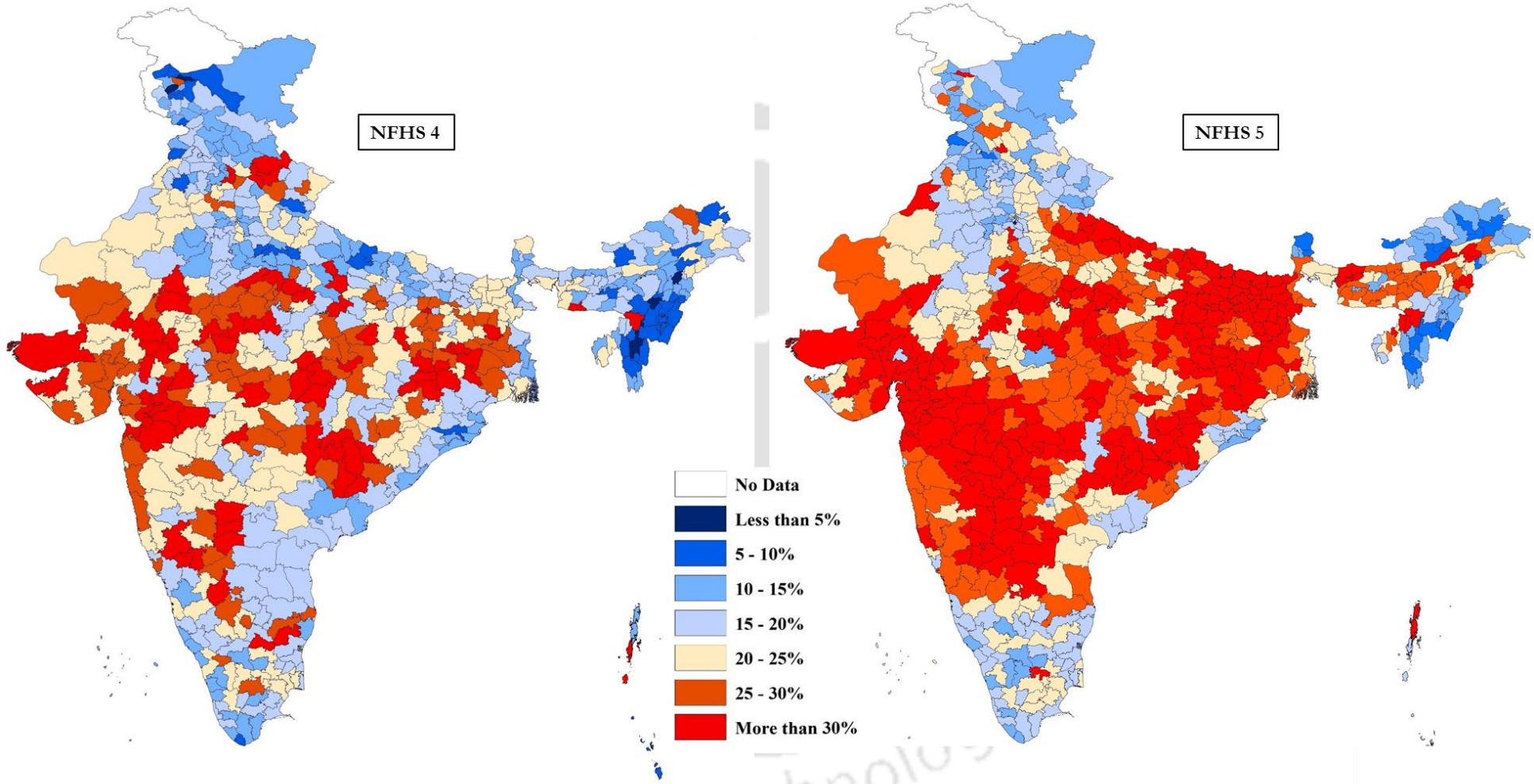
Appendix Figure 1 Prevalence of Stunting in India



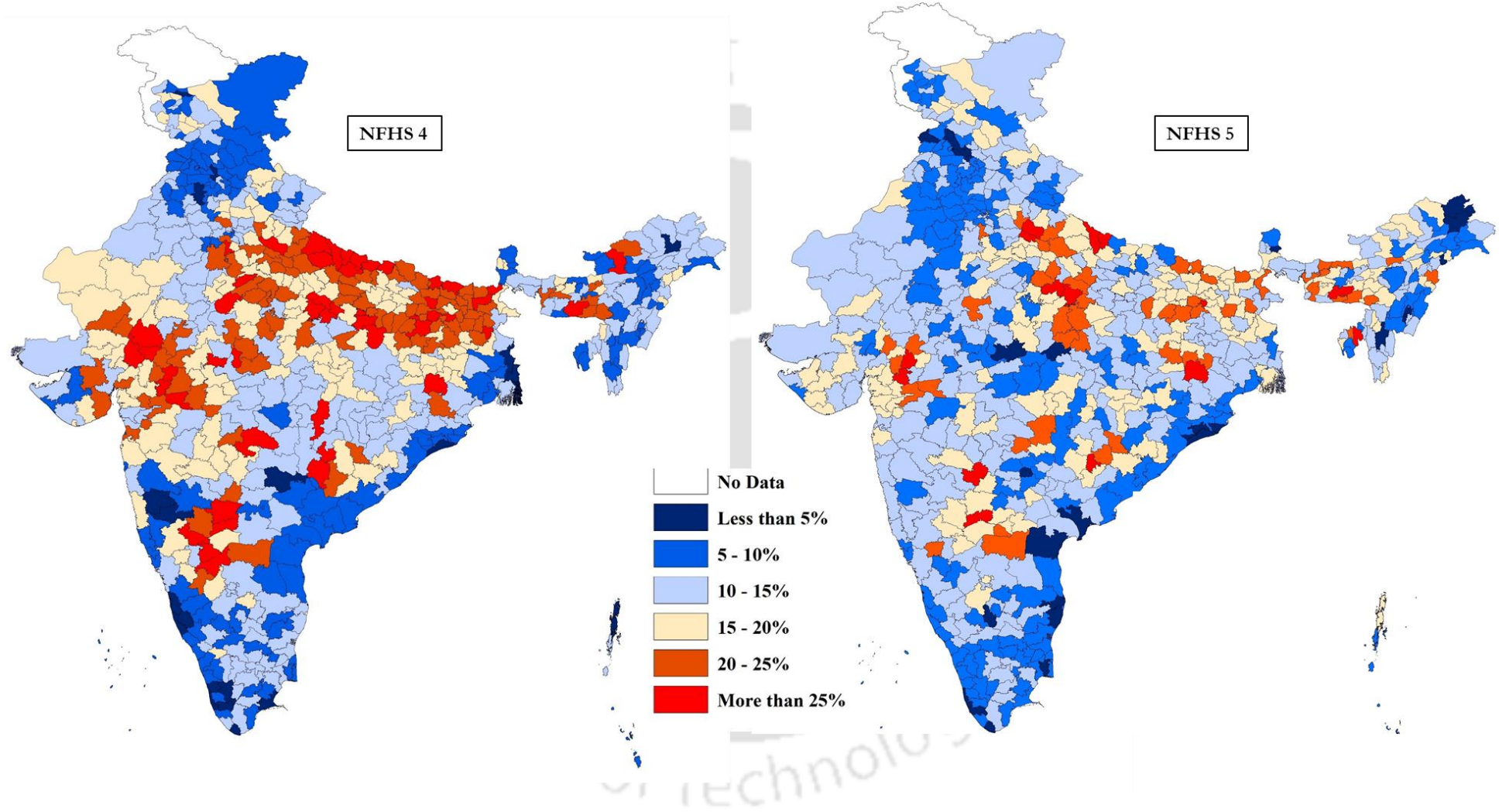
Appendix Figure 2 Prevalence of Underweight in India



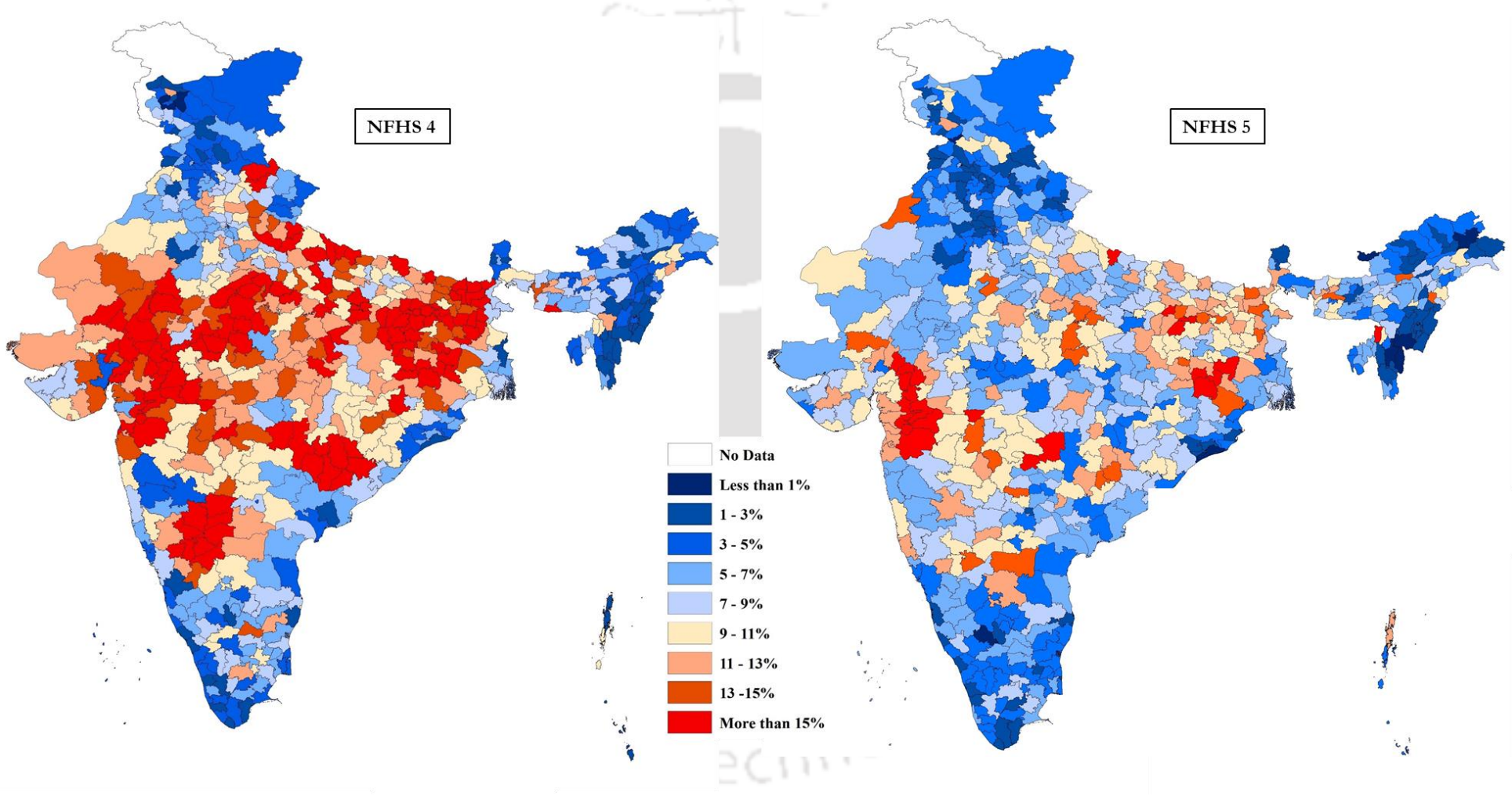
Appendix Figure 3 Prevalence of Wasting in India



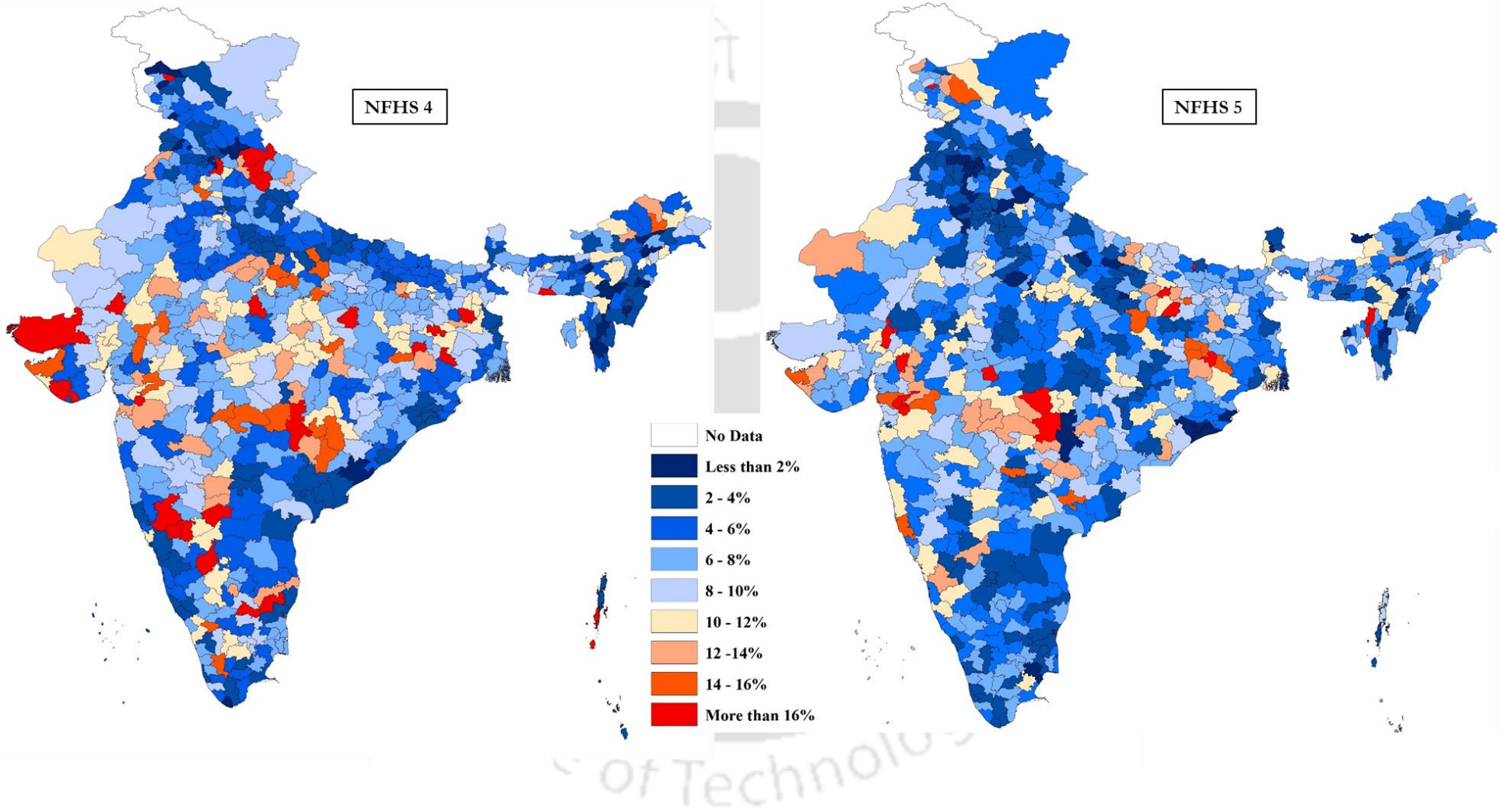
Appendix Figure 4 Prevalence of Severe Stunting in India



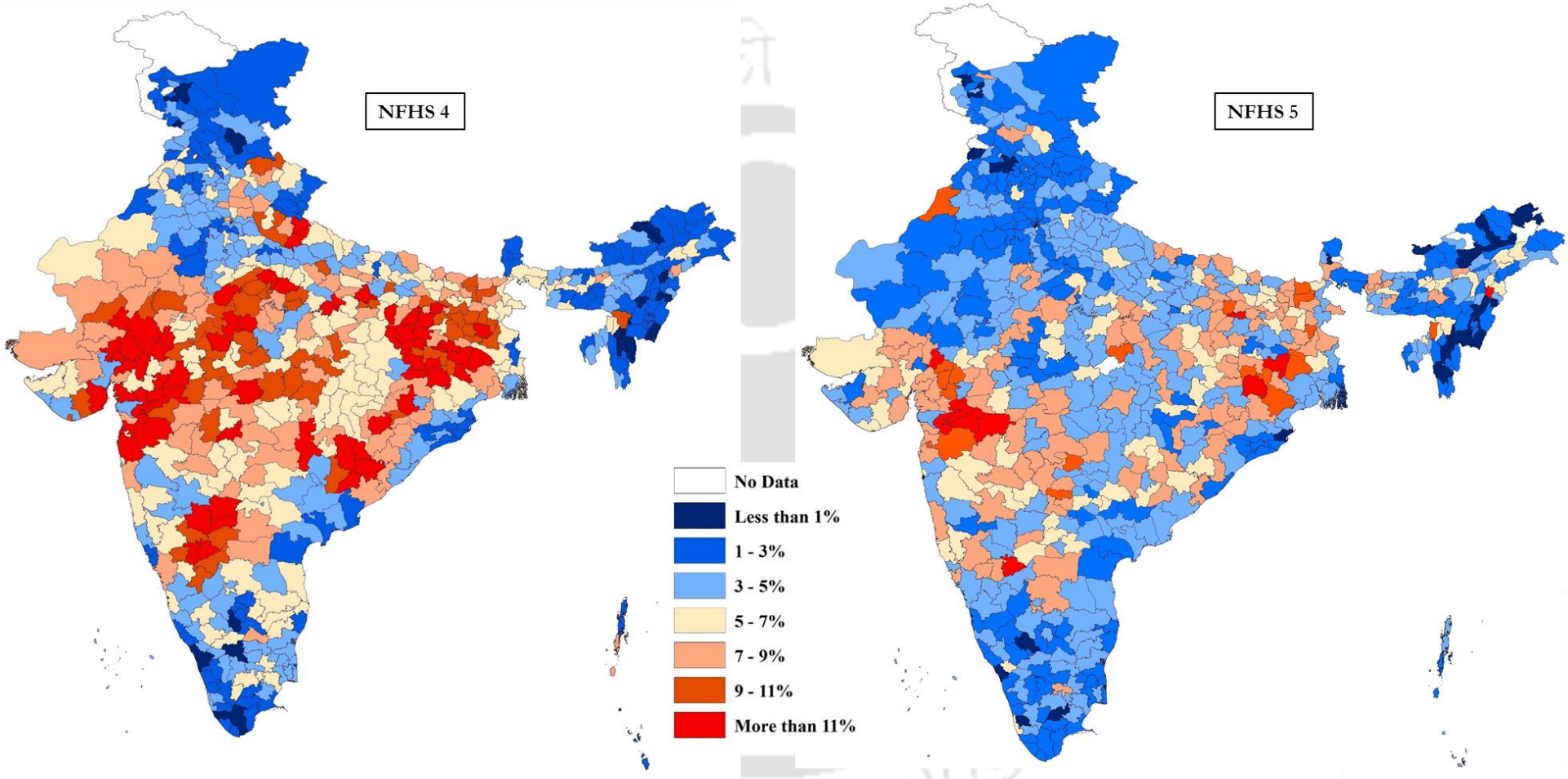
Appendix Figure 5 Prevalence of Severe Underweight in India



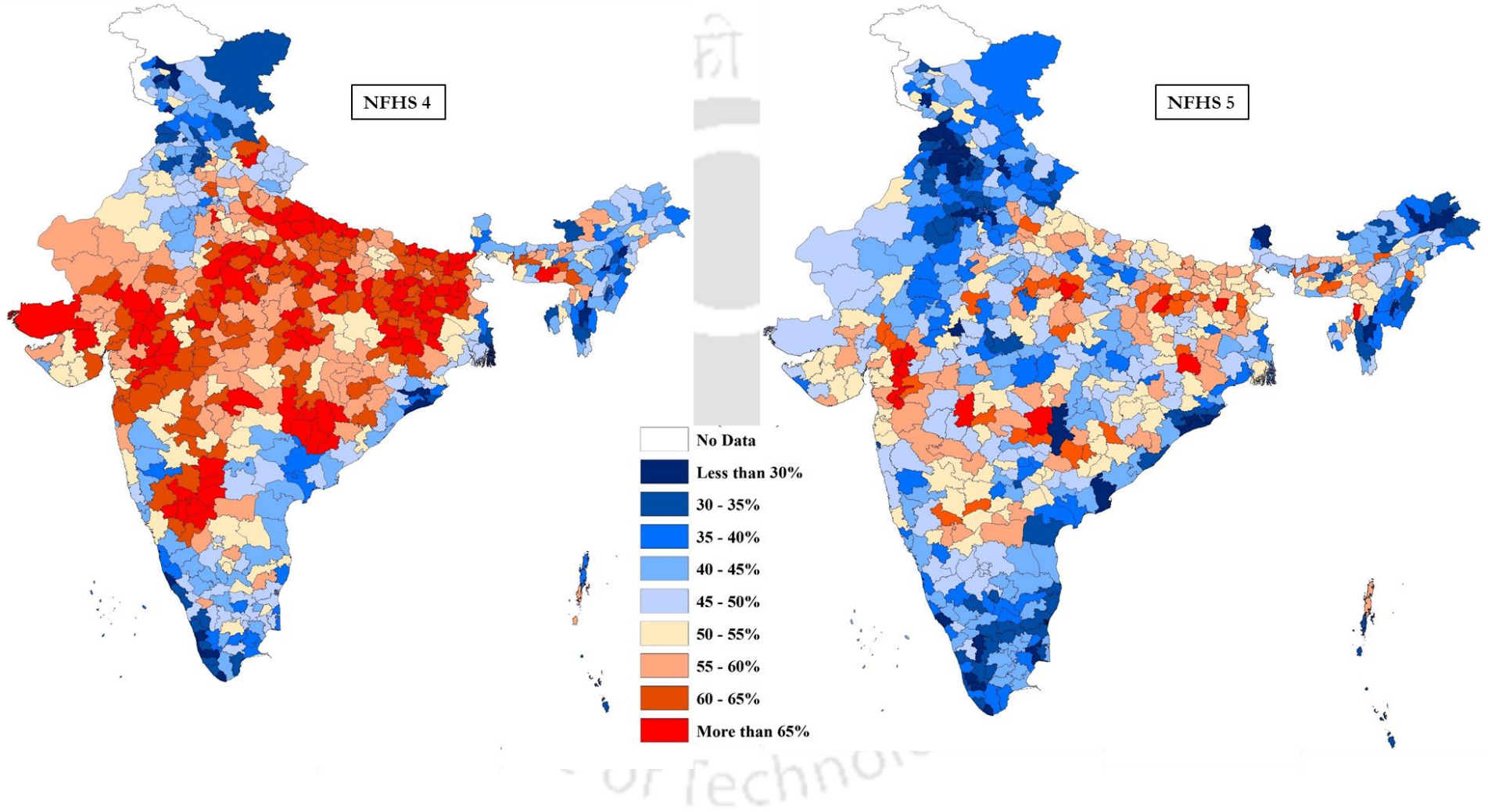
Appendix Figure 6 Prevalence of Severe Wasting in India



Appendix Figure 7 Prevalence of Triple Anthropometric Failure in India



Appendix Figure 8 Prevalence of CIAF in India



Appendix 8 State-wise Changes in Children Under-five (Ch-U5) Population, in Traditional Indicators of Anthropometric Failure and CIAF, 2006-16 (in percent)

	State	*Change in the Ch-U5 population*	*Change in Stunting*	*Change in wasting*	*Change in Underweight*	*Change in CIAF*
1	Arunachal Pradesh	3.65 (+)	12.89 (-)	2.04 (+)	12.90 (-)	8.74 (-)
2	Assam	5.89 (+)	9.42 (-)	2.28 (+)	6.86 (-)	5.80 (-)
3	Bihar	15.98 (+)	5.63 (-)	5.54 (-)	9.94 (-)	5.37 (-)
4	Chhattisgarh	3.59 (+)	13.88 (-)	4.38 (+)	6.58 (-)	4.44 (-)
5	Goa	2.52 (-)	5.41 (-)	5.87 (+)	3.02 (-)	3.60 (+)
6	Gujarat	3.64 (+)	11.90 (-)	9.46 (+)	3.23 (-)	3.83 (-)
7	Haryana	3.90 (+)	11.85 (-)	2.21 (+)	9.69 (-)	4.54 (-)
8	Himachal Pradesh	1.71 (-)	25.33 (-)	5.08 (-)	19.00 (-)	24.57 (-)
9	Jammu & Kashmir	46.83 (+)	6.89 (-)	3.36 (-)	8.92 (-)	8.18 (-)
10	Jharkhand	11.58 (+)	2.95 (-)	2.27 (-)	6.83 (-)	1.78 (-)
11	Karnataka	2.11 (+)	5.65 (-)	7.04 (+)	2.15 (-)	1.01 (+)
12	Kerala	11.29 (-)	4.93 (-)	0.28 (+)	6.26 (-)	4.39 (-)
13	Madhya Pradesh	1.39 (+)	3.85 (-)	8.15 (-)	12.23 (-)	6.76 (-)
14	Maharashtra	1.79 (-)	7.77 (-)	8.81 (+)	1.47 (-)	0.48 (+)
15	Manipur	25.04 (+)	4.69 (-)	1.81 (-)	8.00 (-)	6.39 (-)
16	Meghalaya	25.14 (+)	11.41 (-)	14.36 (-)	18.67 (-)	13.67 (-)
17	Mizoram	20.26 (+)	10.42 (-)	0.78 (-)	6.49 (-)	10.70 (-)
18	Nagaland	5.12 (+)	7.96 (-)	1.02 (-)	7.08 (-)	8.31 (-)
19	Odisha	2.22 (+)	8.84 (-)	2.67 (+)	3.65 (-)	4.81 (-)
20	Punjab	0.23 (+)	11.32 (-)	6.52 (+)	3.40 (-)	4.24 (-)
21	Rajasthan	0.95 (+)	4.44 (-)	3.35 (+)	2.69 (-)	0.01 (+)
22	Sikkim	19.00 (-)	7.95 (-)	4.77 (+)	5.58 (-)	1.52 (-)
23	Tamilnadu	3.54 (+)	3.08 (-)	1.50 (-)	4.69 (-)	3.50 (-)
24	Tripura	9.54 (+)	10.78 (-)	7.22 (-)	14.07 (-)	11.21 (-)
25	Uttar Pradesh	1.66 (-)	8.33 (-)	3.78 (+)	1.01 (-)	4.15 (-)
26	Uttarakhand	0.30 (+)	11.41 (-)	1.15 (+)	10.99 (-)	6.29 (-)
27	West Bengal	3.72 (-)	7.26 (-)	4.32 (+)	1.40 (-)	2.45 (-)

Source: Author's calculations based on unit-level data from NFHS-3 and 4.

Note: Ch-U5 population projections for 2006 and 2016 are based on the decadal growth rate estimated from Census 2001 and 2011. Grey cells are states that registered an increase in the respective indicators

Appendix 9 District-wise anthropometric failure among children under five years of age in Assam, Stunting, Wasting, Underweight and CIAF, 2016-2020

	District Name	Stunting (%)		Underweight (%)		Wasting (%)		CIAF (%)	
		NFHS4	NFHS5	NFHS4	NFHS5	NFHS4	NFHS5	NFHS4	NFHS5
1	Baksa	32.32	43.05	22.26	28.15	10.67	16.56	43.29	56.95
2	Barpeta	41.91	29.47	33.42	24.14	16.18	19.12	55.97	47.34
3	Bongaigaon	39.09	44.48	32.25	32.03	22.15	19.93	57.65	61.57
4	Cachar	35.91	27.27	35.91	33.06	30.54	28.93	59.06	53.72
5	Chirang	39.29	41.33	24.11	36.00	12.80	18.33	49.11	59.33
6	Darrang	43.31	38.49	37.80	29.93	19.95	23.68	58.01	59.21
7	Dhemaji	35.77	34.48	15.93	23.79	6.27	15.52	41.51	48.97
8	Dhubri	47.42	41.61	39.43	32.31	22.16	19.72	64.18	56.90
9	Dibrugarh	32.59	26.02	32.59	30.48	21.85	20.07	51.11	44.98
10	Dima hasao	35.19	29.44	18.52	19.05	6.35	22.94	41.80	50.22
11	Goalpara	43.77	38.74	38.99	29.80	21.22	22.85	61.80	56.95
12	Golaghat	32.48	25.84	20.44	22.01	14.23	18.66	44.53	41.15
13	Hailakandi	37.77	39.13	32.45	36.84	19.15	19.68	53.99	57.21
14	Jorhat	25.84	36.33	19.10	29.39	14.98	14.69	39.70	48.16
15	Kamrup	34.29	18.03	29.64	14.75	18.93	13.52	50.36	31.56
16	Kamrup Metropolitan	23.68	22.04	21.58	24.19	11.05	18.82	36.32	41.40
17	Karbi Anglong	28.25	33.80	23.82	25.46	18.84	20.55	42.94	49.05
18	Karimganj	41.71	29.40	35.71	46.27	17.97	46.51	58.53	68.43
19	Kokrajhar	30.58	31.54	26.46	31.90	15.46	19.71	43.99	46.59
20	Lakhimpur	29.50	39.02	23.91	31.44	11.18	17.80	40.68	54.92
21	Morigaon	37.23	39.78	26.03	29.01	10.46	14.64	43.80	50.83
22	Nagaon	38.40	37.86	31.20	29.01	13.33	12.64	50.13	49.41
23	Nalbari	26.79	26.61	20.36	25.00	15.71	14.52	41.79	41.13
24	Sivasagar	36.36	36.63	22.91	26.93	8.36	15.09	44.73	49.74
25	Sonitpur	28.40	34.95	26.46	31.31	21.01	23.09	48.64	54.82

26	Tinsukia	35.99	29.92	32.48	29.17	14.33	20.45	48.73	47.35
27	Udalguri	38.77	32.03	32.00	28.52	18.77	20.31	55.08	51.17
	Assam	**35.99**	**34.50**	**28.40**	**29.06**	**16.02**	**20.01**	**49.72**	**51.86**
	India	**38.36**	**32.84**	**34.50**	**26.93**	**20.41**	**16.97**	**54.79**	**47.40**

Source: Author's calculations using NFHS 4 & 5-unit level data

Sonitpur, Sivasagar, Nagaon, Dhubri, and Karbi Anglong contains newly formed Biswanath, Charaideo, Hojai, South Salmara, and West Karbi Anglong districts, respectively.

Appendix 10 District-wise indicators of severe and multiple anthropometric failures among children under five years of age in Assam, 2016-2020

	Severe Stunting (%)		**Severe Underweight (%)**		**Severe Wasting (%)**		**Wasted & Underweight (%)**		**Stunted Wasted & Underweight (%)**		**Stunted & Underweight (%)**	
NFHS round→	4	5	4	5	4	5	4	5	4	5	4	5
District Name												
Baksa	7.62	20.20	3.05	6.95	2.74	5.96	3.66	4.97	2.44	4.30	13.41	17.22
Barpeta	16.45	15.36	8.75	6.90	6.10	7.52	7.43	4.08	3.98	4.39	20.16	12.54
Bongaigaon	15.96	23.13	11.73	11.03	11.40	7.83	9.45	6.76	5.21	6.05	15.96	16.01
Cachar	11.74	13.22	11.74	8.54	11.07	11.57	12.42	14.88	9.06	5.23	12.75	10.19
Chirang	17.56	20.67	6.85	10.67	4.46	8.33	4.46	9.67	3.87	3.67	14.88	19.33
Darrang	20.47	14.80	12.07	6.91	5.51	7.57	5.77	6.91	7.61	5.26	22.05	15.46
Dhemaji	11.23	12.41	2.09	4.48	0.78	8.62	1.83	7.93	1.57	2.41	11.49	12.07
Dhubri	23.97	21.12	14.18	11.90	9.28	7.97	8.51	6.97	6.70	5.70	22.94	18.38
Dibrugarh	12.96	8.55	10.74	7.81	7.41	8.18	8.89	8.55	6.30	5.20	14.44	12.64
Dima hasao	9.26	16.02	2.65	3.90	1.32	11.26	3.97	7.36	1.06	2.60	12.17	8.66
Goalpara	24.67	18.21	13.00	13.25	8.22	13.58	9.02	7.62	5.84	5.96	21.49	14.90

Golaghat	8.39	11.96	4.01	6.22	6.57	5.26	5.84	5.74	2.92	5.74	10.95	8.13
Hailakandi	13.56	16.25	10.90	9.38	6.38	7.55	6.38	8.01	6.12	5.26	16.76	19.91
Jorhat	8.61	15.92	4.49	8.98	5.62	4.90	6.37	7.35	2.25	4.49	9.36	15.92
Kamrup	13.57	9.02	7.86	2.05	5.36	4.92	6.79	5.74	5.71	1.64	14.29	5.74
Kamrup Metropolitan	7.37	10.75	3.68	6.99	2.63	7.53	5.26	8.60	1.58	1.61	11.58	11.83
Karbi anglong	10.53	13.33	8.59	9.62	11.08	11.35	6.09	6.11	4.99	6.04	11.91	12.57
Karimganj	15.90	13.01	9.22	18.07	5.99	29.64	7.60	22.41	5.30	9.40	18.66	12.53
Kokrajhar	11.00	11.47	7.56	8.96	5.84	8.60	6.19	8.96	3.44	6.81	15.46	13.98
Lakhimpur	9.01	15.53	4.04	7.58	4.35	7.20	4.35	7.20	3.11	3.41	13.35	19.32
Morigaon	15.09	17.68	9.00	8.84	0.97	6.35	2.43	5.52	5.60	5.25	16.30	16.57
Nagaon	13.87	13.93	4.80	6.34	4.53	4.16	6.40	5.39	3.47	3.05	19.47	18.63
Nalbari	6.43	12.50	4.64	4.03	6.43	4.44	6.43	6.85	2.50	2.82	9.64	12.50
Sivasagar	12.36	14.52	3.27	6.99	1.45	4.10	4.36	5.75	1.45	3.31	15.64	16.55
Sonitpur	14.01	17.64	6.23	9.67	10.51	11.64	7.00	8.11	3.11	5.28	14.01	15.87
Tinsukia	14.65	7.95	10.51	9.85	2.55	8.71	4.78	9.09	5.41	5.30	18.47	12.50
Udalguri	15.08	16.41	8.31	8.59	8.31	10.94	8.00	8.20	4.92	2.73	16.62	16.02
Assam	**13.79**	**15.03**	**7.75**	**8.52**	**5.76**	**8.49**	**6.23**	**7.87**	**4.38**	**4.80**	**15.70**	**14.25**
India	**16.26**	**13.94**	**10.76**	**7.79**	**7.46**	**6.85**	**8.03**	**6.66**	**6.34**	**4.43**	**17.77**	**13.82**

Source: Author's calculations using NFHS 4 & 5-unit level data

Sonitpur, Sivasagar, Nagaon, Dhubri, and Karbi Anglong contains newly formed Biswanath, Charaideo, Hojai, South Salmara, and West Karbi Anglong districts, respectively.

Appendix 11 Percentage change in nutritional status indicators in Assam between NFHS4 and NFHS5

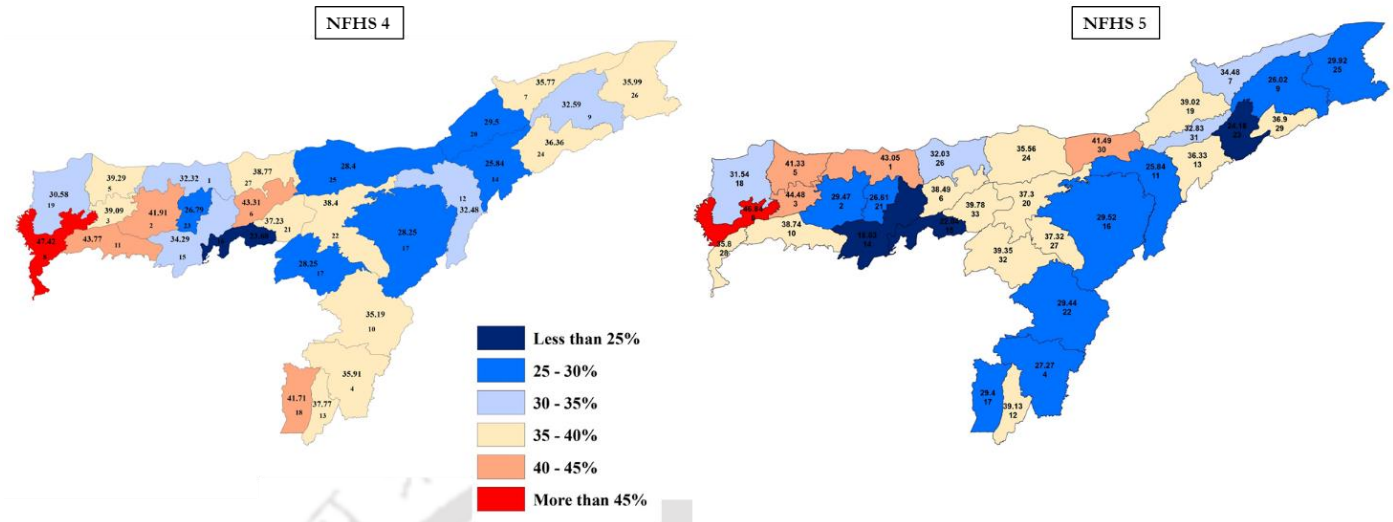
	District	Stunting (%)	Underweight (%)	Wasting (%)	Severe Stunting (%)	Severe Underweight (%)	Severe Wasting (%)	Triple Failure (%)	CIAF (%)
1	Kamrup	16.25 (-)	14.89 (-)	5.40 (-)	4.56 (-)	5.81 (-)	0.44 (-)	4.07 (-)	18.80 (-)
2	Barpeta	12.44 (-)	9.28 (-)	2.94 (+)	1.09 (-)	1.86 (-)	1.42 (+)	0.41 (+)	8.63 (-)
3	Karimganj	12.31 (-)	10.55 (+)	28.53 (+)	2.89 (-)	8.86 (+)	23.65 (+)	4.10 (+)	9.91 (+)
4	Cachar	8.63 (-)	2.85 (-)	1.61 (-)	1.48 (+)	3.21 (-)	0.50 (+)	3.83 (-)	5.34 (-)
5	Udalguri	6.74 (-)	3.48 (-)	1.54 (+)	1.33 (+)	0.29 (+)	2.63 (+)	2.19 (-)	3.91 (-)
6	Golaghat	6.64 (-)	1.57 (+)	4.43 (+)	3.57 (+)	2.21 (+)	1.31 (-)	2.82 (+)	3.38 (-)
7	Dibrugarh	6.57 (-)	2.11 (-)	1.78 (-)	4.41 (-)	2.93 (-)	0.77 (+)	1.09 (-)	6.13 (-)
8	Tinsukia	6.06 (-)	3.32 (-)	6.12 (+)	6.70 (-)	0.66 (-)	6.16 (+)	0.11 (-)	1.38 (-)
9	Dhubri	5.81 (-)	7.12 (-)	2.44 (-)	2.85 (-)	2.27 (-)	1.31 (-)	1.00 (-)	7.27 (-)
10	Dima Hasao	5.75 (-)	0.53 (+)	16.59 (+)	6.76 (+)	1.25 (+)	9.93 (+)	1.54 (+)	8.42 (+)
11	Goalpara	5.02 (-)	9.19 (-)	1.63 (+)	6.46 (-)	0.25 (+)	5.35 (+)	0.12 (+)	4.85 (-)
12	Darrang	4.82 (-)	7.86 (-)	3.74 (+)	5.67 (-)	5.17 (-)	2.05 (+)	2.35 (-)	1.21 (+)
13	Kamrup Metropolitan	1.64 (-)	2.61 (+)	7.76 (+)	3.38 (+)	3.31 (+)	4.90 (+)	0.03 (+)	5.08 (+)
14	Dhemaji	1.29 (-)	7.87 (+)	9.25 (+)	1.19 (+)	2.39 (+)	7.84 (+)	0.85 (+)	7.45 (+)
15	Nagaon	0.54 (-)	2.19 (-)	0.69 (-)	0.06 (+)	1.54 (+)	0.37 (-)	0.42 (-)	0.72 (-)
16	Nalbari	0.17 (-)	4.64 (+)	1.20 (-)	6.07 (+)	0.61 (-)	1.99 (-)	0.32 (+)	0.66 (-)
17	Sivasagar	0.27 (+)	4.02 (+)	6.73 (+)	2.15 (+)	3.72 (+)	2.65 (+)	1.85 (+)	5.02 (+)
18	Kokrajhar	0.96 (+)	5.44 (+)	4.25 (+)	0.47 (+)	1.40 (+)	2.76 (+)	3.37 (+)	2.61 (+)
19	Hailakandi	1.36 (+)	4.40 (+)	0.53 (+)	2.68 (+)	1.52 (-)	1.17 (+)	0.85 (-)	3.22 (+)
20	Chirang	2.05 (+)	11.89 (+)	5.54 (+)	3.11 (+)	3.82 (+)	3.87 (+)	0.20 (-)	10.23 (+)
21	Morigaon	2.55 (+)	2.97 (+)	4.18 (+)	2.59 (+)	0.16 (-)	5.38 (+)	0.35 (-)	7.03 (+)
22	Bongaigaon	5.40 (+)	0.22 (-)	2.22 (-)	7.17 (+)	0.69 (-)	3.57 (-)	0.84 (+)	3.91 (+)
23	Karbi Anglong	5.55 (+)	1.64 (+)	1.71 (+)	2.80 (+)	1.03 (+)	0.27 (+)	1.06 (+)	6.11 (+)
24	Sonitpur	6.54 (+)	4.86 (+)	2.08 (+)	3.63 (+)	3.45 (+)	1.13 (+)	2.17 (+)	6.18 (+)
25	Lakhimpur	9.51 (+)	7.53 (+)	6.62 (+)	6.52 (+)	3.54 (+)	2.85 (+)	0.30 (+)	14.24 (+)
26	Jorhat	10.48 (+)	10.29 (+)	0.29 (-)	7.30 (+)	4.49 (+)	0.72 (-)	2.24 (+)	8.46 (+)

27	Baksa	10.73 (+)	5.89 (+)	5.89 (+)	12.58 (+)	3.90 (+)	3.22 (+)	1.87 (+)	13.66 (+)
	Assam	**1.49** (-)	**0.66** (+)	**3.99** (+)	**1.24** (+)	**0.78** (+)	**2.73** (+)	**0.41** (+)	**2.14** (+)
	India	**5.52** (-)	**7.56** (-)	**3.44** (-)	**2.32** (-)	**2.97** (-)	**0.61** (-)	**1.91** (-)	**7.39** (-)

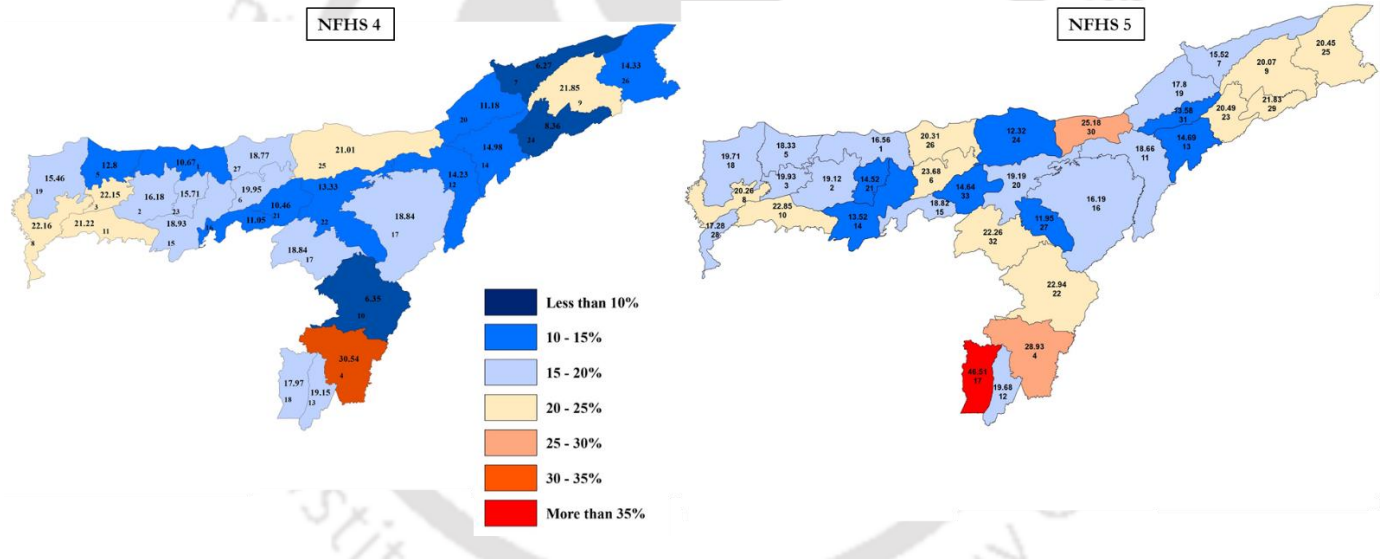
Source: Author's calculations using NFHS 4 & 5-unit level data

Sonitpur, Sivasagar, Nagaon, Dhubri, and Karbi Anglong contains newly formed Biswanath, Charaideo, Hojai, South Salmara, and West Karbi Anglong districts, respectively. Chane is calculated as % in NFHS 5 - % in NFHS 4. Therefore, a negative indicator means that the percentage of children has decreased between NFHS 4 & 5. Districts are sorted based on the change in Stunting rates, with the highest reduction district at the top

Appendix Figure 9 Prevalence of Stunting in Assam



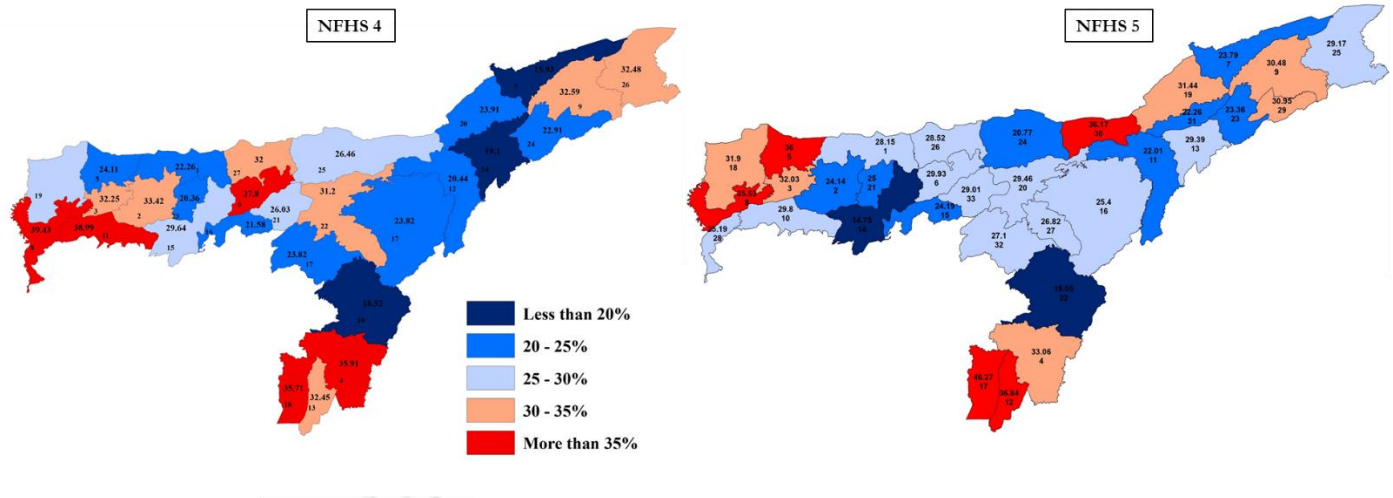
Appendix Figure 10 Prevalence of Wasting in Assam



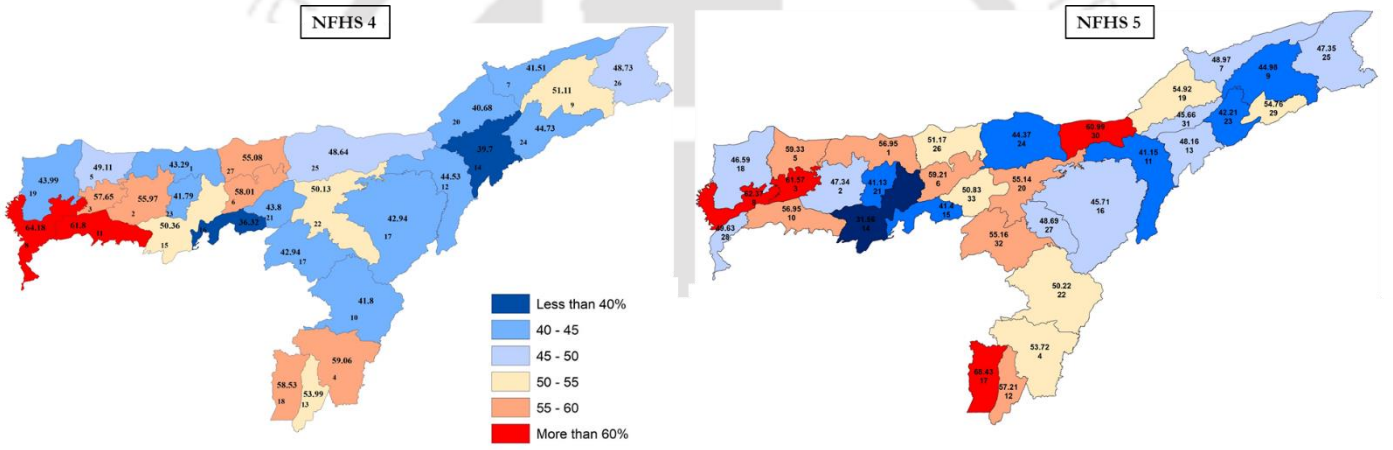
S. No.	DISTRICT	S. No.	DISTRICT
1	Baksa	15	Kamrup
2	Barpeta	16	Kamrup Metropolitan
3	Bongaigaon	17	Karbi Anglong
4	Cachar	18	Karimganj
5	Chirang	19	Kokrajhar
6	Darrang	20	Lakhimpur
7	Dhemaji	21	Marigaon
8	Dhubri	22	Nagaon
9	Dibrugarh	23	Nalbari
10	Dima Hasao	24	Sivasagar
11	Goalpara	25	Sonitpur
12	Golaghat	26	Tinsukia
13	Hailakandi	27	Udalguri
14	Jorhat		

S. No.	District	S. No.	District
1	Baksa	18	Kokrajhar
2	Barpeta	19	Lakhimpur
3	Bongaigaon	20	Nagaon
4	Cachar	21	Nalbari
5	Chirang	22	Dima Hasao
6	Darrang	23	Sivasagar
7	Dhemaji	24	Sonitpur
8	Dhubri	25	Tinsukia
9	Dibrugarh	26	Udalguri
10	Goalpara	27	Hojai
11	Golaghat	28	south salmara mancachar
12	Hailakandi	29	Charaideo
13	Jorhat	30	Biswanath
14	Kamrup	31	Majuli
15	Kamrup Metropolitan	32	West Karbi Anglong
16	Karbi Anglong	33	Morigaon
17	Karimganj		

Appendix Figure 11 Prevalence of Underweight in Assam



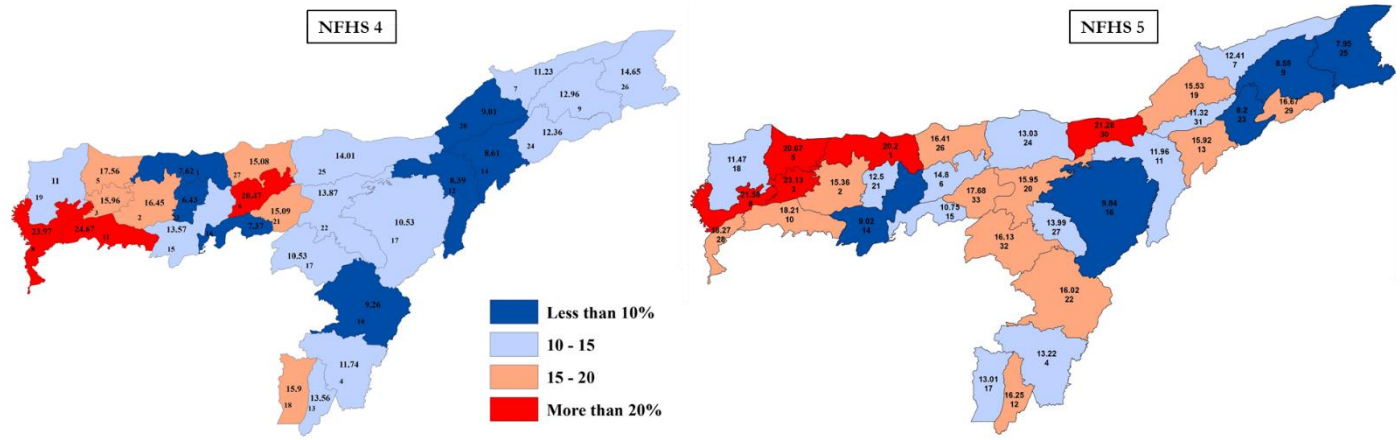
Appendix Figure 12 Prevalence of CIAF in Assam



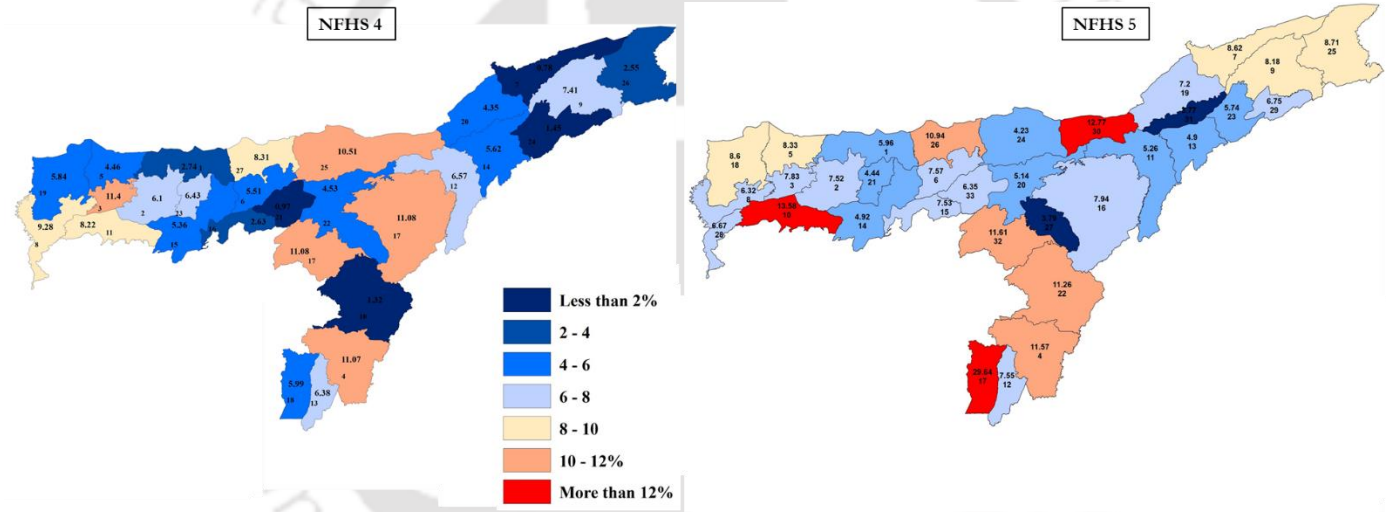
S. No.	DISTRICT	S. No.	DISTRICT
1	Baksa	15	Kamrup
2	Barpeta	16	Kamrup Metropolitan
3	Bongaigaon	17	Karbi Anglong
4	Cachar	18	Karimganj
5	Chirang	19	Kokrajhar
6	Darrang	20	Lakhimpur
7	Dhemaji	21	Marigaon
8	Dhubri	22	Nagaon
9	Dibrugarh	23	Nalbari
10	Dima Hasao	24	Sivasagar
11	Goalpara	25	Sonitpur
12	Golaghat	26	Tinsukia
13	Hailakandi	27	Udalguri
14	Jorhat		

S. No.	District	S. No.	District
1	Baksa	18	Kokrajhar
2	Barpeta	19	Lakhimpur
3	Bongaigaon	20	Nagaon
4	Cachar	21	Nalbari
5	Chirang	22	Dima Hasao
6	Darrang	23	Sivasagar
7	Dhemaji	24	Sonitpur
8	Dhubri	25	Tinsukia
9	Dibrugarh	26	Udalguri
10	Goalpara	27	Hojai
11	Golaghat	28	south salmara mancachar
12	Hailakandi	29	Charaideo
13	Jorhat	30	Biswanath
14	Kamrup	31	Majuli
15	Kamrup Metropolitan	32	West Karbi Anglong
16	Karbi Anglong	33	Morigaon
17	Karimganj		

Appendix Figure 13 Prevalence of Severe Stunting in Assam



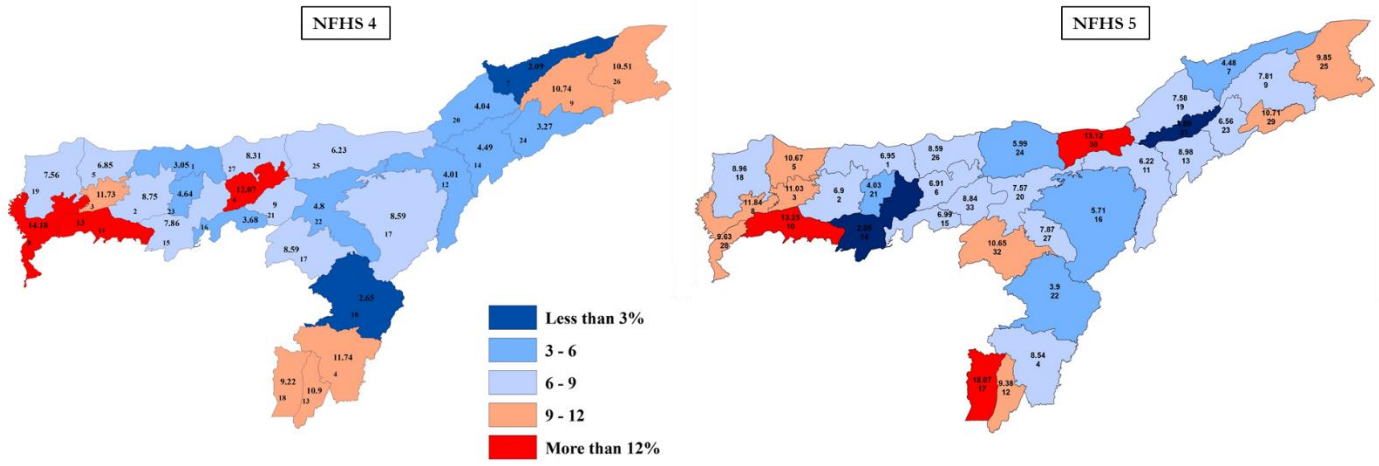
Appendix Figure 14 Prevalence of Severe Wasting in Assam



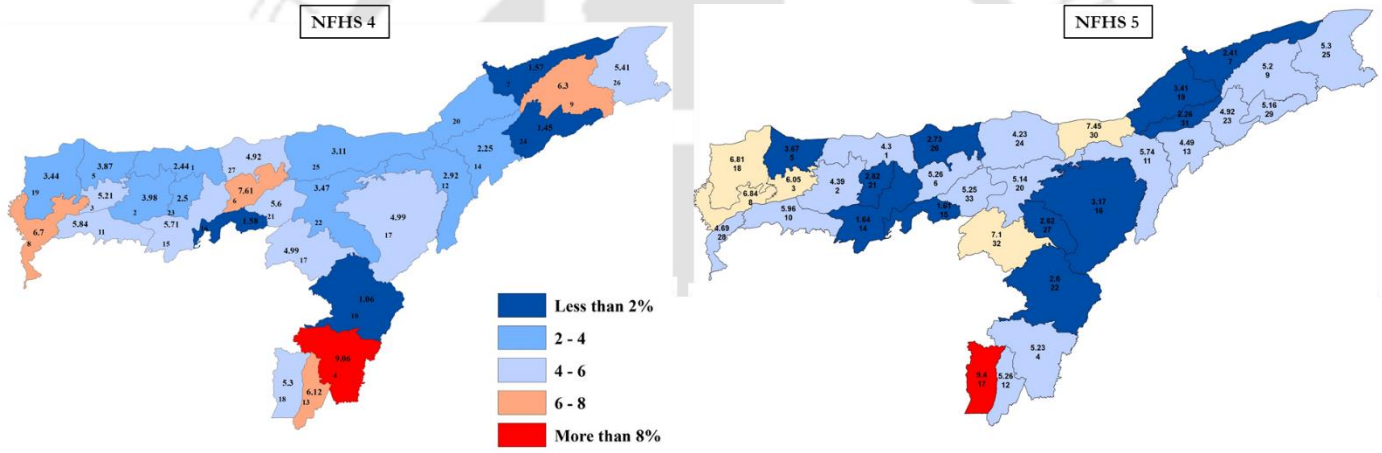
S. No.	DISTRICT	S. No.	DISTRICT
1	Baksa	15	Kamrup
2	Barpeta	16	Kamrup Metropolitan
3	Bongaigaon	17	Karbi Anglong
4	Cachar	18	Karimganj
5	Chirang	19	Kokrajhar
6	Darrang	20	Lakhimpur
7	Dhemaji	21	Marigaon
8	Dhubri	22	Nagaon
9	Dibrugarh	23	Nalbari
10	Dima Hasao	24	Sivasagar
11	Goalpara	25	Sonitpur
12	Golaghat	26	Tinsukia
13	Hailakandi	27	Udalguri
14	Jorhat		

S. No.	District	S. No.	District
1	Baksa	18	Kokrajhar
2	Barpeta	19	Lakhimpur
3	Bongaigaon	20	Nagaon
4	Cachar	21	Nalbari
5	Chirang	22	Dima Hasao
6	Darrang	23	Sivasagar
7	Dhemaji	24	Sonitpur
8	Dhubri	25	Tinsukia
9	Dibrugarh	26	Udalguri
10	Goalpara	27	Hojai
11	Golaghat	28	south salmara mancachar
12	Hailakandi	29	Charaideo
13	Jorhat	30	Biswanath
14	Kamrup	31	Majuli
15	Kamrup Metropolitan	32	West Karbi Anglong
16	Karbi Anglong	33	Morigaon
17	Karimganj		

Appendix Figure 15 Prevalence of Severe Underweight in Assam



Appendix Figure 16 Prevalence of Triple Failure in Assam



S. No.	DISTRICT	S. No.	DISTRICT
1	Baksa	15	Kamrup
2	Barpeta	16	Kamrup Metropolitan
3	Bongaigaon	17	Karbi Anglong
4	Cachar	18	Karimganj
5	Chirang	19	Kokrajhar
6	Darrang	20	Lakhimpur
7	Dhemaji	21	Marigaon
8	Dhubri	22	Nagaon
9	Dibrugarh	23	Nalbari
10	Dima Hasao	24	Sivasagar
11	Goalpara	25	Sonitpur
12	Golaghat	26	Tinsukia
13	Hailakandi	27	Udalguri
14	Jorhat		

S. No.	District	S. No.	District
1	Baksa	18	Kokrajhar
2	Barpeta	19	Lakhimpur
3	Bongaigaon	20	Nagaon
4	Cachar	21	Nalbari
5	Chirang	22	Dima Hasao
6	Darrang	23	Sivasagar
7	Dhemaji	24	Sonitpur
8	Dhubri	25	Tinsukia
9	Dibrugarh	26	Udalguri
10	Goalpara	27	Hojai
11	Golaghat	28	south salmara mancachar
12	Hailakandi	29	Charaideo
13	Jorhat	30	Biswanath
14	Kamrup	31	Majuli
15	Kamrup Metropolitan	32	West Karbi Anglong
16	Karbi Anglong	33	Morigaon
17	Karimganj		

Appendix 12 Height for Age Z-Score Distribution (All selected districts)

Group	-3SD (95% CI)	-2SD (95% CI)	z-score mean (95% CI)	z-score SD
All	19.9 (17.4; 22.7)	41.2 (38.0; 44.5)	-1.7 (-1.8; -1.6)	1.64
Age group: 00-05 mo	15.1 (7.7; 27.4)	41.5 (29.1; 55.1)	-1.9 (-2.3; -1.5)	1.4
Age group: 06-11 mo	27.2 (19.1; 37.2)	48.9 (38.9; 59.1)	-1.9 (-2.2; -1.5)	1.66
Age group: 12-23 mo	27.5 (21.6; 34.2)	46.6 (39.7; 53.7)	-1.8 (-2.1; -1.5)	1.91
Age group: 24-35 mo	22.9 (17.6; 29.2)	43.8 (37.1; 50.7)	-1.6 (-1.9; -1.3)	2.01
Age group: 36-47 mo	12.4 (8.4; 17.8)	30.4 (24.3; 37.3)	-1.5 (-1.7; -1.4)	1.27
Age group: 48-59 mo	12.8 (8.2; 19.4)	39.7 (32.0; 48.0)	-1.8 (-2.0; -1.6)	1.09
Sex: Female	19.8 (16.3; 23.8)	39.3 (34.9; 44.0)	-1.6 (-1.8; -1.5)	1.7
Sex: Male	20.0 (16.5; 24.1)	43.1 (38.5; 47.8)	-1.8 (-1.9; -1.6)	1.58
Age + sex: 00-05 mo.Female	16.7 (7.1; 34.4)	46.7 (29.9; 64.2)	-1.8 (-2.3; -1.3)	1.49
Age + sex: 06-11 mo.Female	31.1 (19.4; 45.9)	53.3 (38.9; 67.3)	-1.9 (-2.5; -1.4)	1.86
Age + sex: 12-23 mo.Female	21.5 (14.3; 31.0)	38.7 (29.4; 49.0)	-1.4 (-1.9; -1.0)	2.1
Age + sex: 24-35 mo.Female	24.5 (16.8; 34.2)	43.6 (34.0; 53.8)	-1.6 (-2.0; -1.3)	1.94
Age + sex: 36-47 mo.Female	16.2 (10.3; 24.5)	29.5 (21.6; 38.9)	-1.6 (-1.8; -1.3)	1.4
Age + sex: 48-59 mo.Female	11.0 (5.6; 20.4)	37.0 (26.7; 48.6)	-1.8 (-2.0; -1.5)	1.07
Age + sex:00-05 mo.Male	13.0 (4.3; 33.6)	34.8 (18.4; 55.8)	-2.0 (-2.5; -1.5)	1.29
Age + sex: 06-11 mo.Male	23.4 (13.4; 37.5)	44.7 (31.2; 59.0)	-1.8 (-2.2; -1.4)	1.46
Age + sex: 12-23 mo.Male	33.0 (24.5; 42.8)	54.0 (44.2; 63.5)	-2.1 (-2.5; -1.8)	1.67
Age + sex:24-35 mo.Male	21.5 (14.7; 30.3)	43.9 (34.8; 53.5)	-1.5 (-1.9; -1.1)	2.07
Age + sex: 36-47 mo.Male	7.9 (3.8; 15.6)	31.5 (22.7; 41.8)	-1.5 (-1.7; -1.3)	1.1
Age + sex: 48-59 mo.Male	14.7 (8.1; 25.2)	42.6 (31.5; 54.6)	-1.8 (-2.1; -1.5)	1.11
Barpeta	27.1 (21.7; 33.4)	54.8 (48.1; 61.2)	-2.0 (-2.2; -1.8)	1.58
Bongaigaon	11.4 (6.0; 20.5)	21.5 (13.8; 31.9)	-1.2 (-1.5; -0.8)	1.49
Darrang	18.8 (12.3; 27.6)	38.6 (29.6; 48.4)	-1.6 (-1.9; -1.3)	1.64
Dhubri	24.2 (19.1; 30.2)	48.0 (41.6; 54.5)	-2.0 (-2.2; -1.8)	1.59
Goalpara	20.8 (13.8; 30.1)	43.8 (34.2; 53.8)	-1.7 (-2.1; -1.4)	1.71
Kokrajhar	3.0 (1.0; 8.9)	20.0 (13.3; 29.0)	-0.9 (-1.1; -0.6)	1.4
Udalguri	16.0 (8.2; 28.9)	24.0 (14.2; 37.7)	-1.4 (-1.9; -0.9)	1.87

Appendix 13 Weight for Age Z Score distribution (All selected districts)

Group	-3SD (95% CI)	-2SD (95% CI)	z-score mean (95% CI)	z-score SD
All	10.8 (8.9; 12.9)	28.2 (25.4; 31.2)	-1.3 (-1.4; -1.2)	1.41
Age group: 00-05 mo	1.9 (0.3; 12.3)	11.3 (5.2; 23.0)	-0.5 (-0.9; -0.1)	1.53
Age group: 06-11 mo	9.8 (5.4; 17.3)	26.5 (18.8; 35.9)	-0.7 (-1.1; -0.3)	2.01
Age group: 12-23 mo	12.5 (8.6; 17.9)	24.0 (18.6; 30.4)	-1.2 (-1.4; -1.0)	1.5
Age group: 24-35 mo	13.0 (9.1; 18.4)	33.8 (27.7; 40.5)	-1.5 (-1.7; -1.3)	1.37
Age group: 36-47 mo	7.4 (4.5; 11.9)	25.6 (20.1; 32.1)	-1.5 (-1.6; -1.3)	1.03
Age group: 48-59 mo	13.7 (9.0; 20.3)	37.0 (29.5; 45.1)	-1.8 (-2.0; -1.7)	0.89
Sex: Female	10.3 (7.8; 13.5)	25.9 (22.1; 30.2)	-1.3 (-1.4; -1.1)	1.43
Sex: Male	11.2 (8.6; 14.4)	30.5 (26.4; 34.9)	-1.4 (-1.5; -1.3)	1.39
Age + sex: 00-05 mo.Female	3.4 (0.5; 20.9)	6.9 (1.7; 23.8)	-0.6 (-1.1; 0.0)	1.45
Age + sex: 06-11 mo.Female	7.8 (3.0; 19.1)	31.4 (20.2; 45.3)	-0.5 (-1.1; 0.1)	2.15
Age + sex: 12-23 mo.Female	13.8 (8.2; 22.4)	21.3 (14.1; 30.7)	-1.1 (-1.5; -0.8)	1.5
Age + sex: 24-35 mo.Female	9.5 (5.0; 17.2)	28.4 (20.3; 38.3)	-1.4 (-1.6; -1.1)	1.3
Age + sex: 36-47 mo.Female	10.2 (5.7; 17.5)	26.9 (19.3; 36.0)	-1.5 (-1.7; -1.3)	1.12
Age + sex: 48-59 mo.Female	11.5 (6.1; 20.7)	30.8 (21.5; 41.8)	-1.7 (-1.9; -1.5)	0.97
Age + sex: 00-05 mo.Male	0.0 (0.0; 0.0)	16.7 (6.4; 37.0)	-0.5 (-1.1; 0.2)	1.64
Age + sex: 06-11 mo.Male	11.8 (5.4; 23.8)	21.6 (12.4; 34.9)	-0.9 (-1.4; -0.4)	1.87
Age + sex: 12-23 mo.Male	11.3 (6.5; 18.9)	26.4 (18.9; 35.6)	-1.3 (-1.6; -1.0)	1.5
Age + sex: 24-35 mo.Male	16.1 (10.4; 24.1)	38.4 (29.9; 47.7)	-1.6 (-1.8; -1.3)	1.44
Age + sex: 36-47 mo.Male	4.2 (1.6; 10.7)	24.2 (16.6; 33.8)	-1.4 (-1.6; -1.2)	0.91
Age + sex: 48-59 mo.Male	16.2 (9.2; 26.9)	44.1 (32.8; 56.0)	-2.0 (-2.2; -1.8)	0.77
Barpeta	14.4 (10.4; 19.6)	41.0 (34.8; 47.5)	-1.7 (-1.9; -1.6)	1.29
Bongaigaon	3.6 (1.2; 10.6)	12.0 (6.6; 21.0)	-1.1 (-1.3; -0.9)	0.98
Darrang	14.8 (9.3; 22.8)	25.9 (18.5; 35.0)	-1.3 (-1.6; -1.1)	1.42
Dhubri	10.1 (6.8; 14.6)	32.8 (27.1; 39.0)	-1.4 (-1.6; -1.2)	1.45
Goalpara	18.8 (12.1; 27.8)	32.3 (23.7; 42.3)	-1.5 (-1.8; -1.2)	1.62
Kokrajhar	0.0 (0.0; 0.0)	7.9 (4.0; 15.1)	-0.6 (-0.8; -0.3)	1.25
Udalguri	7.1 (2.7; 17.6)	14.3 (7.3; 26.1)	-0.8 (-1.2; -0.4)	1.48

Appendix 14 Weight for Height Z Score distribution (All selected districts)

Group	-3SD (95% CI)	-2SD (95% CI)	z-score mean (95% CI)	z-score SD
All	3.8 (2.7; 5.3)	12.9 (10.8; 15.2)	-0.5 (-0.6; -0.4)	1.56
Age group: 00-05 mo	1.8 (0.3; 11.6)	5.4 (1.7; 15.4)	0.9 (0.4; 1.3)	1.83
Age group: 06-11 mo	3.0 (1.0; 8.8)	12.9 (7.6; 20.9)	0.0 (-0.3; 0.4)	1.82
Age group: 12-23 mo	5.8 (3.2; 10.1)	19.4 (14.4; 25.6)	-0.4 (-0.7; -0.2)	1.65
Age group: 24-35 mo	6.0 (3.4; 10.3)	12.5 (8.6; 17.9)	-0.7 (-0.9; -0.5)	1.34
Age group: 36-47 mo	2.1 (0.8; 5.4)	8.8 (5.5; 13.7)	-0.7 (-0.8; -0.5)	1.22
Age group: 48-59 mo	2.1 (0.7; 6.2)	13.8 (9.1; 20.4)	-0.9 (-1.1; -0.7)	1.35
Sex: Female	2.7 (1.5; 4.6)	12.2 (9.5; 15.6)	-0.4 (-0.6; -0.3)	1.52
Sex: Male	5.0 (3.3; 7.4)	13.5 (10.6; 17.0)	-0.5 (-0.7; -0.4)	1.6
Age + sex: 00-05 mo.Female	3.6 (0.5; 21.5)	3.6 (0.5; 21.5)	0.6 (-0.1; 1.2)	1.7
Age + sex: 06-11 mo.Female	2.0 (0.3; 12.9)	10.0 (4.2; 21.9)	0.2 (-0.3; 0.8)	1.95
Age + sex: 12-23 mo.Female	7.6 (3.7; 15.1)	27.2 (19.1; 37.2)	-0.7 (-1.0; -0.4)	1.67
Age + sex: 24-35 mo.Female	2.1 (0.5; 8.1)	8.5 (4.3; 16.1)	-0.4 (-0.7; -0.2)	1.26
Age + sex: 36-47 mo.Female	1.0 (0.1; 6.6)	9.7 (5.3; 17.1)	-0.7 (-0.9; -0.5)	1.14
Age + sex: 48-59 mo.Female	0.0 (0.0; 0.0)	7.8 (3.5; 16.3)	-0.6 (-0.9; -0.4)	1.24
Age + sex: 00-05 mo.Male	0.0 (0.0; 0.0)	7.1 (1.8; 24.5)	1.2 (0.5; 1.9)	1.93
Age + sex: 06-11 mo.Male	3.9 (1.0; 14.4)	15.7 (8.0; 28.4)	-0.1 (-0.6; 0.3)	1.67
Age + sex: 12-23 mo.Male	4.0 (1.5; 10.3)	12.1 (7.0; 20.2)	-0.2 (-0.5; 0.2)	1.61
Age + sex: 24-35 mo.Male	9.4 (5.1; 16.7)	16.0 (10.2; 24.3)	-0.9 (-1.2; -0.7)	1.38
Age + sex: 36-47 mo.Male	3.3 (1.1; 9.7)	7.7 (3.7; 15.3)	-0.6 (-0.9; -0.3)	1.3
Age + sex: 48-59 mo.Male	4.4 (1.4; 12.8)	20.6 (12.6; 31.8)	-1.2 (-1.5; -0.9)	1.41
Barpeta	5.9 (3.4; 9.9)	15.8 (11.6; 21.3)	-0.6 (-0.8; -0.4)	1.61
Bongaigaon	0.0 (0.0; 0.0)	8.9 (4.3; 17.5)	-0.8 (-1.0; -0.5)	1.12
Darrang	5.6 (2.5; 11.9)	15.0 (9.4; 23.0)	-0.6 (-0.9; -0.3)	1.5
Dhubri	3.4 (1.7; 6.6)	11.8 (8.2; 16.5)	-0.4 (-0.6; -0.2)	1.47
Goalpara	4.3 (1.6; 10.9)	17.2 (10.8; 26.3)	-0.6 (-0.9; -0.3)	1.66
Kokrajhar	2.9 (0.9; 8.6)	6.7 (3.2; 13.5)	-0.2 (-0.5; 0.2)	1.66
Udalguri	0.0 (0.0; 0.0)	11.5 (5.3; 23.4)	0.3 (-0.2; 0.8)	1.77

Appendix 15 Z Score distribution based on childcare interventions

Group	-3D (95% CI)	SE	-2D (95% CI)	SE
Height for Age				
Vaccination.Card: No	39.62 (27.44, 53.25)	6.72	58.49 (44.91, 70.9)	6.77
Vaccination.Card: Yes	18.64 (16.11, 21.45)	1.36	40.07 (36.77, 43.47)	1.71
VitaminA: No	21.83 (16.95, 27.66)	2.73	46.72 (40.34, 53.22)	3.30
VitaminA: Yes	19.22 (16.36, 22.46)	1.55	39.22 (35.52, 43.06)	1.92
Deworming: No	24.25 (19.73, 29.43)	2.47	46.51 (40.93, 52.18)	2.88
Deworming: Yes	17.63 (14.72, 20.97)	1.59	38.39 (34.49, 42.45)	2.03
Full Immunization: No	21.19 (17.14, 25.91)	2.23	42.99 (37.77, 48.36)	2.71
Full Immunization: Yes	19.11 (16, 22.66)	1.69	40.07 (36.01, 44.28)	2.11
mid.day.meals: No	22.39 (18.81, 26.44)	1.94	42.83 (38.37, 47.4)	2.31
mid.day.meals: Yes	16.43 (12.94, 20.64)	1.96	39.83 (34.88, 45)	2.59
Diarrhoea: No	18.89 (16.16, 21.96)	1.48	40.06 (36.49, 43.73)	1.85
Diarrhoea: Yes	23.93 (17.05, 32.5)	3.95	45.3 (36.51, 54.39)	4.60
Cough/Fever: No	17.84 (14.26, 22.08)	1.99	39.46 (34.59, 44.54)	2.54
Cough/Fever: Yes	21.74 (18.28, 25.65)	1.88	42.65 (38.3, 47.12)	2.25
Weight for Age				
Vaccination.Card: No	3.7 (0.93, 13.67)	2.57	40.74 (28.53, 54.22)	6.69
Vaccination.Card: Yes	11.2 (9.25, 13.5)	1.08	27.42 (24.53, 30.51)	1.52
VitaminA: No	10.43 (7.09, 15.11)	2.02	33.48 (27.67, 39.84)	3.11
VitaminA: Yes	10.87 (8.74, 13.44)	1.19	26.43 (23.25, 29.88)	1.69
Deworming: No	9.65 (6.82, 13.47)	1.67	28.62 (23.86, 33.9)	2.56
Deworming: Yes	11.33 (9.03, 14.13)	1.29	28 (24.55, 31.74)	1.83
Full Immunization: No	11.37 (8.41, 15.19)	1.71	27.7 (23.21, 32.68)	2.42
Full Immunization: Yes	10.39 (8.13, 13.18)	1.28	28.52 (24.95, 32.38)	1.90
mid.day.meals: No	10.86 (8.36, 13.98)	1.42	26.51 (22.75, 30.66)	2.02
mid.day.meals: Yes	12.03 (9.1, 15.75)	1.68	32.62 (28.05, 37.55)	2.43
Diarrhoea: No	10.76 (8.71, 13.22)	1.14	27.93 (24.8, 31.29)	1.66
Diarrhoea: Yes	13.01 (8.12, 20.2)	3.03	32.52 (24.83, 41.29)	4.23
Cough/Fever: No	12.24 (9.35, 15.88)	1.66	28.32 (24.07, 32.99)	2.28
Cough/Fever: Yes	9.66 (7.35, 12.59)	1.33	28.17 (24.38, 32.29)	2.02
Weight for Height				
Vaccination.Card: No	0 (0, 0)	0.00	5.45 (1.77, 15.62)	3.06
Vaccination.Card: Yes	4.05 (2.91, 5.62)	0.68	13.35 (11.21, 15.83)	1.17
VitaminA: No	2.63 (1.19, 5.74)	1.06	11.84 (8.24, 16.73)	2.14
VitaminA: Yes	4.2 (2.92, 6.03)	0.78	13.21 (10.84, 16.01)	1.31
Deworming: No	3.56 (1.98, 6.32)	1.05	11.97 (8.79, 16.1)	1.85
Deworming: Yes	3.93 (2.62, 5.85)	0.80	13.33 (10.81, 16.34)	1.41
Full Immunization: No	2.88 (1.56, 5.28)	0.90	10.37 (7.57, 14.06)	1.64
Full Immunization: Yes	4.39 (2.96, 6.47)	0.88	14.44 (11.73, 17.65)	1.50
mid.day.meals: No	3.66 (2.28, 5.81)	0.87	12.9 (10.15, 16.27)	1.56
mid.day.meals: Yes	3.77 (2.25, 6.28)	0.99	13.21 (10.12, 17.06)	1.76
Diarrhoea: No	3.88 (2.69, 5.56)	0.72	12.74 (10.5, 15.38)	1.24
Diarrhoea: Yes	4.17 (1.74, 9.63)	1.83	13.33 (8.32, 20.68)	3.10
Cough/Fever: No	3.17 (1.8, 5.5)	0.90	12.93 (9.9, 16.71)	1.72
Cough/Fever: Yes	4.45 (2.95, 6.68)	0.93	12.15 (9.54, 15.34)	1.47

Appendix 16 Z-score distribution by Maternity and Delivery Care Indicators

Group	-3D (95% CI)	SE	-2D (95% CI)	SE
Height for Age				
Birth Order: Firstborn	21.26 (17.43, 25.66)	2.10	39.63 (34.83, 44.64)	2.51
Birth Order: Middle	14.65 (10.93, 19.37)	2.14	35.9 (30.42, 41.77)	2.90
Birth Order: Youngest	24.09 (18.89, 30.19)	2.88	50.45 (43.87, 57.03)	3.37
Birth weight: High	0 (0, 0)	0.00	23.53 (9.1, 48.6)	10.29
Birth weight: Low	23.48 (17.02, 31.48)	3.69	59.85 (51.26, 67.87)	4.27
Birth weight: Normal	19.67 (16.91, 22.74)	1.49	38.21 (34.72, 41.84)	1.82
Birth weight: Very Low	25 (6.29, 62.35)	15.32	37.5 (12.51, 71.57)	17.13
Place of delivery: Home	29.82 (23.44, 37.11)	3.50	53.8 (46.29, 61.15)	3.81
Place of delivery: Others	50 (12.31, 87.69)	25.01	75 (23.71, 96.66)	21.66
Place of delivery: Private Health Sector	15.28 (8.66, 25.54)	4.24	33.33 (23.43, 44.96)	5.56
Place of delivery: Public Health Sector	17.54 (14.76, 20.73)	1.52	38.44 (34.7, 42.32)	1.94
Reg_Preg: No	22.86 (11.85, 39.51)	7.10	42.86 (27.72, 59.46)	8.37
Reg_Preg: Yes	19.79 (17.22, 22.63)	1.38	41.12 (37.83, 44.49)	1.70
ChildProcard: No	31.62 (23.84, 40.6)	4.30	51.28 (42.27, 60.22)	4.62
ChildProcard: Yes	17.94 (15.35, 20.86)	1.40	39.36 (35.91, 42.92)	1.79
IFA Consumption: 30-90 Days	22.76 (16.19, 31.01)	3.78	39.84 (31.56, 48.74)	4.42
IFA Consumption: 90 days	18.82 (13.82, 25.09)	2.87	38.17 (31.46, 45.37)	3.56
IFA Consumption: 90-180 Days	20.98 (15.93, 27.1)	2.85	42.44 (35.84, 49.32)	3.45
IFA Consumption: Less than 30 Days	27.27 (20.07, 35.89)	4.05	52.07 (43.18, 60.83)	4.54
IFA Consumption: More than 180 Days	13 (7.69, 21.13)	3.36	31 (22.71, 40.72)	4.63
IFA Consumption: Not Consumed	13.39 (8.23, 21.05)	3.22	40.18 (31.51, 49.51)	4.63
Awareness Nutrition: No	21.17 (15.12, 28.82)	3.49	43.8 (35.72, 52.22)	4.24
Awareness Nutrition: Yes	19.59 (16.88, 22.63)	1.46	40.54 (37.04, 44.14)	1.81
Awareness Familyplanning: No	22.42 (17.41, 28.37)	2.79	43.05 (36.69, 49.64)	3.32
Awareness Familyplanning: Yes	18.95 (16.11, 22.16)	1.54	40.37 (36.65, 44.2)	1.93
Weight for Age				
Birth Order: Firstborn	9.77 (7.22, 13.11)	1.49	27.32 (23.16, 31.91)	2.23
Birth Order: Middle	8.51 (5.77, 12.39)	1.66	23.4 (18.82, 28.71)	2.52
Birth Order: Youngest	15.22 (11.12, 20.47)	2.37	35.65 (29.72, 42.06)	3.16
Birth weight: High	6.25 (0.87, 33.62)	6.05	25 (9.69, 50.88)	10.83
Birth weight: Low	15.71 (10.57, 22.73)	3.08	42.86 (34.91, 51.19)	4.18
Birth weight: Normal	9.66 (7.74, 12.01)	1.08	25.23 (22.24, 28.49)	1.59
Birth weight: Very Low	30 (9.95, 62.43)	14.50	50 (22.41, 77.59)	15.82
Place of delivery: Home	16.29 (11.56, 22.48)	2.77	41.01 (34.01, 48.39)	3.69
Place of delivery: Others	0 (0, 0)	0.00	66.67 (15.29, 95.68)	27.23
Place of delivery: Private Health Sector	10.53 (5.35, 19.68)	3.52	19.74 (12.25, 30.22)	4.57
Place of delivery: Public Health Sector	9.33 (7.32, 11.81)	1.14	25.54 (22.33, 29.02)	1.71
Reg_Preg: No	17.14 (7.9, 33.29)	6.37	51.43 (35.28, 67.29)	8.45

Reg_Preg: Yes	10.5 (8.64, 12.72)	1.04	27.28 (24.43, 30.34)	1.51
ChildProcard: No	15.57 (10.15, 23.15)	3.28	34.43 (26.53, 43.29)	4.30
ChildProcard: Yes	9.88 (7.97, 12.19)	1.07	27.09 (24.08, 30.32)	1.59
IFA Consumption: 30-90 Days	8.59 (4.82, 14.87)	2.48	22.66 (16.21, 30.72)	3.70
IFA Consumption: 90 days	10.05 (6.57, 15.08)	2.13	22.61 (17.32, 28.96)	2.97
IFA Consumption: 90-180 Days	8.17 (5.14, 12.76)	1.90	30.29 (24.42, 36.88)	3.19
IFA Consumption: Less than 30 Days	16.67 (11, 24.44)	3.40	40.83 (32.4, 49.85)	4.49
IFA Consumption: More than 180 Days	7.27 (3.67, 13.89)	2.48	20 (13.54, 28.53)	3.82
IFA Consumption: Not Consumed	18.64 (12.59, 26.71)	3.59	33.05 (25.16, 42.03)	4.33
Awareness Nutrition: No	7.33 (4.1, 12.77)	2.13	31.33 (24.41, 39.2)	3.79
Awareness Nutrition: Yes	11.46 (9.38, 13.94)	1.16	27.54 (24.47, 30.83)	1.62
Awareness Familyplanning: No	10.88 (7.51, 15.51)	2.02	29.29 (23.86, 35.38)	2.95
Awareness Familyplanning: Yes	10.75 (8.61, 13.33)	1.20	27.76 (24.49, 31.28)	1.73
Weight for Height				
Birth Order: Firstborn	3.6 (2.14, 5.99)	0.94	11.57 (8.74, 15.15)	1.62
Birth Order: Middle	2.85 (1.43, 5.6)	0.99	11.39 (8.16, 15.67)	1.90
Birth Order: Youngest	5.36 (3.06, 9.2)	1.51	16.96 (12.59, 22.47)	2.51
Birth weight: High	6.25 (0.87, 33.62)	6.05	31.25 (13.62, 56.72)	11.59
Birth weight: Low	3.62 (1.51, 8.42)	1.59	24.64 (18.15, 32.52)	3.67
Birth weight: Normal	3.82 (2.65, 5.48)	0.71	10.23 (8.23, 12.65)	1.12
Birth weight: Very Low	0 (0, 0)	0.00	14.29 (1.96, 58.15)	13.23
Place of delivery: Home	4.97 (2.6, 9.29)	1.62	16.57 (11.83, 22.73)	2.77
Place of delivery: Others	0 (0, 0)	0.00	0 (0, 0)	0.00
Place of delivery: Private Health Sector	4.17 (1.35, 12.16)	2.36	13.89 (7.63, 23.95)	4.08
Place of delivery: Public Health Sector	3.45 (2.28, 5.18)	0.72	11.76 (9.47, 14.5)	1.28
Reg_Preg: No	0 (0, 0)	0.00	22.22 (11.51, 38.57)	6.93
Reg_Preg: Yes	3.96 (2.84, 5.5)	0.67	12.47 (10.42, 14.86)	1.13
ChildProcard: No	4.2 (1.76, 9.71)	1.84	13.45 (8.4, 20.84)	3.13
ChildProcard: Yes	3.79 (2.65, 5.41)	0.69	12.68 (10.5, 15.24)	1.20
IFA Consumption: 30-90 Days	2.38 (0.77, 7.13)	1.36	4.76 (2.15, 10.21)	1.90
IFA Consumption: 90 days	3.08 (1.39, 6.69)	1.24	15.9 (11.4, 21.73)	2.62
IFA Consumption: 90-180 Days	2.36 (0.98, 5.55)	1.04	11.32 (7.7, 16.35)	2.18
IFA Consumption: Less than 30 Days	9.65 (5.42, 16.6)	2.77	16.67 (10.88, 24.68)	3.49
IFA Consumption: More than 180 Days	3.77 (1.42, 9.64)	1.85	7.55 (3.81, 14.39)	2.57
IFA Consumption: Not Consumed	4.42 (1.85, 10.21)	1.94	20.35 (13.91, 28.79)	3.79
Awareness Nutrition: No	3.52 (1.47, 8.19)	1.55	11.97 (7.57, 18.43)	2.73
Awareness Nutrition: Yes	3.87 (2.7, 5.51)	0.70	13.07 (10.83, 15.68)	1.23
Awareness Familyplanning: No	4.27 (2.31, 7.77)	1.32	13.25 (9.47, 18.23)	2.22
Awareness Familyplanning: Yes	3.65 (2.45, 5.39)	0.73	12.77 (10.42, 15.55)	1.30

Appendix 17 Z Score distribution based on Marriage and Women Empowerment Indicators

Group	-3D (95% CI)	SE	-2D (95% CI)	SE
Height for Age				
Preg_Wanted: No	25.35 (16.58, 36.72)	5.17	49.3 (37.89, 60.78)	5.94
Preg_Wanted: Yes	19.45 (16.84, 22.35)	1.40	40.4 (37.04, 43.86)	1.74
Age_Firstbirth: <15	36.36 (19.31, 57.7)	10.26	54.55 (34.11, 73.56)	10.62
Age_Firstbirth: > 21	16.09 (9.76, 25.38)	3.94	40.23 (30.47, 50.84)	5.26
Age_Firstbirth: 15-17	15.09 (7.72, 27.41)	4.92	58.49 (44.91, 70.9)	6.77
Age_Firstbirth: 18-21	18.88 (13.27, 26.15)	3.27	37.06 (29.54, 45.28)	4.04
Mother.s.Decision.Making.Power: High	22.73 (14.18, 34.37)	5.16	36.36 (25.69, 48.57)	5.92
Mother.s.Decision.Making.Power: Low	21.27 (17.09, 26.15)	2.31	42.86 (37.49, 48.4)	2.79
Mother.s.Decision.Making.Power: Moderate	15.96 (12.59, 20.02)	1.89	38.03 (33.25, 43.06)	2.50
Mother.s.Decision.Making.Power: Nil	27.35 (20.03, 36.13)	4.12	49.57 (40.61, 58.56)	4.62
Mother Land/House Score: High	37.5 (20.77, 57.86)	9.89	54.17 (34.58, 72.54)	10.18
Mother Land/House Score: Low	16.19 (12.3, 21)	2.21	37.77 (32.25, 43.62)	2.91
Mother Land/House Score: Moderate	21.69 (17.18, 26.99)	2.50	43.01 (37.24, 48.98)	3.00
Mother Land/House Score: Nil	20.33 (16.15, 25.28)	2.32	41.67 (36.21, 47.34)	2.85
Mother Aware_Violence: High	16.2 (13.02, 19.99)	1.77	35.42 (31.04, 40.05)	2.30
Mother Aware_Violence: Low	23.67 (18.36, 29.95)	2.96	50.24 (43.46, 57.02)	3.48
Mother Aware_Violence: Moderate	22.67 (17.66, 28.61)	2.79	43.56 (37.21, 50.12)	3.31
Mother Aware_Rights: High	18.7 (15.88, 21.9)	1.53	39.41 (35.71, 43.24)	1.92
Mother Aware_Rights: Low	23.19 (14.71, 34.58)	5.08	49.28 (37.71, 60.92)	6.02
Mother Aware_Rights: Moderate	22.3 (16.3, 29.72)	3.42	44.59 (36.78, 52.69)	4.09
Weight for Age				
Preg_Wanted: No	12.33 (6.53, 22.05)	3.85	30.14 (20.72, 41.58)	5.37
Preg_Wanted: Yes	10.7 (8.77, 12.99)	1.07	28 (25.05, 31.16)	1.56
Age_Firstbirth: <15	18.18 (6.98, 39.68)	8.23	40.91 (22.81, 61.86)	10.49
Age_Firstbirth: > 21	3.33 (1.08, 9.85)	1.89	11.11 (6.08, 19.45)	3.31
Age_Firstbirth: 15-17	9.26 (3.9, 20.42)	3.95	46.3 (33.53, 59.57)	6.79
Age_Firstbirth: 18-21	14.09 (9.37, 20.67)	2.85	36.24 (28.91, 44.27)	3.94
Mother.s.Decision.Making.Power: High	10 (4.84, 19.55)	3.59	27.14 (18.02, 38.71)	5.32
Mother.s.Decision.Making.Power: Low	13.58 (10.26, 17.77)	1.90	32.72 (27.82, 38.02)	2.61
Mother.s.Decision.Making.Power: Moderate	9.49 (6.95, 12.83)	1.48	25.38 (21.3, 29.95)	2.20
Mother.s.Decision.Making.Power: Nil	7.87 (4.28, 14.03)	2.39	25.98 (19.09, 34.31)	3.89
Mother Land/House Score: High	26.09 (12.2, 47.28)	9.16	43.48 (25.19, 63.73)	10.34
Mother Land/House Score: Low	12.41 (9.08, 16.74)	1.94	27.93 (23.06, 33.38)	2.64
Mother Land/House Score: Moderate	9.12 (6.28, 13.07)	1.71	23.16 (18.62, 28.42)	2.50

Mother Land/House Score: Nil	9.58 (6.78, 13.39)	1.66	31.95 (27.01, 37.33)	2.64
Mother Aware_Violence: High	7.13 (5.08, 9.91)	1.21	21.16 (17.62, 25.19)	1.93
Mother Aware_Violence: Low	14.75 (10.62, 20.12)	2.41	35.94 (29.83, 42.56)	3.26
Mother Aware_Violence: Moderate	13.36 (9.55, 18.39)	2.24	32.76 (27.02, 39.07)	3.08
Mother Aware_Rights: High	8.61 (6.71, 10.98)	1.08	26.11 (22.93, 29.57)	1.69
Mother Aware_Rights: Low	13.7 (7.52, 23.65)	4.03	26.03 (17.25, 37.27)	5.14
Mother Aware_Rights: Moderate	17.88 (12.55, 24.83)	3.12	35.76 (28.51, 43.72)	3.90
Weight for Height				
Preg_Wanted: No	4.17 (1.35, 12.16)	2.36	9.72 (4.7, 19.04)	3.49
Preg_Wanted: Yes	3.8 (2.68, 5.35)	0.67	12.99 (10.85, 15.48)	1.18
Age_Firstbirth: <15	18.18 (6.98, 39.68)	8.23	18.18 (6.98, 39.68)	8.23
Age_Firstbirth: > 21	1.14 (0.16, 7.65)	1.13	9.09 (4.61, 17.16)	3.07
Age_Firstbirth: 15-17	5.66 (1.83, 16.16)	3.18	13.21 (6.42, 25.24)	4.65
Age_Firstbirth: 18-21	5.44 (2.74, 10.52)	1.87	15.65 (10.62, 22.46)	3.00
Mother.s.Decision.Making.Power: High	1.43 (0.2, 9.48)	1.42	5.71 (2.16, 14.28)	2.78
Mother.s.Decision.Making.Power: Low	4.06 (2.37, 6.88)	1.10	16.88 (13.15, 21.39)	2.09
Mother.s.Decision.Making.Power: Moderate	4.77 (3.03, 7.46)	1.10	11.94 (9.03, 15.62)	1.67
Mother.s.Decision.Making.Power: Nil	1.57 (0.39, 6.09)	1.11	9.45 (5.44, 15.92)	2.60
Mother Land/House Score: High	8.7 (2.18, 28.94)	5.88	17.39 (6.67, 38.27)	7.91
Mother Land/House Score: Low	3.19 (1.67, 6.03)	1.05	13.83 (10.26, 18.38)	2.06
Mother Land/House Score: Moderate	4.33 (2.47, 7.48)	1.22	10.83 (7.67, 15.08)	1.87
Mother Land/House Score: Nil	3.53 (1.96, 6.26)	1.04	13.46 (10.1, 17.73)	1.93
Mother Aware_Violence: High	2.73 (1.55, 4.74)	0.78	11.36 (8.71, 14.69)	1.51
Mother Aware_Violence: Low	5.66 (3.24, 9.71)	1.59	16.98 (12.5, 22.66)	2.58
Mother Aware_Violence: Moderate	4.37 (2.36, 7.93)	1.35	12.66 (8.94, 17.64)	2.20
Mother Aware_Rights: High	2.9 (1.85, 4.5)	0.66	11.59 (9.35, 14.27)	1.25
Mother Aware_Rights: Low	6.76 (2.84, 15.25)	2.92	16.22 (9.44, 26.44)	4.29
Mother Aware_Rights: Moderate	6.62 (3.6, 11.88)	2.02	17.88 (12.55, 24.83)	3.12

Appendix 18 Z Score distribution based on household characteristics

Group	-3D (95% CI)	SE	-2D (95% CI)	SE
Height for Age				
Religion.: Christianity	0 (0, 0)	0.00	22.58 (11.15, 40.4)	7.51
Religion.: Hinduism	14.1 (10.62, 18.48)	1.99	28.85 (24.04, 34.2)	2.60
Religion.: Islam	24.35 (20.9, 28.16)	1.85	49.26 (45.04, 53.48)	2.16
Source_drinking: Improved	20.46 (17.84, 23.35)	1.40	41.16 (37.85, 44.56)	1.71
Source_drinking: No Improved Source	8.89 (3.37, 21.44)	4.24	42.22 (28.78, 56.93)	7.37
Sanitation Facility: Improved	18.34 (15.74, 21.26)	1.41	39.31 (35.89, 42.85)	1.78
Sanitation Facility: No Improved Source	29.2 (21.56, 38.24)	4.28	52.21 (43.02, 61.26)	4.70
Electricity: No	20.41 (11.33, 33.96)	5.76	38.78 (26.26, 52.97)	6.96
Electricity: Yes	19.66 (17.07, 22.53)	1.39	41.15 (37.82, 44.56)	1.72
Cooking.fuel: Clean	16.76 (13.8, 20.21)	1.63	37.9 (33.84, 42.14)	2.12
Cooking.fuel: Not Clean	24.28 (20.04, 29.08)	2.31	45.66 (40.47, 50.95)	2.68
owns.homestead.land: No	26.83 (15.51, 42.28)	6.92	43.9 (29.67, 59.21)	7.75
owns.homestead.land: Yes	19.73 (17.14, 22.61)	1.39	41.3 (37.96, 44.72)	1.72
owns.agricultural.land: No	21.47 (18.09, 25.28)	1.83	45.53 (41.21, 49.91)	2.22
owns.agricultural.land: Yes	18.15 (14.38, 22.65)	2.10	35.12 (30.19, 40.39)	2.61
Rationcard: No	17.78 (13.93, 22.41)	2.16	37.14 (31.97, 42.63)	2.72
Rationcard: Yes	20.84 (17.64, 24.46)	1.74	43.69 (39.58, 47.89)	2.12
Weight for Age				
Religion.: Christianity	0 (0, 0)	0.00	9.68 (3.15, 26.1)	5.31
Religion.: Hinduism	5.28 (3.3, 8.33)	1.25	13.35 (10.05, 17.53)	1.90
Religion.: Islam	14.52 (11.83, 17.7)	1.49	37.81 (33.87, 41.92)	2.05
Source_drinking: Improved	10.63 (8.73, 12.88)	1.05	27.69 (24.79, 30.79)	1.53
Source_drinking: No Improved Source	14.89 (7.26, 28.12)	5.20	38.3 (25.61, 52.8)	7.09
Sanitation Facility: Improved	10.53 (8.57, 12.88)	1.09	26.78 (23.79, 29.98)	1.58
Sanitation Facility: No Improved Source	12.5 (7.67, 19.72)	3.02	38.33 (30.07, 47.33)	4.44
Electricity: No	6 (1.94, 17.05)	3.36	28 (17.32, 41.92)	6.35
Electricity: Yes	11.11 (9.17, 13.4)	1.08	28.42 (25.49, 31.54)	1.54
Cooking.fuel: Clean	9.71 (7.49, 12.49)	1.27	25.46 (21.97, 29.29)	1.87
Cooking.fuel: Not Clean	12.43 (9.41, 16.25)	1.74	32.6 (27.96, 37.61)	2.46
owns.homestead.land: No	9.52 (3.61, 22.81)	4.53	30.95 (18.88, 46.33)	7.14
owns.homestead.land: Yes	11.03 (9.09, 13.32)	1.07	28.52 (25.58, 31.65)	1.55
owns.agricultural.land: No	13.51 (10.86, 16.69)	1.48	32.08 (28.25, 36.17)	2.02
owns.agricultural.land: Yes	6.74 (4.52, 9.95)	1.36	21.7 (17.64, 26.4)	2.23
Rationcard: No	9.26 (6.55, 12.94)	1.61	24.38 (20.01, 29.36)	2.39
Rationcard: Yes	10.96 (8.65, 13.79)	1.30	29.91 (26.3, 33.79)	1.91
Weight for Height				
Religion.: Christianity	0 (0, 0)	0.00	6.67 (1.67, 23.11)	4.56
Religion.: Hinduism	1.27 (0.48, 3.35)	0.63	8.28 (5.69, 11.89)	1.56

Religion.: Islam	5.45 (3.84, 7.7)	0.97	15.82 (13, 19.12)	1.56
Source_drinking: Improved	3.8 (2.7, 5.33)	0.66	12.35 (10.29, 14.76)	1.13
Source_drinking: No Improved Source	4.26 (1.06, 15.52)	2.95	21.28 (11.83, 35.24)	5.97
Sanitation Facility: Improved	3.88 (2.72, 5.49)	0.69	12.4 (10.26, 14.92)	1.19
Sanitation Facility: No Improved Source	3.39 (1.28, 8.7)	1.67	16.1 (10.5, 23.89)	3.39
Electricity: No	4.08 (1.02, 14.94)	2.83	16.33 (8.37, 29.42)	5.28
Electricity: Yes	3.81 (2.7, 5.34)	0.66	12.5 (10.43, 14.92)	1.14
Cooking.fuel: Clean	4.18 (2.77, 6.27)	0.87	13.5 (10.83, 16.7)	1.49
Cooking.fuel: Not Clean	3.28 (1.87, 5.69)	0.93	12.02 (9.06, 15.78)	1.70
owns.homestead.land: No	4.65 (1.16, 16.82)	3.21	20.93 (11.25, 35.59)	6.21
owns.homestead.land: Yes	3.84 (2.72, 5.38)	0.67	12.59 (10.5, 15.02)	1.15
owns.agricultural.land: No	3.8 (2.46, 5.81)	0.83	14.61 (11.84, 17.9)	1.54
owns.agricultural.land: Yes	3.92 (2.28, 6.63)	1.07	9.64 (6.89, 13.32)	1.62
Rationcard: No	2.8 (1.46, 5.29)	0.92	11.8 (8.7, 15.81)	1.80
Rationcard: Yes	3.92 (2.59, 5.89)	0.82	13.19 (10.63, 16.26)	1.43

Appendix 19 Z-score distribution based on indicators of Breastfeeding and Complementary feeding practices

Group	-3D (95% CI)	SE	-2D (95% CI)	SE
Height for Age				
Breastfed within1: No	24.82 (18.29, 32.74)	3.69	43.07 (35.02, 51.49)	4.23
Breastfed within1: Yes	19 (16.32, 22)	1.45	40.84 (37.34, 44.44)	1.81
Breastfed_After6: No	25.56 (17.6, 35.56)	4.60	43.33 (33.49, 53.73)	5.23
Breastfed_After6: Yes	19.26 (16.64, 22.18)	1.41	40.94 (37.55, 44.43)	1.76
Age_CF: After 6 Months	17.75 (13.34, 23.23)	2.52	41.99 (35.78, 48.47)	3.25
Age_CF: At 6 Months	21.83 (18.02, 26.19)	2.08	38.83 (34.13, 43.75)	2.46
Age_CF: Before 6 Months	21.43 (16.06, 28)	3.04	48.35 (41.16, 55.61)	3.71
Handwash: No	29.51 (19.43, 42.08)	5.84	45.9 (33.88, 58.42)	6.38
Handwash: Yes	19.06 (16.49, 21.92)	1.38	40.84 (37.49, 44.28)	1.73
min_diet: No	29.56 (23.68, 36.21)	3.20	52.71 (45.82, 59.5)	3.51
min_diet: Yes	23.38 (15.24, 34.11)	4.83	33.77 (24.11, 45)	5.39
Diet_Diver: No	29.29 (23.36, 36.02)	3.24	52.53 (45.55, 59.4)	3.55
Diet_Diver: Yes	24.39 (16.3, 34.83)	4.74	35.37 (25.8, 46.27)	5.28
Diet_Freq: No	29.47 (21.18, 39.4)	4.68	52.63 (42.6, 62.45)	5.13
Diet_Freq: Yes	27.03 (21.11, 33.89)	3.27	44.86 (37.84, 52.1)	3.66
Weight for Age				
Breastfed within1: No	14.89 (9.91, 21.78)	3.00	29.08 (22.17, 37.11)	3.83
Breastfed within1: Yes	10 (8.07, 12.33)	1.08	28.05 (24.99, 31.34)	1.62
Breastfed_After6: No	12.5 (7.23, 20.75)	3.38	31.25 (22.78, 41.19)	4.73
Breastfed_After6: Yes	10.55 (8.62, 12.86)	1.08	27.85 (24.88, 31.04)	1.57
Age_CF: After 6 Months	10.66 (7.35, 15.2)	1.98	29.92 (24.5, 35.97)	2.93
Age_CF: At 6 Months	9 (6.59, 12.19)	1.41	24.09 (20.19, 28.47)	2.11

Age_CF: Before 6 Months	15.87 (11.32, 21.81)	2.66	38.62 (31.94, 45.77)	3.54
Handwash: No	17.19 (9.77, 28.46)	4.72	42.19 (30.74, 54.54)	6.18
Handwash: Yes	10.36 (8.47, 12.61)	1.05	27.26 (24.35, 30.38)	1.54
min_diet: No	11.42 (7.83, 16.36)	2.15	26.03 (20.64, 32.25)	2.97
min_diet: Yes	11.54 (6.11, 20.73)	3.62	19.23 (11.93, 29.51)	4.46
Diet_Diver: No	11.9 (8.17, 17.04)	2.24	25.24 (19.82, 31.56)	3.00
Diet_Diver: Yes	10.34 (5.46, 18.72)	3.27	21.84 (14.37, 31.74)	4.43
Diet_Freq: No	11.65 (6.73, 19.42)	3.16	28.16 (20.31, 37.6)	4.43
Diet_Freq: Yes	11.34 (7.58, 16.63)	2.28	22.16 (16.86, 28.56)	2.98
Weight for Height				
Breastfed within1: No	2.21 (0.71, 6.63)	1.26	12.5 (7.91, 19.2)	2.84
Breastfed within1: Yes	4.09 (2.89, 5.76)	0.72	12.93 (10.72, 15.52)	1.22
Breastfed_After6: No	5.26 (2.2, 12.04)	2.29	20 (13.13, 29.26)	4.11
Breastfed_After6: Yes	3.63 (2.53, 5.18)	0.66	12.02 (9.93, 14.46)	1.15
Age_CF: After 6 Months	4.1 (2.22, 7.46)	1.27	12.3 (8.73, 17.05)	2.10
Age_CF: At 6 Months	1.75 (0.84, 3.63)	0.66	10.25 (7.63, 13.63)	1.52
Age_CF: Before 6 Months	9.24 (5.82, 14.37)	2.14	19.02 (13.97, 25.35)	2.89
Handwash: No	6.45 (2.44, 15.99)	3.12	17.74 (10.1, 29.29)	4.85
Handwash: Yes	3.64 (2.55, 5.16)	0.65	12.24 (10.17, 14.67)	1.14
min_diet: No	4.23 (2.21, 7.93)	1.38	17.84 (13.25, 23.58)	2.62
min_diet: Yes	5.41 (2.04, 13.55)	2.63	14.86 (8.42, 24.91)	4.14
Diet_Diver: No	4.37 (2.29, 8.19)	1.42	18.45 (13.72, 24.35)	2.70
Diet_Diver: Yes	4.94 (1.86, 12.45)	2.41	13.58 (7.67, 22.9)	3.81
Diet_Freq: No	4 (1.51, 10.19)	1.96	20 (13.27, 29)	4.00
Diet_Freq: Yes	4.81 (2.52, 9)	1.57	15.51 (10.99, 21.44)	2.65

Appendix 20 Expenditure on food categories as a percentage of total food expenditure (Combined)

	Expenditure as % of total food expenditure							
	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
Cereals & Millets	8.15%	4.23%	4.20%	5.33%	4.22%	9.39%	5.41%	5.86%
Edible Oils	15.59%	20.83%	23.79%	22.09%	23.10%	14.08%	24.60%	20.42%
Egg	0.26%	0.26%	0.26%	0.15%	0.26%	0.21%	0.17%	0.22%
Fish	17.94%	9.64%	14.53%	13.18%	12.00%	16.28%	9.68%	13.87%
Fruits	5.43%	9.96%	7.90%	9.98%	8.29%	5.95%	5.31%	7.96%
Leafy Vegetables	1.11%	1.91%	1.35%	1.40%	1.48%	1.02%	0.91%	1.34%
Meat & Poultry	16.49%	15.61%	9.73%	19.56%	17.23%	9.26%	11.40%	15.59%
Milk & Milk Products	3.43%	4.38%	3.14%	2.11%	2.77%	3.14%	6.27%	3.17%
Non-Leafy Vegetables	5.38%	5.46%	4.74%	4.84%	4.93%	5.95%	3.98%	5.06%
Pulses & Legumes	8.91%	12.94%	13.78%	8.92%	10.99%	16.87%	13.83%	11.20%
Roots & Tubers	9.79%	9.02%	9.93%	7.22%	8.69%	11.06%	10.35%	8.98%
Sugars & Salt	7.51%	5.77%	6.66%	5.23%	6.03%	6.79%	8.09%	6.34%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Appendix 21 Quantity consumed as a percentage of total food consumption

	Barpeta	Bongaigaon	Darrang	Dhubri	Goalpara	Kokrajhar	Udalguri	Total
Cereals & Millets	13.94%	9.60%	10.31%	12.27%	11.01%	15.11%	12.20%	12.28%
Edible Oils	8.66%	7.16%	8.47%	7.94%	8.49%	7.72%	9.36%	8.20%
Egg	2.45%	2.31%	2.46%	1.35%	2.34%	1.79%	1.61%	2.01%
Fish	5.47%	3.22%	4.59%	4.20%	3.99%	4.47%	3.48%	4.41%
Fruits	6.40%	10.92%	9.74%	10.55%	8.17%	5.76%	6.17%	8.55%
Leafy Vegetables	5.15%	8.80%	7.72%	7.01%	7.25%	5.03%	5.68%	6.60%
Meat & Poultry	2.90%	3.02%	1.74%	3.59%	3.83%	2.51%	2.95%	3.03%
Milk & Milk Products	4.06%	5.06%	3.93%	2.32%	3.11%	3.89%	5.15%	3.61%
Non-Leafy Vegetables	8.44%	11.36%	9.52%	13.30%	11.48%	8.55%	7.67%	10.52%
Pulses & Legumes	7.49%	8.98%	9.99%	6.88%	8.77%	13.21%	10.26%	8.65%
Roots & Tubers	17.43%	16.06%	16.32%	16.46%	15.91%	16.91%	18.56%	16.73%
Sugars & Salt	17.61%	13.51%	15.20%	14.13%	15.67%	15.05%	16.92%	15.42%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Appendix 22 Number of ICDS sample blocks allotted to Survey Districts

District	Total no of ICDS blocks	ICDS blocks allotted
Barpeta	10	7
Bongaigaon	5	3
Darrang	6	4
Dhubri	11	7
Goalpara	6	4
Kokrajhar	5	3
Udalguri	5	3

Appendix 23 Number of households & AWCs allotted to the chosen ICDS blocks

District	Level	Name	Allotted Sample households	Households surveyed	Total no of AWCs	Allotted AWCs
Barpeta	ICDS BLOCK	Ruposhi	44	40	298	3
Barpeta	ICDS BLOCK	Mandia	97	96	448	4
Barpeta	ICDS BLOCK	Chenga	27	26	260	3
Barpeta	ICDS BLOCK	Gomaphulbari	21	19	116	1
Barpeta	ICDS BLOCK	Bhabanipur	48	46	388	4
Barpeta	ICDS BLOCK	Sarukhetri	17	14	109	1
Barpeta	ICDS BLOCK	Bajali	12	12	657	6
Bongaigaon	ICDS BLOCK	Srijangram	29	29	250	2
Bongaigaon	ICDS BLOCK	Tapattary	31	31	157	2
Bongaigaon	ICDS BLOCK	Manikpur (Part)	29	28	270	3
Darrang	ICDS BLOCK	Sipajhar (Part)	37	37	465	5
Darrang	ICDS BLOCK	Pachim-Mangaldai (Part)	12	Nc*	129	1
Darrang	ICDS BLOCK	Pub-Mangaldai (Part)	50	44	321	3
Darrang	ICDS BLOCK	Dolgaon-Sialmari	50	38	569	6
Dhubri	ICDS BLOCK	Golakganj (Part)	24	24	153	1
Dhubri	ICDS BLOCK	Rupsi (Part)	29	29	229	2
Dhubri	ICDS BLOCK	Chapar-Salkocha (Part)	29	29	266	3
Dhubri	ICDS BLOCK	Gauripur	57	57	289	3
Dhubri	ICDS BLOCK	Birshingjarua	46	45	204	2
Dhubri	ICDS BLOCK	Nayeralga	30	30	190	2
Dhubri	ICDS BLOCK	South Salmara	36	35	134	1
Goalpara	ICDS BLOCK	Jaleswar	42	41	267	3
Goalpara	ICDS BLOCK	Kharmuza	25	25	206	2
Goalpara	ICDS BLOCK	Krishnai	24	25	479	5
Goalpara	ICDS BLOCK	Kuchdhowa	15	16	198	2
Kokrajhar	ICDS BLOCK	Kachugaon	42	41	341	3

Kokrajhar	ICDS BLOCK	Dotoma	28	27	499	5
Kokrajhar	ICDS BLOCK	Kokrajhar	43	41	341	3
Udalguri	ICDS BLOCK	Bhergaon	27	16	297	3
Udalguri	ICDS BLOCK	Udalguri	38	28	447	4
Udalguri	ICDS BLOCK	Mazbat	27	18	213	2

Source: Computed

Note: The number of households & AWCs allotted to the ICDS blocks are proportional to the population of children under six in the respective blocks. The Census of India estimates of 2011 served as the base. * Could not be covered as the survey areas were out of bounds.

Appendix 24 List of Anganwadi Centres Covered in the Sample Survey

No.	District	ICDS Block	AWC Name
1	**Barpeta**	Bajali	278 No Santipur Singimari Dakhin
2			49 No Borbari-1 (B)
3			50 No Bangaon
4			Bagaribari 371 B
5			192 Haldhia Pathor
6		Bhabanipur	Anandpur2
7			Duttakuchi Pub Uttar 7
8			Kurobaha 2
9			Kurobahapathar PM 2
10		Chenga	Anandabhanga Elahi Mahajan Supa
11			Kashimpur1
12			Sunersali
13		Goma Phulbari	Damaljhar B
14		Mandia	110 Kasimpur
15			Chapra
16			Kapoha
17			Rupakuchi & Muhammadpur
18		Ruposhi	Charcharia
19			Dewkura
20			Khatartari
21		Sarukhetri	Bannapur
22	**Bongaigaon**	Manikpur	2 No Bashbari Uttar
23			Garugaon-1
24			Jaraguri
25		Srijangram	Kalikura Pt-II
26			Tapattary West AWC
27		Tapattary	53 No Roumari Thakuranipara
28			61 No Chotto Barjana
29	**Darrang**	Dolgaon-Sialmari	1/2 Baruajhar pt.VIII
30			Bihudiya anganbadi 314
31			Jangalpara pt.IV

32			Rowmari pt.II
33			Ward no.7 Taxistand
34		Pub-Mangaldai	Atakatta Pachim (M)
35			Batabari Uttar
36			Gerimari Pub Dakhin
37		Sipajhar	Alikas Chuba
38			Alikhapara
39			Khas Dipila
40			No.27 Chengapara
41			Pub Khandra
42	**Dhubri**	Birshinjarua	107 No Jharnarchar pt-1
43			193 No Pubkathulipara
44		Chapar Salkocha	100. Jamduar Part 3
45			253 no akla para
46			No.34 Sagolkhoti
47		Gauripur	107 No. Dalshingeralga Part 2
48			248 no. Khiripara
49			63 No. Dighaltari pt.ii
50		Golakganj	103 No. Sonahat
51		Nayeralga	100 No. Das Para
52			156 No. Paschim Para (Gourang Nodi)
53		Rupshi	126no debottar Barundanga
54			226.no Debottar Barundanga
55			51 No Balajan Pt.III
56		South Salamara	120 no Bilpara (Noskara)
57			97no Noskara
58			Bilpara 120 No
59			Bilpara Noskara
60	**Goalpara**	Jaleswar	116 No.Ambari Kortimari Daspara
61			Thangpuripara
62			Ververy Part 2
63		Kharmuza	96 no Kharmuja Majerpara
64			South Katlamari
65		Krishnai	batabari
66			Bengaguri
67			Namapara
68			Nodiyapara
69		Kuchdhowa	181 no Lengrapara
70			Udmari
71	**Kokrajhar**	Dotoma	Guabari (Kaljhar)
72			N/Khagrabari
73			Ouguri F/V
74		Kochugaon	Kashiabari Tapu 2M
75			N/22 Aibhander Boro Basti
76			Sapkata

77		Kokrajhar	Belguri
78			Dekadamra
79			Nayekgaon Pt ii
80			Nayekgaon Pt III
81	**Udalguri**	Bhergaon	10 no. Harshapara
82			Khanimandir
83		Mazbat	bheluguri
84			NC bheluguri
85			Niz-Rangapani-2 (M)
86			No. 2 Bheluguri
87		Udalguri	Botabari
88/89			Gitibari/Sarubengara

Annexure 1: Tool for primary data collection

Household schedule

Schedule No.					
Date					
Investigator name					
Start Time					
End Time					

TABLE 1 IDENTIFICATION			
District		**Name of the Household Head (major earner)**	
Block		**AWC Supervisor's Name & Contact Number**	
AWC name		**Mother tongue of the respondent**	
Gaon Panchayat		**Religion**	
Revenue village		**Social Group/Jati (Specify name)**	

TABLE 2 FAMILY MEMBER DETAILS

Member ID	Name	Relationship with Head	sex	Age		Marital Status	Age at Marriage (in yrs)	Physiological status (code)	Activity Status	Consumption units (code)	Education Level
				Yrs	Mnths						
1.											
2.											
3.											
4.											
5.											
6.											
7.											
		Self=0, Spouse-1, Child – 2, Spouse of Married Child – 3, Parent – 4, Grand-parent – 5, Grand-child -6, Brother/Sister – 7, In-laws-8, Other relatives – 9, Servant/Employee -10, Others - 11		Age in completed years; Up to the nearest month in case of children below 5 years of age		1. Never married 2. Currently married 3. Widowed 4. Separated/Divorced 5. Other (specify)		Women in the age group 15-45 yrs: NPNL =1; Pregnant =2; Lactating upto 12 months =3 Children <2 yrs of age: Only breastfed =4; Breastfed+water =5; Breastfed+complementary feeding =6; Not breastfed =7 All others: Not applicable=9	Agriculture & Allied -1, Agricultural Labourer -2, Daily Wage Earner – 3, Housewife -4, Petty Business/Self-employed-5, Trade/Business – 6, Salaried Service (reg) – 7, Salaried but casual – 8, Student – 9, Pensioners – 10, Not Applicable –11, Seeking/Available for work-12, Others – 13	Adult male (>= 18 yrs): Sedentary=1.0; Moderate=1.2; Heavy=1.6 Adult female (>=18 yrs) NPNL: Sedentary=0.8; Moderate=0.9; Heavy=1 Pregnant: Sedentary=0.9; Moderate=1.0; Heavy=1.1 Lactating: Sedentary=1.3; Moderate=1.4; Heavy=1.5 Adolescent and children (<18 yrs) Children (16-17 yrs) boys=1.2; girls=0.9; (13-15 yrs) boys=1.1; girls=1.0; (10-12 years) boys=1.0; girls=0.9 (7-9 yrs) B+G=0.9; (4-6 yrs) B+G=0.7; (1-3 yrs) B+G=0.5; <1 yr B+G=0	In completed years of formal education

TABLE 3 WORK STATUS OF ADULT MALE AND FEMALE MEMBERS

Item	Male head	Female head
What have you been doing for most of the time over the last 12 months?	Looking for work . . . . . .1 Wage labour . . . .2 Household Work/Childcare . . . . ..3 Currently unemployed . . .. 4 Other:	Looking for work . . . . . .1 Wage labour . . . . . 2 Household Work/Childcare . . . . .3 Currently unemployed . . .. 4 Other:
If currently unemployed, mention duration of unemployment (in years of months)		
Do you usually work throughout the year, or do you work seasonally, or only once in a while?	Throughout the year . . . . . 1 Seasonally/ part of the year . . . . 2 Once in a While 3	Throughout the year . . . . . 1 Seasonally/ part of the year . . . . 2 Once in a While 3
Are you paid in cash or kind for the work, or are you not paid at all?	Cash only . . . . . .1 Cash and Kind . . . . . .2 In Kind only . . . . . .3 Not Paid 4	Cash only . . . . . .1 Cash and Kind . . . . . .2 In Kind only . . . . . .3 Not Paid 4
If currently unemployed, make note of the reasons and circumstances of unemployment:		

TABLE 4 EMPLOYMENT DETAILS

Member ID	Main Occupation	Secondary Occupation	Identifier of nature of work

Codes: Identifier: *Casual Worker – 1, Permanent salaried worker – 2, Self-employed/ Non-farm activity – 3, Cultivator/Farm activity – 4, Livestock – 5.* If **Identifier** is 1 go to section **4A**, if 2 go to section **4B**, if 3 go to section **4C**

Section 4A: For Casual Work

ID	Wage rate/day (Rs)	Frequency of wage*

*Frequency: Daily – 1, Weekly- 2, Monthly- 3

Section 4B: For Permanent Work

ID	Wage rate/day or salary (Rs)	Frequency of wage*

*Frequency: Daily – 1, Weekly- 2, Monthly- 3

Section 4C: For Self-employment/non-farm

ID	Activity	Annual income (take last reference year approximate)

	TABLE 5 AGRICULTURE				
1.	Household's homestead land: (Area in Bigha/Katha/lessa)				
2.	Whether household owns any agricultural land? (Yes-1, No-2) if Yes Go to 3, else skip to 4				
3.	Total agricultural land owned (in Bigha/Katha/Lessa)				
4.	Total agricultural land leased in (in Bigha/Katha/Lessa)				
5.	Total agricultural land leased out (in Bigha/Katha/Lessa)				
6.	Total land possessed otherwise (in Bigha/Katha/Lessa)				
7.	Total area of land cultivated (in Bigha/Katha/Lessa)				
8.	Total area irrigated of total cultivated land (put 0 if no irrigation) (in Bigha/Katha/Lessa)				
9.	If 8 is Yes, source of irrigation (Govt. canal/tanks/tubewells-1, Self-owned/operated tube wells /pump-sets -2, On payment – 3, Natural – 4, User society/cooperative – 5, Multiple sources – 6, If other specify)				
10.	Three Major crops grown in the last agricultural year				
11.	Total area under the crop (in bigha)				
12.	Total input cost for the 3 crops (take approximate of last year)				
13.	Total income from cultivation of three major crops (take approximate of last year)				
14.	Whether owns any plantation? (Yes-1, No-2) If yes, specify (only upto 3)				
15.	Whether owns any horticultural crop/orchard? (Yes-1, No-2) If yes, specify (only upto 3)				
16.	Whether engaged in any sericulture activity? (Yes-1, No-2)				
17.	Total household income from farm activities, excluding agricultural crop incomes (take approximate of last year)				

TABLE 6

During the last 12 months, how many adult female and male members of your household lived and worked in a different town or village within the country? (tick on the response)

Male migrants		Female migrants	
0 to 3 months		0 to 3 months	
4 to 6 months		4 to 6 months	
7 to 9 months		7 to 9 months	
1o months or more		1o months or more	

During the last 12 months, how many adult female and male members of your household lived and worked in a different town or village outside the country? (tick on the response)

Male migrants		Female migrants	
0 to 3 months		0 to 3 months	
4 to 6 months		4 to 6 months	
7 to 9 months		7 to 9 months	
1o months or more		1o months or more	

TABLE 7 ANTHROPOMETRIC DETAILS				
	Mother	**Child 1**	**Child 2**	**Child 3**
Member ID				
Height (cm)				
Weight (kg)				
MUAC				

Notes:

TABLE 8 DETAILS OF CHILDREN			
	Child 1	**Child 2**	**Child 3**
1. Member ID			
2. Date of Birth			
3. Birth order			
4. Birth weight			
5. Place of delivery			
6. Who assisted with the delivery			
7. Vaccination card (Y/N)			
8. Vitamin A given in last 6 months (Y/N)			
9. Deworming done in last 6 months (Y/N)			
10. Polio vaccine received (Y/N)			
11. Complete immunization (Y/N) Has the child received all the vaccines mentioned in the vaccination card?			
12. Diarrhoeal episode in last 8 weeks (Y/N)			
13. Number of diarrhoeal episodes			
14. Treatment given for Diarrhoea			
15. Severe cough or fever in last 8 weeks (Y/N)			
16. Number of episodes of cough or fever			
17. Treatment given for cough or fever			
18. Was pregnancy registered? (Y/N)			
19. Breastfeeding started within one hour (Y/N)			
20. Continued breastfeeding after 6 months (Y/N)			
21. Age at introducing complimentary feeding			

Codes for Q. 5 – Home =1, Public Health Sector=2 (Government hospitals and health facilities), Private Health Sector=3, Other= 4 (specify)
Codes for Q.6- Doctor=1, ANM/Nurse/Midwife=2, Dai/Other person=3, Friend/Relative=4
Codes for Q. 14&17= Medicines from hospital after consultation with doctor=1, Straight from pharmacy=2, Traditional medicines (Specify)=3, No treatment = 4
Codes for Q.21- < 6 months=1, 6 months= 2, > 6 months=3

Notes:

TABLE 9 PRE-NATAL CHECKS			
Sl. No	Item	Specify	Codes/comment
1	How old were you when your first child was born?		
	When you got pregnant, did you want to get pregnant at that time?		YES . . . . . 1 NO 2
2	With whom did you register your pregnancy?		ANM .... 1 ASHA ..... 2 AWW ..... 3 Other 9
3	Did you receive a Mother and Child Protection Card after registration?		YES . . . . . 1 NO 2
4	Who among the given options did you see for your pregnancy?		Doctor .....1 ANM/Nurse/Mid-wife.....2 Dai/Traditional Birth attendant.....3 Community Health worker.....4 Anganwadi worker.....5 ASHA..... . . .6 Others 9
5	As part of your antenatal care during this pregnancy, were any of the following done at least once		
	a. Were you weighed?		YES . . . . . 1 NO 2
	b. Was your blood pressure measured?		YES . . . . . 1 NO 2
	c. Was a sample of your blood taken for testing?		YES . . . . . 1 NO 2
	d. Was your abdomen examined?		YES . . . . . 1 NO 2
	e. Did you give a urine sample?		YES . . . . . 1 NO 2
6	If registered, what are the benefits you received from the health department?		Iron and Folic Acid tablet.....1 Measuring your blood pressure.....2 Measuring your weight.....3 Receiving Tetanus toxoid Injection.....4 Any other.....9
7	For how many days you consumed Iron and Folic Acid Tablets (IFA)?		
8	If you did not, what are the main reasons for not going for any pre-natal checkup?		
9	During the last three months of this pregnancy, did you meet with an ANM, Lady Health Visitor, ASHA, Anganwadi Worker, or other community health worker?		YES . . . . . 1 NO 2
10	If yes where?		HOME ONLY. . . . . .1 ELSEWHERE ONLY. . . . . .2 BOTH HOME AND ELSEWHERE. . . .3
11	At any time during your pregnancy did any health provider speak to you about: a) Importance of delivering the baby in a hospital or health facility? b) Importance of proper nutrition for the mother during pregnancy? c) Family planning or delaying your next child?		Yes / No Delivery advice 1 2 Nutrition advice 1 2 Family Planning 1 2

TABLE 10 POST-NATAL CHECKS			
Sl. no	Item	Specify	Code/Comment
1.	Have you received any cash/kind benefit if you delivered in a government facility?		YES . . . . . 1 NO. 2
2.	What was the main mode of transportation used by you to reach the health facility for delivery?		GOVERNMENT AMBULANCE. . . .01 OTHER AMBULANCE.. . . .02 JEEP/CAR. . . . . .03 MOTORCYCLE/SCOOTER. . . . . .04 BUS/TRAIN. . . . . .05 TEMPO/AUTO/TRACTOR. . . . . .06 CART. . . . . .07 ON FOOT. . . . . .08 OTHER.. 09
3.	iF it cost you out of your pocket for transportation, how was this met?		BANK ACCOUNT/SAVINGS. . . . . .1 BORROWED FROMFRIENDS. . . . . .2 SELLING PROPERTY. . . . . .3 SELLING JEWELLERY . . . . 4 INSURANCE. . . . . .5 OTHER.. . . . . 6 (Specify)
4.	In the first three days after delivery, was the newborn given anything to drink other than breast milk?		YES . . . . . 1 NO. 2
5.	If answer to Qn. 4 is yes, what was given to drink other than breast milk?		Milk (other than Breast Milk).....1 Plain water.....2 Sugar or Glucose water.....3 Gripe water.....4 Sugar salt water.....5 Fruit Juice.....6 Infant Formula.....7 Other.....9
6.	Did you receive any Supplementary Take Home Ration during pregnancy and after delivery of the child?		YES . . . . . 1 NO 2
7.	Did the child receive any Supplementary Take Home Ration		YES . . . . . 1 NO 2
8.	What kind of items did you receive as Supplementary Take Home Ration		
9.	What were the reason(s) for starting complementary feeding?		AWW/ASHA instruction.....1 Family Custom.....2 Breast milk was not enough.....3 Baby was always crying.....4 Radio.....5 Television .....6 Newspaper/Magazine.....7 Poster/Hoardings.....8 Exhibition.....10 Religious Leader.....11 Other.....9
10.	Do you hand wash with soap before feeding the child?		YES . . . . . 1 NO. 2
11.	Does the Anganwadi Worker measure the weight and height of the child at regular interval?		
12.	Do you know about the growth monitoring card for the child?		
13.	Do you have any sons or daughters to whom you have given birth who are alive but do not live with you?		YES . . . . . 1 NO. 2
14.	Is there any child you have given birth but could not survive?		YES . . . . . 1 NO. 2
15.	If yes, what was the age of death?		
16.	What was the cause of death?		

TABLE 11 24 HOUR RECALL OF DIETARY INTAKE OF THE CHILD					
Sl. no.	**Food Item taken by the child**	**Amount**	**Yes**	**No**	**Don't Know**
1	Mother milk	_____Times	1	2	3
2	Plain water	_____Glass	1	2	3
3	Juice or Juice drink	_____Glass	1	2	3
4	Clear Broth	_____Bowl	1	2	3
5	Milk such as tinned , powdered, or fresh animal milk	_____Glass	1	2	3
6	Infant formula	_____Bowl	1	2	3
7	Any other milk product	_____Bowl	1	2	3
8	Any commercially fortified baby food e.g. Cerelac or Farex	_____Bowl	1	2	3
9	Any bread, roti, rice, noodles, biscuits, pitha, or any other foods from grains	_____Number/_____Bowl	1	2	3
10	Any vegetables	_____Bowl	1	2	3
11	Any green leafy vegetables	_____Tablespoon	1	2	3
12	Any fruit	_____Number	1	2	3
13	Any egg	_____Number			
14	Any meat (white/red)	_____Gram	1	2	3
15	Any fresh or dry fish	_____Gram	1	2	3
16	Any food from beans, peas, lentils, or nuts	_____Bowl	1	2	3
17	Any other solid, semi-solid, or soft food		1	2	3
17(i)	If yes, what kind of food?				
17(ii)	How many times did the child eat solid, semi-solid, or soft foods yesterday during the day or at night?				

TABLE 12 DETAILS OF HOUSEHOLD CONSUMPTION DURING LAST ONE MONTH OF FOOD ITEMS (RECALL MONTHLY)

Sl no.	Food Group	Food Code	Frequency of consumption (code)	Raw amounts consumed Qty (kg/Ltr)	Purchased from PDS Qty (Kg/Ltr)	Home grown Qty (Kg/Ltr)	Purchased from market Qty (Kg/Ltr)	From other sources		Market price (Rs./Kg)
								Qty (Kg/Ltr)	Other source code	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Cereals & Millets	**101**								
1	Rice									
2	Wheat									
3	Rice flakes									
4	Semolina									
5	Puffed rice									
6	Ragi (Maruba dhan/mandua)									
8	Foxtail millet (koni dhan)									
9	Any other (specify)									
10										
11										
	Pulses & legumes	**102**								
12	Bengal gram whole (kabooli boot)									
13	Bengal gram dal (boot dal)									
14	Black gram dal (mati mahor dal)									
15	Greengram whole (mogu)									
16	Greengram dal (mogu dal)									
17	Pigeon pea (Arhar/Tur)									
18	Red Lentil (Masoor dal)									
19	Rajmah									
20	Soyabean									
21	Any other (specify)									
22										
23										

Code for Col (4) – Frequency of Consumption
Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (9), Col (11)
Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (13)
Relatives/friends=1;
ICDS=2; Forest=3; Agricultural land=4
Any other=5

Sl no.	Food Group	Food Code	Frequency of consumption (code)	Raw amounts consumed Qty (kg/ltrs)	Purchased from PDS Qty (Kg/Ltr)	Home grown Qty (Kg/Ltr)	Purchased from market Qty (Kg/Ltr)	From other sources		Market price (Rs./Kg)
								Qty (Kg/Ltr)	Other source code	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Leafy vegetables	**103**								
24	Spinach leaves (palak)									
25	Fenugreek leaves (Methi)									
26	Mustard greens (Laai)									
27	Indian spinach (Pui saag)									
28	Fiddlehead fern (Dhekia saag)									
29	Spiny Amaranth (Khutura saag)									
30										
31										
32										
	Roots & Tubers	104								
33	Carrot									
34	Colocasia (kosu)									
35	Beetroot									
36	Onion									
37	Potato (big)									
38	Potato (small)									
39	Sweet potato									
40	Yam (kath alu)									
41										
42										
43										
44										
45										

Code for Col (4) – Frequency of Consumption
Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (9), Col (11)
Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (13)
Relatives/friends=1;
ICDS=2; Forest=3; Agricultural land=4
Any other=5

Sl no.	Food Group	Food Code	Frequency of consumption (code)	Raw amounts consumed Qty (kg/ltrs)	Purchased from PDS Qty (Kg/Ltr)	Home grown Qty (Kg/Ltr)	Purchased from market Qty (Kg/Ltr)	From other sources		Market price (Rs./Kg)
								Qty (Kg/Ltr)	Other source code	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Non Leafy vegetables	**105**								
46	Cabbage									
47	Cauliflower									
48	Knolkhol (Oolkobi)									
49	Banana flower									
50	Curry banana (Kaskol)									
51	Banana shoot (Posola)									
52	Jackfruit (Kothal)									
53	Pointed gourd (Potol)									
54	Ridge gourd (Jikaa)									
55	Snake gourd (Dhunduli)									
56	Pumpkin									
57	Bitter gourd (Karela)									
58	Teasle gourd (Bhat karela)									
59	Okra (bhendi)									
60	Ivy gourd (kunduli)									
61	Bottle gourd (lau)									
62										
63	**Edible Oils**									
64	Mustard oil									
65	Sunflower oil									
66	Refined oil									
67										
68	Any other									

Code for Col (4) – Frequency of Consumption

Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (9), Col (11)

Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (13)

Relatives/friends=1;

ICDS=2; Forest=3; Agricultural land=4

Any other=5

Sl no.	Food Group	Food Code	Frequency of consumption (code)	Raw amounts consumed Qty (g/ltrs)	Purchased from PDS Qty (Kg/Ltr)	Home grown Qty (Kg/Ltr)	Purchased from market Qty (Kg/Ltr)	From other sources		Market price (Rs./Kg)
								Qty (Kg/Ltr)	Other source code	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Fruits	**106**								
69	Amla									
70	Grapes									
71	Guava country									
72	Orange									
73	Mango									
74	Banana ripe									
75	Jackfruit									
76	Dates fresh									
77	Lemon									
78	Papaya									
79	Custard apple (seetaphal)									
80	Tomato ripe									
81	Pomegranate									
82	Apples									
83	Water melon									
84										
85										
	Fish	**107**								
86	Fish (big)									
87	Fish (small)									
88										
89										
90										

Code for Col (4) – Frequency of Consumption

Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (9), Col (11)

Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (13)

Relatives/friends=1;

ICDS=2; Forest=3; Agricultural land=4

Any other=5

Sl no.	Food Group	Food Code	Frequency of consumption (code)	Raw amounts consumed Qty (kg/Ltrs)	Purchased from PDS Qty (Kg/Ltr)	Home grown Qty (Kg/Ltr)	Purchased from market Qty (Kg/Ltr)	From other sources		Market price (Rs./Kg)
								Qty (Kg/Ltr)	Other source code	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Meat & Poultry	**108**								
91	Egg duck									
92	Egg chicken									
93	Fowl (chicken)									
94	Goat meat									
95	Pork meat									
96	Snail small									
97										
	Milk & milk products	**109**								
100	Milk buffalo									
101	Milk cow									
102	Milk goat									
103	Curd									
104	Paneer									
105										
	Sugars	**110**								
107	Sugar									
108	Jaggery date palm									
109	Jaggery Cane									
	Salt	**111**								
110	Iodized salt									
111	Non-iodized salt									
112	Black salt									
113										

Code for Col (4) – Frequency of Consumption
Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (9), Col (11)
Daily=1; Twice/thrice a week=2; Once a week=3; Once in fifteen days=4; Once in a month=5; Occasionally=6

Code for Col (13)
Relatives/friends=1;
ICDS=2; Forest=3; Agricultural land=4
Any other=5

TABLE 12 HEALTH SERVICE ACCESS, FOOD HABITS AND PERCEPTION			
1. Is any usual member of this household covered by a health scheme or health insurance? If Yes, mention the type from the codes			EMPLOYEES STATEINSURANCE SCHEME (ESIS). . . . . 1 CENTRAL GOVERNMENT HEALTHSCHEME (CGHS). . . . . .2 STATE HEALTH INSURANCESCHEME. . . . . .3 RASHTRIYA SWASTHYA BIMA YOJANA(RSBY). . . . . 4 COMMUNITY HEALTH INSURANCEPROGRAMME. . . . . .5 OTHER HEALTH INSURANCETHROUGH EMPLOYER. . . . . .6 MEDICAL REIMBURSEMENT FROMEMPLOYER. . . . . .7 PRIVATELY PURCHASEDCOMMERCIAL HEALTH INSURANCE. . .8 OTHER. 9
2. When members of your household get sick, where do they generally go for treatment?			PUBLIC HEALTH SECTOR (GOVERNMENT HOSPITAL) – 1 PRIVATE HOSPITAL – 2 HOME TREATMENT – 3 PHARMACY - 4 OTHER – 3 (SPECIFY)
3. Why don't members of your household generally go to a government facility when they are sick? Any other reason?			NO NEARBY FACILITY. . . . . .1 FACILITY TIMING NOT CONVENIENT. . . .2 HEALTH PERSONNEL OFTEN ABSENT. . . 3 WAITING TIME TOO LONG. . . . . .4 POOR QUALITY OF CARE. . . . . .5 OTHER. 6
4. What are the main reasons if not receiving any vaccination? (If applicable)			
5. According to you, which foods and drinks may not be consumed by the following categories, and why	Kinds of food	Reason	
a. Infants during weaning			
b. Girls			
c. Women during pregnancy			
d. Women in general			
e.			
6. According to you, which special foods and drinks may be consumed by the following categories, and why	Kinds of food	Reason	
a. During pregnancy			
b. Infants			
c. Women during lactation			
d. Puberty rites of girls			
e.			
7. In what order do the members of the household eat? (Indicate 1,2,3 along with the member details)			
8. Do the children receive any kind of supplementary nutrition from the government or other agencies? (e.g. Nutrimixes)			
9. Do the children attending school get mid-day meals?			
10. Are there any children not attending school? If yes, why?			
11. Do you think the prices of the following commodities have gone up in the last one year? a. Rice/Wheat b. Pulses c. Sugar d. Fruits and vegetables	a. . . . . b. . . . . c. . . . . d.		
12. If yes, which among the above had the highest price rice?			
13. Do you think more income is required to be able to afford food in the coming one year?			

TABLE 13 INFORMATION ON ATTITUDE TOWARDS GENDER ROLE:

Sl. No.	Details about Gender Role	Coding Categories				
1	In a couple, who do you think should have the greater say in each of the following decisions: the husband, the wife or both equally:		Husband	Wife	Both Equally	Don't Know/ Depends
	a) Making major household purchase?	a	1	2	3	4
	b) Making purchase of daily household needs?	b	1	2	3	4
	c) Deciding about visits to the wife's family or relatives?	c	1	2	3	4
	d) Deciding what to do with the money the wife earns from her work	d	1	2	3	4
	e) Deciding how many children to have?	e	1	2	3	4
2	Who usually makes decisions about healthcare for yourself: mainly you and your husband jointly or someone else.	Husband ……. 1 Wife ……. 2 Husband and Wife Jointly…… 3 Someone else…… 4 Others……				
3	Who usually makes decisions about making major household purchase: mainly you and your husband jointly or someone else.	Husband ……. 1 Wife ……. 2 Husband and Wife Jointly…… 3 Someone else…… 4 Others……				
4	Do you own this or any other house either alone or jointly with someone else?	Alone only…… 1 Jointly Only…… 2 Both alone and Jointly…… 3 Does not own…… 4				
5	Do you own any land either alone or jointly with someone else?	Alone only…… 1 Jointly Only…… 2 Both alone and Jointly…… 3 Does not own…… 4				
6	In your opinion, is a husband justified in hitting or beating his wife in the following situation:		Yes	No		Don't Know
	a) If she goes out without telling him?	Goes out	1	2		4
	b) If she neglects the house of the children?	Neglect Children	1	2		4
	c) If she argues with him?	Argues	1	2		4
	d) If she refuses to have sex with him?	Refuses sex	1	2		4
	e) If she does not cook food properly?	Poor Cooking	1	2		4
	f) If he suspects her of being unfaithful?	Unfaithful	1	2		4
	g) If she shows disrespect for in-laws?	Disrespect	1	2		4
7	Do you think that if a woman refuse to have sex with her husband when he wants her to , he has right to:		Yes	No	Don't Know	
	a) Get angry and reprimand her?	Angry	1	2	4	
	b) Refuse to give her money or other means of financial support?	Refuse support	1	2	4	
	c) Use force and have sex with her even if she does not want to?	Use Force	1	2	4	
	d) Go and have sex with another woman?	Sex with another woman	1	2	4	

TABLE 14 TIME-USE DIARY OF ADULT MALE AND FEMALE MEMBERS				
Time	Adult male		Adult female	
	Primary Activity	Location	Primary Activity	Location
04:00 - 05:00				
05:00 - 06:00				
06:00 - 07:00				
07:00 - 08:00				
08:00 - 09:00				
09:00 - 10:00				
10:00 - 11:00				
11:00 - 12:00				
12:00 - 13:00				
13:00 - 14:00				
14:00 - 15:00				
15:00 - 16:00				
16:00 - 17:00				
17:00 - 18:00				
18:00 - 19:00				
19:00 - 20:00				
20:00 - 21:00				
21:00 - 22:00				
22:00 - 23:00				
23:00 - 00:00				

Notes:

TABLE 15 Public Distribution System							
1. Does the household have a ration card?		2. Type of card (specify)					
3. Color of the card		4. Number of persons registered		a. Adults		b. Children	
5. Reason for not having a card							
6. Distance to the PDS shop							

TABLE 16 SOURCE OF WATER FOR DOMESTIC USE					
Source of water	Ownership	Distance from house	Purpose for which used	Who brings water	Cost/payment

TABLE 17 MEMBERSHIP IN SHGS/NGOS/CSO					
Name of the member	Name/type of the Organisation	Period of membership	Number of members in the group	Activities	Comments

TABLE 18 HOUSING												
No.	Owned/rented	Verandah	Separated kitchen	No. of rooms	Main material used for roof	Main material Used for wall	Main material used for floor	Latrine	Electricity	Cooking fuel	Place of cooking	Type of stove

TABLE 19 ASSETS									
Immovables		**Means of transport**		**Electric equipment**		**Other domestic durable goods**		**Inventories**	
Agricultural land		Bicycle		Television		Sewing machine		Food grain	
Cattle-shed		Scooter/bike		Radio		Mattress		Fodder	
Shops/establishments		Car/jeep		Mobile phone		Dining table			
				Landline					
				Refrigerator					
				DTH/Cable				**Livestock**	
				Air-conditioner					
				Computer					
				Fan					
				Washing machine					

Categories of response for Table 16: (FOR REFERENCE)

Source of water:

PIPED WATER, TUBE WELL OR BOREHOLE, DUG WELL, WATER FROM SPRING, RAINWATER, TANKER TRUCK, SURFACE WATER (RIVER/DAM/ LAKE/POND/STREAM/CANAL), BOTTLED WATER, Specify if any other

Who brings water:

ADULT WOMAN, ADULT MAN, FEMALE CHILD UNDER AGE 15 YEARS, MALE CHILD UNDER AGE 15 YEARS, Specify others

Categories of response for Table 18: (FOR REFERENCE)

MAIN MATERIAL USED FOR ROOF:

Natural roofing (no roof, thatch/palm leaf/, reed/grass, mud, sod/mud and grass mixture, plastic/polythene sheeting)

Rudimentary roofing (rustic mat, palm/bamboo, raw wood planks/timber, unburnt brick, loosely packed stone)

Finished roofing (metal/gi, wood, calamine/cement fiber, asbestos sheets, rcc/rbc/cement/concrete, roofing shingles, tiles, slate, burnt brick)

MAIN MATERIAL USED FOR WALL:

Natural walls (no walls, cane/palm/trunks/bamboo, mud, grass/reeds/thatch)

Rudimentary walls (bamboo with mud, stone with mud, plywood, cardboard, unburnt brick, raw wood/reused wood)

Finished walls (cement/concrete, stone with lime/cement, burnt bricks, cement blocks, wood planks/shingles, gi/metal/asbestos sheets

MAIN MATERIAL USED FOR FLOOR:

Natural floor (mud/clay/earth, sand, dung

Rudimentary floor (raw wood planks, palm/bamboo, brick, stone

Finished floor (parquet or polished wood, vinyl or asphalt, ceramic tiles, cement, carpet, polished stone/marble/, granite, other

LATRINE:

Flush or pour flush toilet, pit latrine, no facility/uses open space, shared latrine, public latrine

COOKING FUEL:

Electricity, lpg/natural gas, biogas, kerosene, coal/lignite, charcoal, wood, straw/shrubs/grass, agricultural crop waste, dung cakes, other

PLACE OF COOKING:

In the kitchen, in the house, in a separate building, outdoors, other

TYPE OF STOVE:

Stove, chullah, open fire, other

NOTES:

Instructions to investigators:

1. Ask about the regularity of Take Home Rations. How many days in a month they get the ration? Whether THR has been regular over the period of last 12 months
2. Ask about the functioning of AWW and ASHAs. Are the AWCs functioning properly?
3. Whether the respondent mothers have heard about Nutrition Rehabilitation Centres? Has their child ever been referred to an NRC facility?
4. Overall observations of the Investigator on the nutritional status of children of the household.

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Annexure 2

Tool for Qualitative Data Collection

Note: This tool was used as a guide to help cover all the topics. The order of questions was changed, probing questions were asked, and some questions were skipped depending on interviewee's level of involvement and responses.

Topic Guide for In-Depth Interviews

Respondent	
Number	
Date and Time	
Notes about the respondent (Sex, occupation, etc.)	
Place	

Domain/Topic	Probes/Questions
Introduction	• How long have you been working in this position? • How has your experience been in working in your current role? • What are the intervention activities carried out by you? What is a typical workday like?
Landscape of interventions	• What are the actors and institutions involved in the implementation of each maternal and child care interventions implemented in the locality? • Can you elaborate on the relationship between different actors in the implementation process of the interventions? Starting from frontline workers till the district level?
Resources	• Are the resources available at your disposal adequate? If not, what are the main shortages? • Were you able to mobilise any additional resources for the interventions? If yes, how?
Challenges faced	• What are the main challenges faced by you in the implementation process of the interventions? How has it changed over the years? • What is the mechanism you resort to reduce and manage these challenges?
Governance and policy aspects	• What are your roles and responsibilities according to policy documents or guidelines? • What is the policy reshaping needed to make the interventions more effective in your opinion? • Are there any policy bottle necks that are observed over the years that were rectified or otherwise?

Cooperation and Coordination for the interventions	• How do you coordinate with each other? What is the role played by different actors and institutions in in this regard? • What are the formal and informal platforms for vertical and horizontal coordination of interventions? • How effective do you think the coordination effects have been in bringing together different departments, institutions and organisations for achieving maternal and child health goals?
Nutrition monitoring and surveillance	• What are the interventions aimed at nutrition monitoring and surveillance? • How effective are these interventions according to you? What are the main challenges in this regard?
Accountability in implementation	• What is the attitude of political parties and leaders towards the interventions at the village level? • How is financial accountability ensured in interventions, and what are your observations in this topic?
Responsiveness of the system	• How effective is the intervention machinery in collecting feedback from the community and the frontline workers and responding to them? • How do you evaluate the responsiveness of different departments and institutions and personals both on the basis of time taken and efficiency towards maternal and child care interventions?
Equitable access to interventions	• What are the measures taken to ensure different marginalised sections are benefiting equitably from the interventions? What are your observations?
Community Participation	• How do you evaluate the level of community participation in the implementation of these interventions? • What are the initiatives taken to ensure participation and that the voices are heard and documented? • Has the nature of participation and level changed over the years? If yes how? • How do you evaluate the responsiveness of actors and institutions in identifying local needs and addressing them?
Interpretations	• What were the successes in the implementation of maternal and child care interventions? What are your learnings? • What is the future of these interventions/initiatives? • Can you imagine of a scenario where the interventions don't exist? What will be the needs in the community in such a situation?