Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Mapping Child Feeding Quality in India: Regional Diet Patterns, Determinants, and Equity Gaps

Abdul Jaleel
National Institute of Nutrition
Benson M Thomas
bensontm@srmist.edu.in
SRM Institute of Science and Technology
Arlappa N
National Institute of Nutrition
Joemet Jose
University of California, San Diego
Anuj Kumar Pandey
IIHMR University

Research Article

Keywords: IYCF, Nutrition, Regional Disparity, Inequality, NFHS-5, India

Posted Date: March 11th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8760324/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

FIRST PAGE

Manuscript type-
Original Research
Title-
Mapping Child Feeding Quality in India: Regional Diet Patterns, Determinants, and Equity Gaps
Name(s) of the author(s) –
Abdul Jaleel[1], Benson Thomas M[2], N. Arlappa[1], Joemet Jose[3], Anuj Kumar Pandey[4]
Affiliation(s) of author(s) (including current affiliation and affiliation where the work was primarily carried out) –
[1] Division of Public Health Nutrition; ICMR-National Institute of Nutrition; Hyderabad; India
[2] School of Public Health, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu; India.
[3]Center on Gender Equity and Health (GEH); University of California; San Diego; California; USA
[4]Department of Health Systems and Implementation Research, International Institute of Health Management Research New Delhi, India.
Name and postal address of the corresponding author-
Dr Benson Thomas M, School of Public Health, SRM Institute of Science and Technology, (Anatomy Annex), SRMIST, SRM University, 5th Floor, Medical College New Building, via, Potheri, SRM Nagar, Kattankulathur, Chennai, Tamil Nadu 603203
Email address (es) of all authors-
Email:jaleel.cp@icmr.gov.in, bensontm@srmist.edu.in, arlappan@yahoo.com, joemetjose@gmail.com, anuj@iihmrdelhi.edu.in
Running title-
Spatial Patterns of Infant and Young Child Feeding
Contributions by the Author-
Concepts, design – AJ, BTM, NA Literature search, data Analysis – AJ, JJ, BTM, AKP Manuscript preparation- AKP, BTM, AJ, JJ, NA Manuscript editing, and manuscript review- AJ, BTM, NA
Conflicts of Interest-
NIL
Financial Support-
NIL
The manuscript has been read and approved by
Abdul Jaleel, Benson Thomas M, N. Arlappa, Joemet Jose, Anuj Kumar Pandey

Mapping Child Feeding Quality in India: Regional Diet Patterns, Determinants, and Equity Gaps

Abstract:

This study examined regional disparities, determinants, and wealth-related inequalities in Infant and young child feeding (IYCF) practices in India using nationally representative NFHS-5 (2019–21) data. Eleven WHO–UNICEF IYCF indicators were analysed, with particular emphasis on Minimum Dietary Diversity (MDD) and Minimum Acceptable Diet (MAD). Descriptive analyses, multivariate logistic regression models, and equity assessments employing Concentration Index and the Concentration Curves were conducted across six geographic regions. Findings demonstrate pronounced regional heterogeneity, alongside persistently inadequate dietary diversity and meal frequency nationwide. Less than one in four children met MDD and only one in ten achieved MAD, with the poorest outcomes concentrated in the Central, Western, and Northern regions. Maternal education, household wealth, child age, and maternal nutritional status emerged as significant predictors of dietary adequacy, although wealth-based inequalities remained relatively modest. Overall, the pervasive deficits in complementary feeding underscore the need for context-specific interventions to strengthen young children's diets in India.

Keywords: IYCF, Nutrition, Regional Disparity, Inequality, NFHS-5, India

1. Introduction

Malnutrition among infants and young children remains a critical global public health challenge, encompassing chronic undernutrition alongside overweight and micronutrient deficiencies (1). According to the Joint Child Malnutrition Estimates 2025, 150.2 million children under five are stunted, 42.8 million are wasted, and 35.5 million are overweight, with the burden disproportionately concentrated in low- and middle-income countries across Africa and Asia (2). Undernutrition alone accounts for nearly half of all under-five deaths globally, underscoring its profound implications for child survival, growth, and development (1).

The earliest months of life represent a critical window during which susceptibility to malnutrition and growth failure is particularly high. Longitudinal evidence from multiple settings demonstrates that linear growth faltering begins early and accelerates rapidly throughout the first 12–15 months (3, 4). Optimal Infant and Young Child Feeding (IYCF) practices (including early initiation of breastfeeding, exclusive breastfeeding for the first six months, and timely introduction of nutritionally adequate complementary foods) have been consistently linked to improved cognitive and motor development, enhanced immune function, and healthier long-term growth trajectories (5-9).

India, home to approximately 115 million children under five—nearly one-fifth of the global under-five population—continues to bear a disproportionate share of the global malnutrition burden (10). Despite gradual improvements, undernutrition remains pervasive: 36% of children are stunted, 32% are underweight, 19% are wasted, and 67.1% are anaemic (11-13). Micronutrient deficiencies, particularly iron, folate, and vitamin B12, contribute to more than half of anaemia cases (14). In 2017, malnutrition was implicated in approximately 68% of under-five deaths in the country (15). Longitudinal assessments further show that length-for-age Z-scores decline sharply from birth to 24 months, with stunting prevalence nearly tripling during this critical period (16). These deficits are shaped by socioeconomic disadvantage, environmental enteric dysfunction, suboptimal complementary feeding, and persistent gender disparities that disproportionately disadvantage girls (17, 18).

Despite its centrality to early childhood nutrition, IYCF practice in India remains poor. Only 25% of children aged 6–23 months achieve Minimum Dietary Diversity (MDD), and just 10.5% meet the Minimum Acceptable Diet (MAD) (6). Pronounced socioeconomic gradients persist: children from households with low maternal education or limited wealth are substantially less likely to receive adequate dietary quality (6, 19). Regional heterogeneity

further complicates nutrition programming, yet comprehensive assessments of region-specific IYCF inequalities remain limited (19, 20). Understanding spatial variation and socioeconomic inequities in complementary feeding practices is therefore essential to informing targeted nutrition policies and guiding strategic interventions.

To address this evidence gap, the present study uses nationally representative data from NFHS-5 to: (i) examine spatial variation in key IYCF indicators across India's six major geographic regions; (ii) identify demographic, socioeconomic, and nutritional determinants of MDD and MAD; (iii) describe regional patterns in complementary food group consumption; and (iv) quantify wealth-related inequalities in achieving MDD and MAD. Together, these analyses aim to strengthen the evidence base for designing region-specific, equity-oriented strategies to improve complementary feeding and accelerate progress in reducing child malnutrition in India.

2. Data and Methods

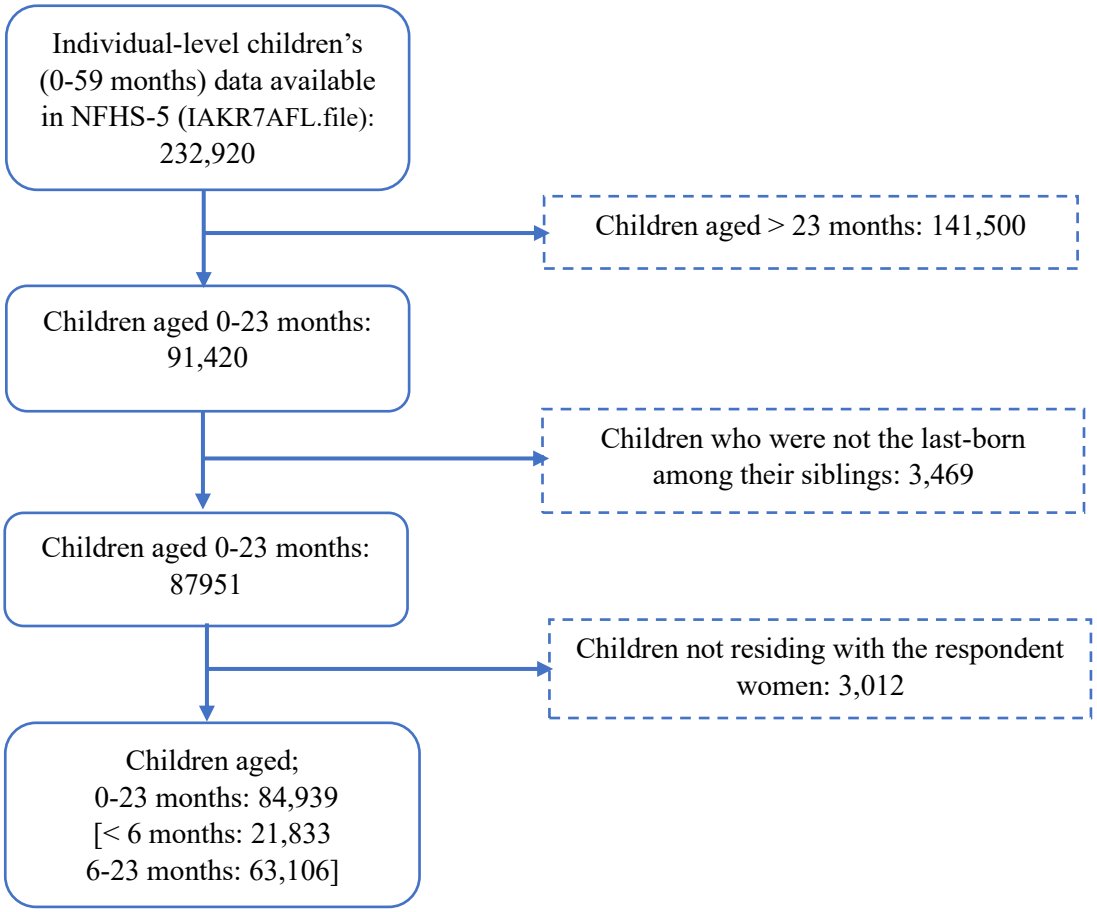
2.1 Data Source

This study draws on secondary data from the fifth round of the National Family Health Survey (NFHS-5), conducted across India between 2019 and 2021. Implemented by the Ministry of Health and Family Welfare (MoHFW), Government of India, with the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency, NFHS-5 provides nationally representative data on demographic, health, and nutrition indicators for all states and union territories.

Data were collected using four standardised survey tools such as household, women's, men's, and biomarker questionnaires, covering 636,699 households. The survey includes information from 724,115 women (15–49 years), 101,839 men (15–54 years), and 232,920 children (0–59 months). Details of sampling design and field implementation are documented elsewhere (12).

For the present analysis, we used the household dataset (IAHR7EFL) and children's dataset (IAKR7EFL), obtained from the Demographic and Health Surveys (DHS) database. Child nutrition and health variables were extracted from the children's file, while household wealth indicators were obtained from the household file. Figure 1 presents the inclusion and exclusion criteria used to derive the final analytical sample.

Figure 1: Flow diagram of sample data from the NFHS-5 survey



2.2 List of Variables

Infant and Young Child Feeding Indicators

The study focused on 11 standard IYCF indicators defined by WHO and UNICEF (5). Together, these indicators offer a structured way to examine feeding quality across the first two years of life. Of 11 indicators, three capture practices among infants younger than six months, including (i) Early initiation of breastfeeding (EIBF), (ii) Exclusive breastfeeding for the first three days after birth (EBF3D), and (iii) Exclusive breastfeeding for infants under six months (EBF). A fourth indicator reflects the timely introduction of complementary foods among infants aged 6–8 months. The remaining seven indicators track the feeding practices of children aged 6–23 months, focusing on continued breastfeeding, diversity of foods consumed, feeding frequency, and consumption of nutrient-rich items such as eggs and flesh foods. They also capture less desirable behaviours, such as the consumption of sweetened beverages or the absence of any fruits or vegetables in the diet.

Among these seven, two indicators, (i) Minimum Dietary Diversity (MDD) and (ii) Minimum Acceptable Diet (MAD), served as the major outcome indicators for in-depth analysis. MDD measures whether a child consumed at least five out of eight recommended food groups in the preceding 24 hours (5). These food groups are: (i) breast milk, (ii) grains, roots, tubers, and plantains, (iii) pulses (beans, peas, lentils), nuts, and seeds, (iv) dairy products (milk, infant formula, yogurt, cheese), (v) flesh foods (meat, fish, poultry, organ meats), (vi) eggs, (vii) vitamin A-rich fruits and vegetables, and (viii) other fruits and vegetables. The MAD reflects whether children received both adequate dietary diversity and adequate meal frequency for their age within the preceding 24 hours (5). According to the WHO feeding guidelines, breastfed infants aged 6–8 months should receive 2–3 complementary feedings per day, while those aged 9–23 months should receive 3–4 feedings daily. For non-breastfed children, the MAD criterion requires 4–5 feedings per day and the inclusion of at least two milk feeds, in addition to meeting both dietary diversity and meal frequency requirements.

Independent Variables

To explore the factors that shape IYCF practices, the study considered fifteen variables. These included religious and caste affiliation, household wealth status, maternal education, and the structure and size of the household. Child-level factors such as age, sex, and the number of living siblings were also included. Maternal nutritional status was assessed using BMI categories, and children's growth and micronutrient status were captured through indicators of stunting, wasting, underweight, overweight, and anaemia.

2.3 Geographical Scope

Given that feeding behaviours and food environments differ widely across India, the analysis is organised around six major geographic regions of India: East, West, South, Northeast, Central, and North. These regions represent distinct social, cultural, and economic contexts that influence household diets, caregiving patterns, and access to nutritious foods. Employing this regional framework enables a nuanced examination of complementary feeding practices, capturing variation not only within households but also across India's broader sociocultural and ecological landscapes.

2.4 Statistical Analysis

The analytical approach proceeded in three stages. First, descriptive analyses were conducted to map regional variation across IYCF indicators, providing a comparative overview of how

young children's diets differ across India's diverse geographic regions. Second, multivariate logistic regression models assess the associations between socioeconomic status, demographic characteristics, and nutritional factors with the probability of achieving MDD and MAD. These models identify the determinants most strongly linked to adequate or inadequate complementary feeding among children aged 6–23 months in each region. Regional patterns in food group consumption among children aged 6–23 months were assessed to identify which foods are most and least commonly consumed. Finally, to assess whether dietary adequacy is equitably distributed across economic groups, the study applied standard equity metrics. Concentration Curves (CCs) were used to visually illustrate inequality patterns, while the Concentration Index (CI) quantified the extent to which MDD and MAD are disproportionately concentrated among wealthier or poorer households (21, 22). The CI was computed using the conventional covariance-based estimator:

$$CI = \frac{2}{\mu} Cov\ (Y_{i,} R_i)$$

Where, *Yi* represents the child's feeding status and *Ri* reflects the household's wealth rank. Positive values signal that dietary adequacy is more common among wealthier households.

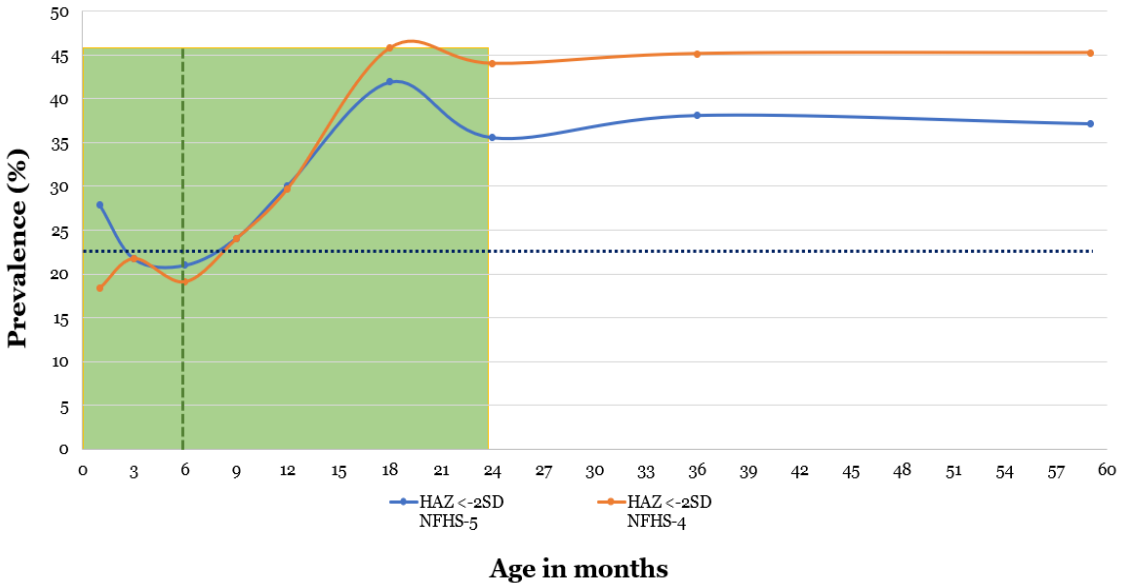
All analyses were conducted in STATA 17 (StataCorp. 2021. *Stata: Release 17. Statistical Software*. College Station, TX: StataCorp LLC), and spatial visualizations were produced using QGIS.

3. Results

3.1 Growth Faltering Pattern in Childhood (0–59 Months)

Figure 2 shows age-specific stunting prevalence and the pattern of linear growth faltering among Indian children from birth to 59 months. Stunting is already considerable at birth, declines slightly in the first six months, and then rises sharply from six to 24 months marking this as a critical period of vulnerability. After two years, stunting levels plateau, indicating that most growth faltering occurs early and that recovery thereafter is limited. While NFHS-5 records small improvements compared with NFHS-4, the fundamental pattern of early-onset linear growth decline remains consistent. The subsequent sections of this paper examine how IYCF practices, their determinants, and associated wealth-related inequalities contribute to this early growth deficit across regions of India.

Figure 2: Age-specific stunting prevalence and the pattern of linear growth faltering among Indian children from birth to 59 months

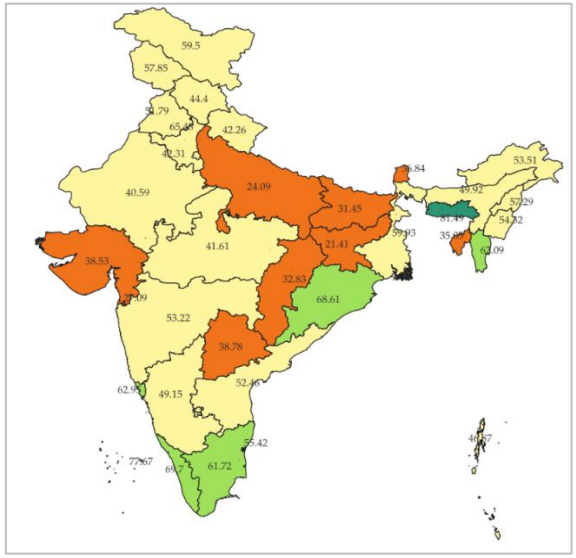


3.2 Regional Variation in IYCF Practices

Substantial regional heterogeneity was observed in IYCF practices (Annexture 1 & Figure 3). EIBF remained low nationally (42%), with wide variation across regions, from 28.6% in the Central region to 54.5% in the South. While exclusive breastfeeding within the first three days after birth was nearly universal (national average: 84.4%), EBF under six months declined to 63.7%. Continued breastfeeding after six months remained common (80.5%), though lowest in the South (69.6%).

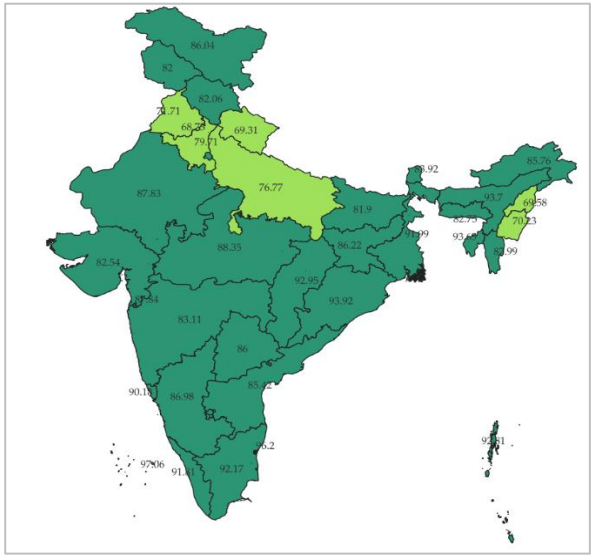
Complementary feeding practices revealed pronounced deficits. Only half of children aged 6–23 months had timely introduction of solid, semi-solid, or soft foods (49.4%), and just over one-third met the minimum meal frequency (35.1%). Dietary diversity was particularly inadequate: 52.1% consumed no fruits or vegetables, with the highest burden in the Central region (58.9%). Consumption of eggs or flesh foods was low (20.4% nationally), with stark regional variations (below 14% in the North, West, and Central regions, and above 28% in the East, Northeast, and South). Achievement of MDD (22.7%) and MAD (10.9%) was poor across all regions, especially in the Central, Western, and Northern regions. Conversely, intake of sweet beverages was relatively high (21%), reaching 28.1% in the South.

Figure 3: Spatial distribution of Indicators of infant and young child feeding practices across states in India, 2019-21



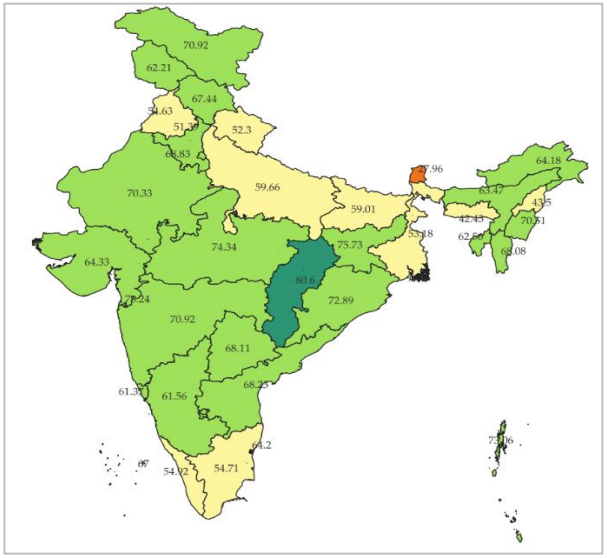
Early Initiation of Breast Feeding (EIBF)

a



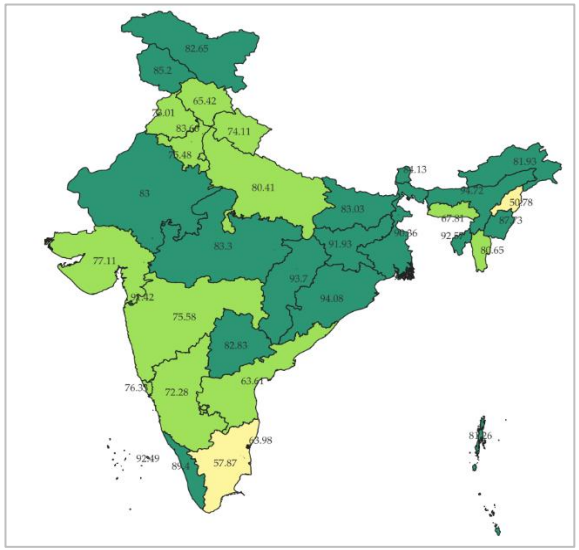
Exclusively Breastfed for the first three days after birth (EBF3D)

b



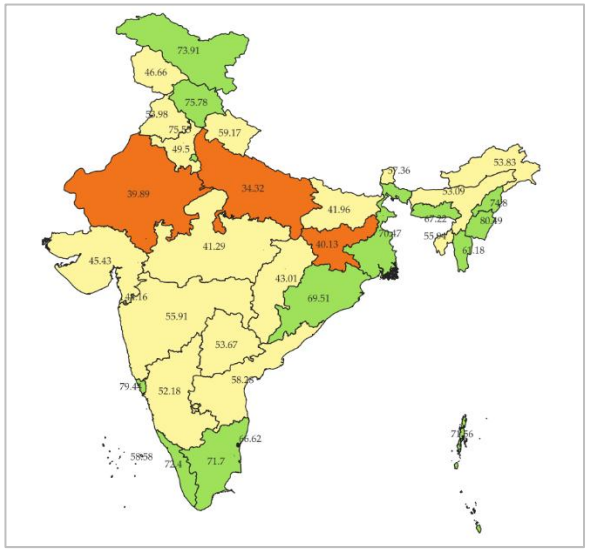
Exclusive Breastfeeding under Six months (EBF)

c



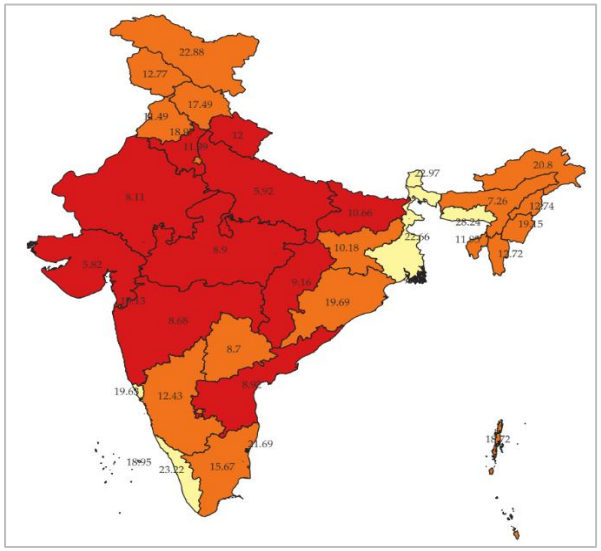
Continued Breast Feeding 12-23 months (CBF)

d



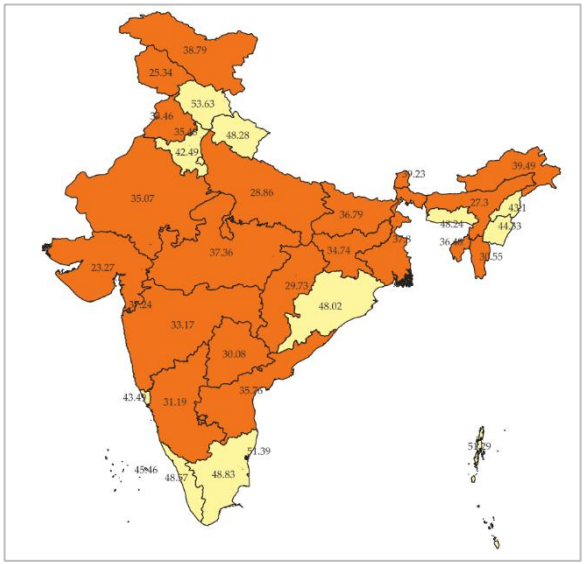
Introduction of solid, semi-solid and soft foods 6-8 months (ISSSF)

e



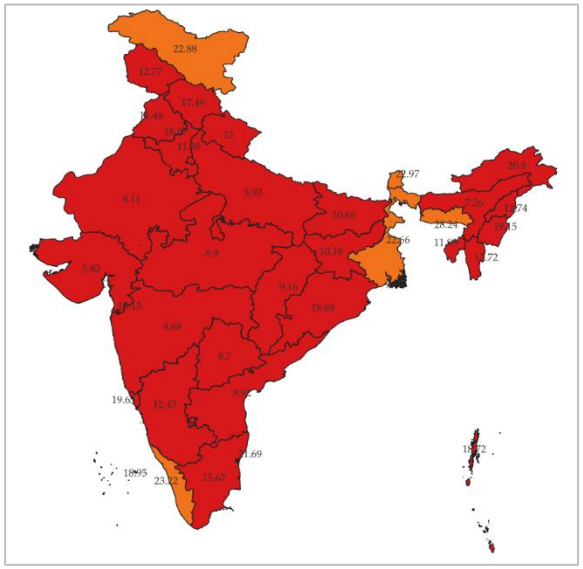
Minimum Dietary Diversity 6-23 months (MDD)

f



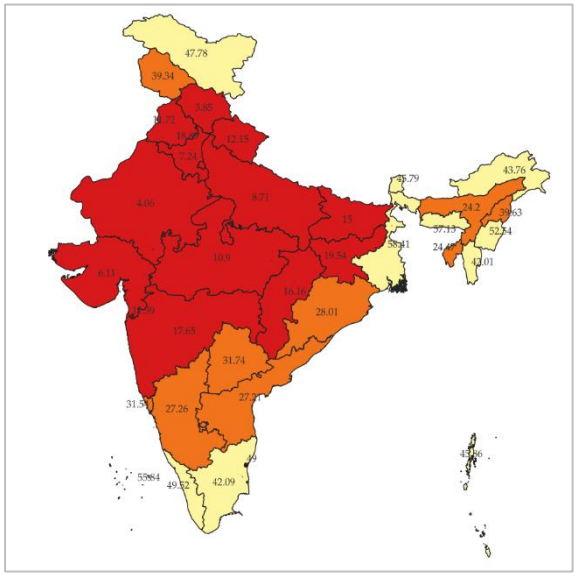
Minimum Meal Frequency 6-23 months (MMF)

g



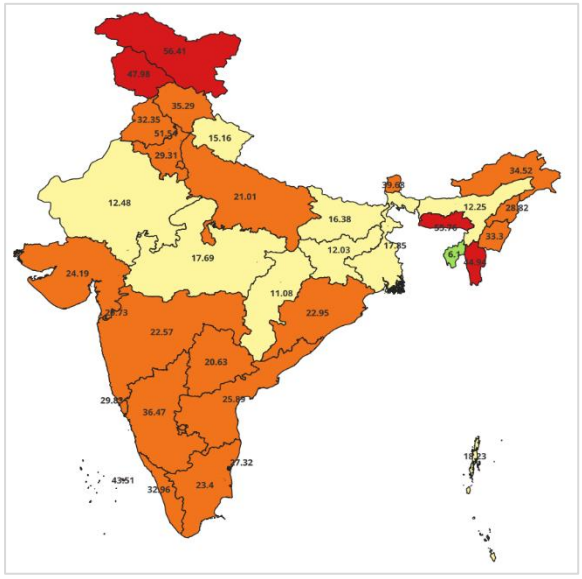
Minimum Acceptable Diet 6-23 months (MAD)

h



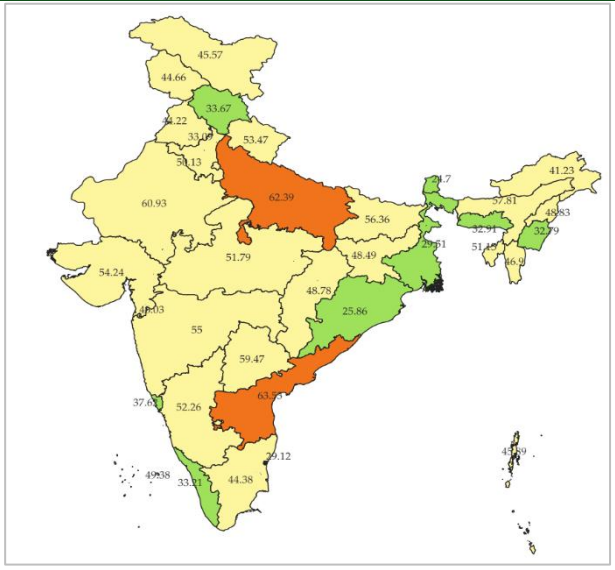
Egg and/or flesh food consumption 6-23 months (EFF)

i



Sweet Beverage Consumption 6-23 months (SWB)

j



Zero vegetable or fruit consumption 6-23 months (ZVF)

k

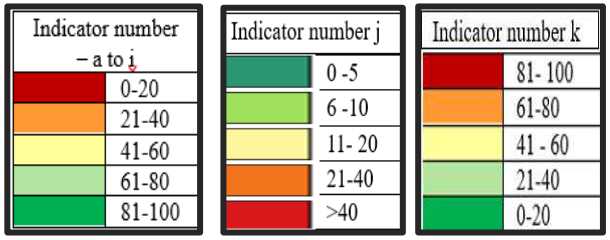


Figure 4 shows that young children's diets in India vary widely by region. Breastfeeding and staple foods like grains and tubers are common everywhere; the intake of nutrient-dense foods, including dairy, fruits and vegetables, pulses, eggs, and flesh foods, varies markedly. Children in the North-East and South have more balanced diets, while those in the Central and Northern regions have the least variety, especially in protein-rich foods. Figure 5 shows that between 14% and 24% of children across India experienced severely inadequate feeding in the past 24 hours, having received either no food, including breast milk, or only breast milk. Figure 6 presents mean DDS values across age groups, showing markedly lower scores among younger children.

Figure 4: Prevalence of intake of various food-group among children aged 6–23 months across regions of India

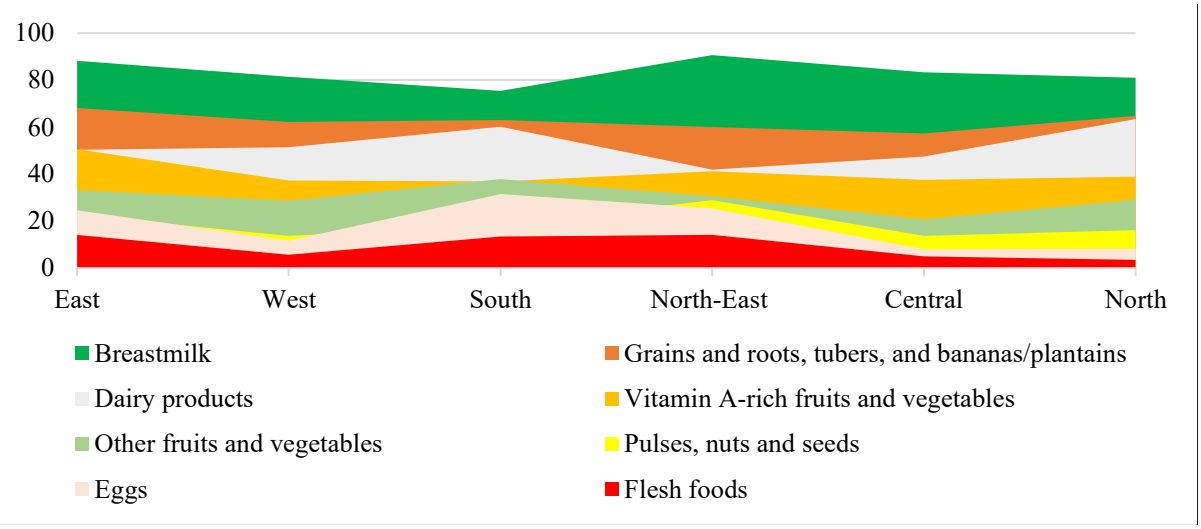


Figure 5. Prevalence of no food-group or breastmilk-only intake among children 6–23 months across regions of India

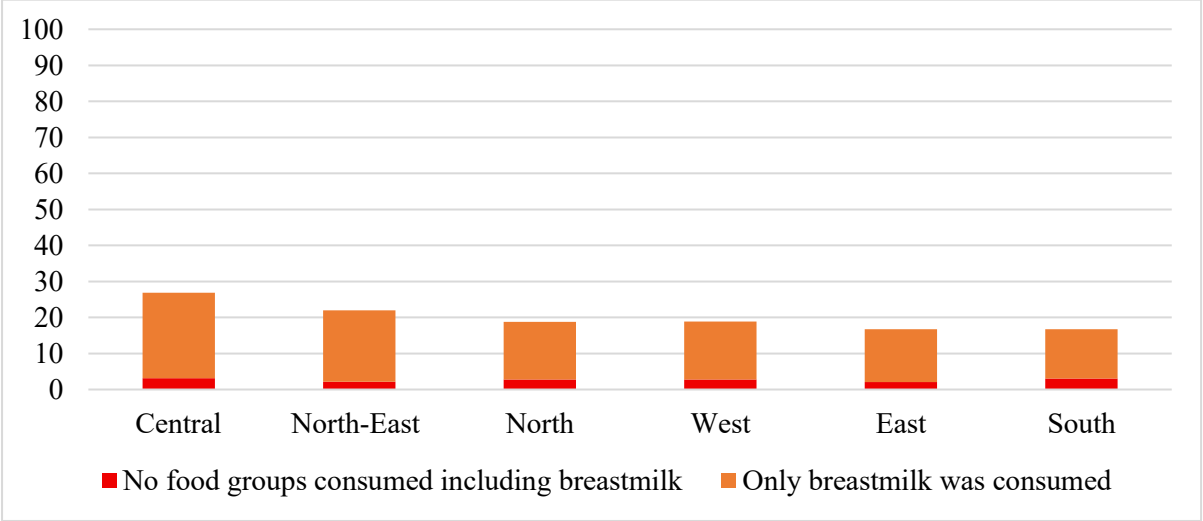
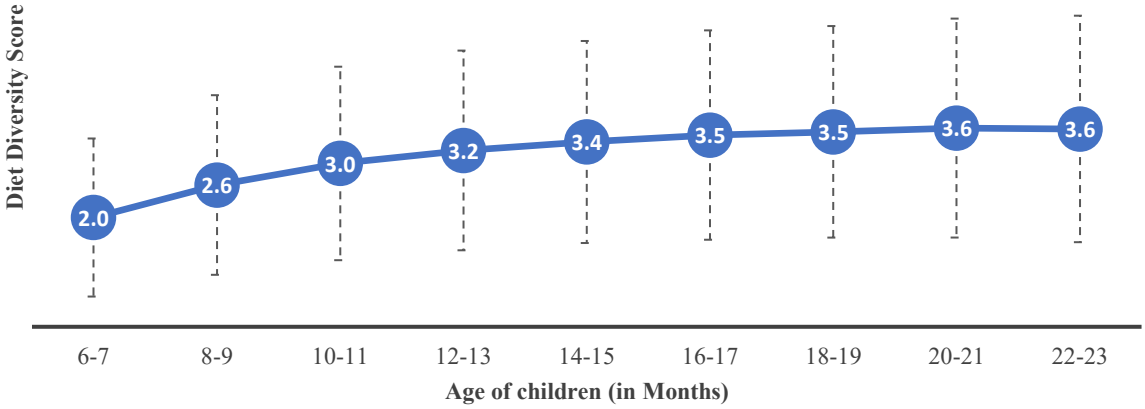


Figure 6. Mean diet diversity score among children aged 6-23 months in India



3.3 Regional Variation in the Predictors of Adequate Diet

At the national level, multiple sociodemographic and maternal factors predicted dietary adequacy among children aged 6–23 months (Table 1). Children from Other Backward Classes (OBC) had lower odds of achieving MDD (AOR = 0.88), as did those from the poorest households (AOR = 0.89) and children of mothers with no formal education (AOR = 0.73). Larger households and those with three or more children were also associated with reduced likelihood of achieving MDD. In contrast, older child age (18–23 months), maternal overweight status (BMI ≥ 25 kg/m²), and absence of maternal anaemia significantly increased the likelihood of meeting MDD. Regional determinants were broadly consistent with the national pattern; however, in the west, south, and central regions, children with three or more siblings were more likely to attain MDD.

Determinants of MAD displayed strong regional specificity (Table 2). Nationally, children from Muslim and Christian households, those with overweight mothers, and those aged 12–23 months were more likely to achieve MAD, whereas children from lowest wealth quantile and low maternal education reduced the likelihood. In Eastern region, rural residence and non-Hindu religion were positively associated with MAD, while wealth and caste disadvantages lowered odds. In West, children from SC/ST households and those with overweight mothers had higher odds of meeting MAD. In South, older child age and higher maternal BMI improved dietary adequacy, whereas SC status, low maternal education, and large household size were negative predictors. In North-East, Christian households and older child age remained the

strongest determinants. In Central region, ST and SC households had higher odds of achieving MAD, though poverty and large family size remained limiting factors. In Northers region, Christian households, medium-sized families (5–6 members), maternal education, and older child age were positively associated with MAD.

Table 1: Factors associated with Minimum Diet Diversity (MDD) among children (aged 6–23 months) in the regions of India

	India	East	West	South	North East	Central	North
Religion							
Hindu	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Muslim	1.44*** [1.35-1.54]	1.30*** [1.16-1.45]	1.31** [1.05-1.62]	1.45*** [1.24-1.69]	0.92 [0.49-1.72]	1.32*** [1.14-1.53]	1.61*** [1.33-1.95]
Christian	1.82*** [1.60-2.08]	0.99 [0.65-1.51]	0.38 [0.11-1.35]	1.48*** [1.23-1.80]	2.00*** [1.34-2.98]	0.85 [0.32-2.27]	4.56*** [1.85-1.28]
Others	1.02 [0.89-1.18]	0.64** [0.43-0.96]	0.74 [0.52-1.07]	0.52 [0.18-1.50]	2.14** [1.15-3.96]	1.06 [0.51-2.20]	1.47*** [1.20-1.81]
Caste/Tribe							
Others	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Scheduled Castes	1.08** [1.01-1.16]	0.94 [0.83-1.07]	1.32** [1.06-1.66]	0.86 [0.72-1.03]	1.08 [0.64-1.81]	1.15 [0.97-1.36]	1.06 [0.89-1.25]
Scheduled Tribes	1.16*** [1.06-1.26]	1.00 [0.85-1.18]	1.24* [0.99-1.55]	0.95 [0.74-1.22]	1.41 [0.85-2.33]	1.83*** [1.50-2.23]	0.73** [0.55-0.97]
Other Backward Classes	0.88*** [0.83-0.93]	0.65*** [0.58-0.73]	1.05 [0.89-1.25]	0.81** [0.69-0.95]	1.25 [0.78-2.01]	1.09 [0.95-1.27]	0.81** [0.69-0.95]
Wealth quintile							
Richest	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Poorest	0.89** [0.81-0.97]	0.96 [0.82-1.13]	0.70** [0.53-0.93]	1.02 [0.84-1.24]	0.68 [0.41-1.12]	0.99 [0.81-1.20]	0.81* [0.63-1.03]
Poorer	0.97 [0.90-1.05]	0.9 [0.77-1.04]	0.75** [0.58-0.97]	1.21** [1.01-1.44]	0.76 [0.47-1.23]	1.09 [0.90-1.31]	0.98 [0.78-1.23]
Middle	0.93* [0.87-1.01]	0.93 [0.8-1.07]	0.74** [0.58-0.95]	1.16* [0.98-1.37]	0.97 [0.61-1.54]	0.98 [0.82-1.17]	0.83* [0.67-1.03]
Richer	0.96 [0.89-1.04]	0.94 [0.82-1.08]	0.96 [0.76-1.20]	1.17* [1.00-1.37]	0.91 [0.59-1.41]	0.94 [0.80-1.11]	0.85 [0.69-1.04]
Household size							
1 to 4 members	Ref	Ref	Ref	Ref	Ref	Ref	Ref
5 to 6 members	0.97 [0.91-1.02]	0.98 [0.89-1.08]	1.07 [0.89-1.28]	0.99 [0.89-1.11]	1.30 [0.95-1.77]	0.91 [0.79-1.04]	1.26** [1.05-1.51]
7+ members	0.80*** [0.75-0.84]	0.77*** [0.69-0.85]	0.86 [0.71-1.03]	1.01 [0.88-1.15]	1.25 [0.87-1.77]	0.89* [0.78-1.02]	1.07 [0.90-1.29]
Place of residence							
Urban	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Rural	1.02 [0.97-1.08]	1.05 [0.94-1.18]	0.94 [0.80-1.10]	1.01 [0.91-1.13]	0.83 [0.58-1.19]	0.93 [0.81-1.07]	0.96 [0.83-1.1]
Maternal Education							
Higher Secondary	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Secondary	0.96 [0.91-1.03]	1.01 [0.87-1.16]	1.16 [0.95-1.42]	0.90* [0.8-1.01]	1.06 [0.66-1.71]	0.88* [0.76-1.02]	0.78** [0.65-0.93]
Primary	0.86*** [0.79-0.94]	0.95 [0.79-1.13]	1.13 [0.84-1.52]	0.59*** [0.46-0.75]	1.11 [0.62-2]	0.85 [0.71-1.04]	0.70** [0.55-0.91]
No Education	0.73*** [0.67-0.8]	0.66*** [0.56-0.79]	0.85 [0.62-1.18]	0.65*** [0.52-0.82]	1.15 [0.61-2.18]	0.76*** [0.63-0.91]	0.75** [0.59-0.95]
No.of living children							
1	Ref	Ref	Ref	Ref	Ref	Ref	Ref
2	1.07** [1.02-1.13]	0.95 [0.87-1.04]	1.11 [0.95-1.28]	1.11** [1.00-1.23]	1.23 [0.92-1.64]	1.21*** [1.08-1.36]	1.21** [1.05-1.40]

3	0.91** [0.85-0.98]	0.73*** [0.65-0.83]	0.88 [0.69-1.12]	0.98 [0.82-1.17]	0.92 [0.59-1.44]	1.18** [1.02-1.37]	1.05 [0.85-1.29]
>3	1.01 [0.92-1.1]	0.73*** [0.63-0.85]	1.64*** [1.23-2.19]	1.33* [0.97-1.83]	1.09 [0.67-1.77]	1.26** [1.06-1.50]	1.20 [0.92-1.57]
Maternal BMI							
BMI <18.5 Kg/m2	Ref	Ref	Ref	Ref	Ref	Ref	Ref
BMI 18.5 - 24.9 Kg/m2	0.98 [0.93-1.04]	0.93 [0.85-1.02]	1.23** [1.05-1.45]	0.96 [0.84-1.10]	1.06 [0.75-1.48]	1.08 [0.96-1.21]	0.93 [0.78-1.10]
BMI ≥ 25.0 Kg/m2	1.17*** [1.09-1.25]	1.15** [1.00-1.33]	1.31** [1.05-1.62]	1.18** [1.02-1.37]	0.98 [0.61-1.57]	1.06 [0.89-1.26]	1.15 [0.94-1.42]
Age of children (in months)							
6 to 11	Ref	Ref	Ref	Ref	Ref	Ref	Ref
12 to 17	2.28*** [2.15-2.42]	2.29*** [2.07-2.54]	2.15*** [1.79-2.59]	2.68*** [2.36-3.05]	2.52*** [1.80-3.53]	2.44*** [2.14-2.78]	2.25*** [1.90-2.66]
18 to 23	2.93*** [2.76-3.10]	3.09*** [2.79-3.42]	2.90*** [2.43-3.48]	3.27*** [2.88-3.72]	4.18*** [3.00-5.82]	2.71*** [2.37-3.10]	2.63*** [2.20-3.13]
Sex of children							
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	0.98 [0.94-1.02]	0.94 [0.87-1.02]	0.96 [0.84-1.09]	1.04 [0.94-1.14]	1.06 [0.82-1.36]	1.07 [0.97-1.17]	0.97 [0.86-1.10]
Stunting status							
Not stunted (HAZ ≥ -2SD)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Stunted (HAZ < -2SD)	0.98 [0.93-1.03]	0.91** [0.82-1.00]	1.11 [0.95-1.31]	1.07 [0.95-1.2]	1.08 [0.80-1.47]	0.95 [0.85-1.07]	1.01 [0.86-1.19]
Wasting status							
Not wasted (WHZ ≥ -2SD)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Wasted (WHZ < -2SD)	0.97 [0.91-1.03]	0.85*** [0.76-0.95]	1.14 [0.96-1.36]	1.01 [0.87-1.17]	1.10 [0.75-1.62]	0.98 [0.85-1.13]	1.09 [0.89-1.33]
Underweight status							
Not underweight (WAZ ≥ -2SD)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Underweight (WAZ < -2SD)	1.02 [0.96-1.09]	1.04 [0.94-1.16]	1.24** [1.04-1.49]	0.98 [0.85-1.13]	0.88 [0.61-1.27]	0.92 [0.8-1.05]	0.86 [0.71-1.05]
Overweight Status							
Not overweight	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Overweight	0.96 [0.85-1.09]	0.94 [0.73-1.22]	0.90 [0.62-1.3]	0.97 [0.76-1.25]	1.11 [0.64-1.92]	0.91 [0.66-1.25]	0.97 [0.7-1.35]
Anemia Status							
Severe anaemia (Hb <7.0 g/dl)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Moderate anaemia (Hb 7-9 g/dl)	1.13* [1.00-1.28]	1.47** [1.10-1.96]	0.72** [0.52-0.99]	1.13 [0.85-1.49]	0.96 [0.34-2.76]	0.96 [0.75-1.24]	1.16 [0.85-1.58]
Mild anaemia (Hb 10-10.9 g/dl)	1.18** [1.04-1.35]	1.48** [1.11-1.98]	0.68** [0.48-0.96]	1.17 [0.87-1.56]	1.00 [0.34-2.88]	0.97 [0.75-1.27]	1.24 [0.90-1.70]
No anaemia (Hb >11.0 g/dl)	1.24*** [1.09-1.42]	1.55*** [1.16-2.09]	1.04 [0.73-1.47]	1.24 [0.93-1.66]	1.09 [0.38-3.17]	0.90 [0.69-1.18]	1.03 [0.74-1.44]
Constant	0.15*** [0.13-0.18]	0.24*** [0.17-0.35]	0.11*** [0.07-0.18]	0.15*** [0.11-0.22]	0.11*** [0.03-0.38]	0.09*** [0.06-0.13]	0.13*** [0.09-0.21]

Table 2: Factors associated with minimum acceptable diet (MAD) among children (aged 6–23 months) in the regions of India

	India	East	West	South	NE	Central	North
Religion							
Hindu	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Muslim	1.35*** [1.24-1.47]	1.16** [1.01-1.33]	0.98 [0.71-1.35]	1.51*** [1.25-1.82]	1.07 [0.44-2.57]	1.41*** [1.15-1.73]	1.18 [0.91-1.52]
Christian	1.56*** [1.32-1.85]	0.96 [0.56-1.63]	0.77 [0.17-3.43]	1.26* [0.98-1.62]	2.19*** [1.30-3.69]	1.26 [0.38-4.16]	3.28** [1.18-9.06]
Others	0.95 [0.79-1.15]	0.48** [0.27-0.87]	0.53** [0.30-0.92]	0.10 [0.00-2.05]	2.32** [1.08-4.98]	1.69 [0.74-3.91]	1.28* [0.98-1.67]
Caste/Tribe							
Others	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Scheduled Castes	1.06 [0.97-1.16]	0.84** [0.72-0.98]	1.91*** [1.39-2.61]	0.77** [0.61-0.97]	0.96 [0.45-2.04]	1.33** [1.05-1.68]	1.01 [0.81-1.26]
Scheduled Tribes	1.15** [1.03-1.29]	0.91 [0.74-1.12]	1.49** [1.07-2.07]	0.98 [0.71-1.35]	1.37 [0.68-2.77]	2.03*** [1.54-2.68]	0.83 [0.58-1.19]
Other Backward Classes	0.91** [0.85-0.99]	0.67*** [0.58-0.76]	1.33** [1.03-1.71]	0.86 [0.70-1.05]	1.04 [0.53-2.07]	1.13 [0.92-1.39]	0.85 [0.69-1.05]
Wealth quintile							
Richest	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Poorest	0.74*** [0.66-0.82]	0.74*** [0.61-0.90]	0.56** [0.37-0.85]	1.02 [0.78-1.32]	0.64 [0.32-1.26]	0.61*** [0.46-0.80]	0.91 [0.67-1.24]
Poorer	0.87** [0.78-0.97]	0.75*** [0.63-0.91]	0.84 [0.58-1.21]	1.21 [0.97-1.50]	0.79 [0.41-1.52]	0.71** [0.55-0.92]	1.04 [0.78-1.38]
Middle	0.86*** [0.78-0.95]	0.82** [0.68-0.97]	0.83 [0.59-1.17]	1.19 [0.96-1.46]	1.07 [0.58-1.98]	0.66*** [0.51-0.84]	0.86 [0.66-1.14]
Richer	0.85*** [0.78-0.94]	0.76*** [0.64-0.91]	1.18 [0.87-1.61]	0.95 [0.78-1.17]	0.83 [0.45-1.52]	0.76** [0.61-0.95]	0.89 [0.68-1.16]
Household size							
1 to 4 members	Ref	Ref	Ref	Ref	Ref	Ref	Ref
5 to 6 members	0.93* [0.87-1.00]	1.06 [0.94-1.21]	0.94 [0.73-1.21]	0.85** [0.73-0.98]	0.90 [0.59-1.38]	0.82* [0.68-1.00]	1.30** [1.03-1.64]
7+ members	0.85*** [0.78-0.91]	0.91 [0.80-1.04]	0.80 [0.62-1.04]	1.03 [0.87-1.22]	1.03 [0.65-1.65]	0.90 [0.75-1.08]	1.11 [0.88-1.41]
Place of residence							
Urban	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Rural	1.06 [0.99-1.14]	1.41*** [1.22-1.63]	1.00 [0.80-1.26]	0.91 [0.79-1.05]	0.97 [0.59-1.58]	0.96 [0.80-1.16]	0.90 [0.75-1.08]
Maternal Education							
Higher Secondary	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Secondary	0.90** [0.83-0.98]	0.84** [0.71-1.00]	1.20 [0.91-1.58]	0.78*** [0.67-0.90]	1.15 [0.59-2.23]	1.02 [0.83-1.25]	0.78** [0.62-0.97]
Primary	0.90* [0.80-1.01]	0.90 [0.72-1.11]	1.17 [0.77-1.79]	0.62** [0.45-0.87]	1.63 [0.75-3.55]	1.01 [0.77-1.32]	0.75* [0.54-1.03]

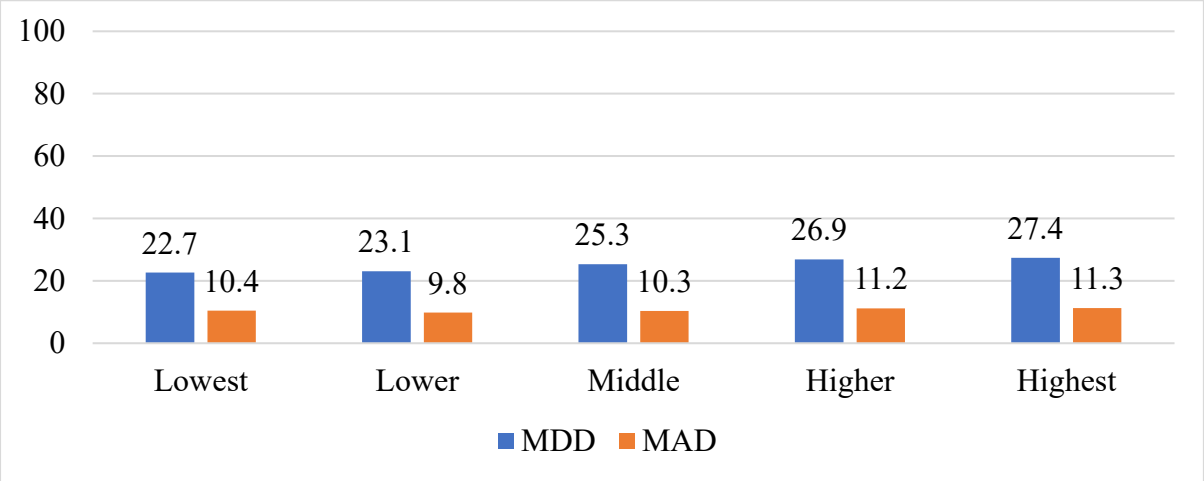
No Education	0.78*** [0.70-0.87]	0.67*** [0.54-0.82]	1.06 [0.67-1.67]	0.64*** [0.47-0.87]	1.00 [0.41-2.44]	0.83 [0.64-1.08]	0.83 [0.62-1.13]
No.of living children							
1	Ref	Ref	Ref	Ref	Ref	Ref	Ref
2	1.09** [1.02-1.16]	1.03 [0.92-1.16]	1.11 [0.90-1.36]	1.06 [0.92-1.21]	1.15 [0.77-1.71]	1.24** [1.06-1.45]	1.25** [1.04-1.50]
3	0.91** [0.82-1.00]	0.81** [0.69-0.95]	0.82 [0.58-1.16]	0.78** [0.61-0.99]	1.28 [0.72-2.28]	1.12 [0.90-1.38]	1.16 [0.89-1.51]
>3	1.09 [0.97-1.23]	1.00 [0.84-1.20]	1.05 [0.66-1.65]	1.12 [0.74-1.71]	1.21 [0.65-2.25]	1.28* [1.00-1.64]	1.38* [0.99-1.91]
Maternal BMI							
BMI <18.5 Kg/m2	Ref	Ref	Ref	Ref	Ref	Ref	Ref
BMI 18.5 - 24.9 Kg/m2	1.05 [0.98-1.13]	0.93 [0.83-1.04]	1.66*** [1.29-2.14]	1.13 [0.94-1.36]	1.04 [0.65-1.65]	1.07 [0.90-1.26]	1.09 [0.87-1.37]
BMI ≥ 25.0 Kg/m2	1.25*** [1.14-1.37]	1.09 [0.91-1.30]	1.85*** [1.34-2.54]	1.50*** [1.23-1.84]	0.85 [0.45-1.63]	1.00 [0.79-1.28]	1.25 [0.95-1.64]
Age of children (in months)							
6 to 11	Ref	Ref	Ref	Ref	Ref	Ref	Ref
12 to 17	1.84*** [1.7-1.99]	1.95*** [1.71-2.22]	1.89*** [1.44-2.47]	2.14*** [1.81-2.54]	1.63** [1.04-2.56]	1.55*** [1.29-1.85]	1.98*** [1.60-2.45]
18 to 23	2.35*** [2.18-2.54]	2.41*** [2.12-2.74]	3.01*** [2.33-3.89]	2.62*** [2.22-3.11]	2.23*** [1.44-3.44]	1.96*** [1.64-2.35]	2.01*** [1.61-2.52]
Sex of children							
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	0.97 [0.91-1.02]	0.98 [0.89-1.08]	0.83* [0.69-1.00]	0.93 [0.82-1.06]	1.11 [0.79-1.55]	1.13* [0.99-1.29]	0.97 [0.82-1.13]
Stunting status							
Not stunted (HAZ ≥ -2SD)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Stunted (HAZ < -2SD)	0.96 [0.89-1.03]	0.90* [0.8-1.01]	0.91 [0.72-1.14]	1.15* [0.99-1.34]	0.97 [0.64-1.47]	0.96 [0.82-1.13]	0.97 [0.79-1.19]
Wasting status							
Not wasted (WHZ ≥ -2SD)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Wasted (WHZ < -2SD)	0.97 [0.89-1.05]	0.91 [0.79-1.04]	1.23 [0.95-1.59]	0.92 [0.76-1.12]	1.04 [0.62-1.74]	0.98 [0.80-1.19]	0.96 [0.74-1.25]
Underweight status							
Not underweight (WAZ ≥ -2SD)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Underweight (WAZ < -2SD)	1 [0.92-1.08]	1.09 [0.96-1.25]	0.93 [0.71-1.21]	0.85* [0.70-1.03]	1.00 [0.61-1.64]	0.97 [0.80-1.18]	0.91 [0.70-1.18]
Overweight Status							
Not overweight	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Overweight	0.95 [0.8-1.12]	1.06 [0.78-1.45]	1.78** [1.16-2.71]	0.58*** [0.40-0.84]	1.12 [0.54-2.32]	0.80 [0.5-1.27]	0.94 [0.62-1.43]
Anemia Status							
Severe anaemia (Hb <7.0 g/dl)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Moderate anaemia (Hb 7-9 g/dl)	1.21** [1.01-1.44]	1.62** [1.09-2.42]	0.81 [0.50-1.31]	1.15 [0.78-1.70]	2.02 [0.34-12.11]	0.96 [0.67-1.38]	1.30 [0.86-1.94]
Mild anaemia (Hb 10-10.9 g/dl)	1.28** [1.07-1.54]	1.72** [1.15-2.58]	0.82 [0.50-1.35]	1.23 [0.83-1.84]	1.91 [0.32-11.55]	0.94 [0.65-1.36]	1.34 [0.88-2.04]

No anaemia (Hb >11.0 g/dl)	1.28** [1.07-1.53]	1.85*** [1.23-2.78]	1.02 [0.61-1.70]	1.27 [0.85-1.90]	1.91 [0.32-11.55]	0.78 [0.53-1.14]	1.01 [0.65-1.56]
Constant	0.07*** [0.06-0.09]	0.09*** [0.06-0.14]	0.03*** [0.02-0.06]	0.08*** [0.05-0.14]	0.03*** [0.00-0.20]	0.06*** [0.03-0.09]	0.06*** [0.03-0.10]

3.4 Economic Inequality in Dietary Adequacy

Figure 7 shows relatively narrow disparity in dietary adequacy across wealth quintiles. MDD improves by 4.7 percentage points between the lowest and highest quintiles, whereas MAD shows only a marginal increase of 0.9 percentage points. Such limited variation implies that household economic status, though relevant, is not a decisive determinant of adequate IYCF practices. Importantly, the low levels observed even among the wealthiest households highlight the universality of suboptimal IYCF practices in India.

Figure 7. Wealth-related differences in MDD and MAD among children (6–23 months) in India



The concentration curve analysis shows that dietary adequacy tends to be higher among wealthier households, but the level of inequality is small. Nationally, MDD (Figure 8) has a slight pro-rich pattern (CI = 0.035), with somewhat higher inequality in the East, North, and South. MAD (Figure 9) shows a slightly stronger pro-rich pattern (CI = 0.060), mainly due to moderate inequality in the West. Other regions such as South, East, Central, North, and Northeast also show pro-rich patterns for MAD, but these are weak. Overall, children from richer households are somewhat more likely to meet MDD and MAD, but the differences between wealth groups are small, indicating that poor dietary adequacy is widespread across all households.

Figure 8: The concentration curve of income-related inequality in Minimum Dietary Diversity among children aged 6-23 months in India and its regions.

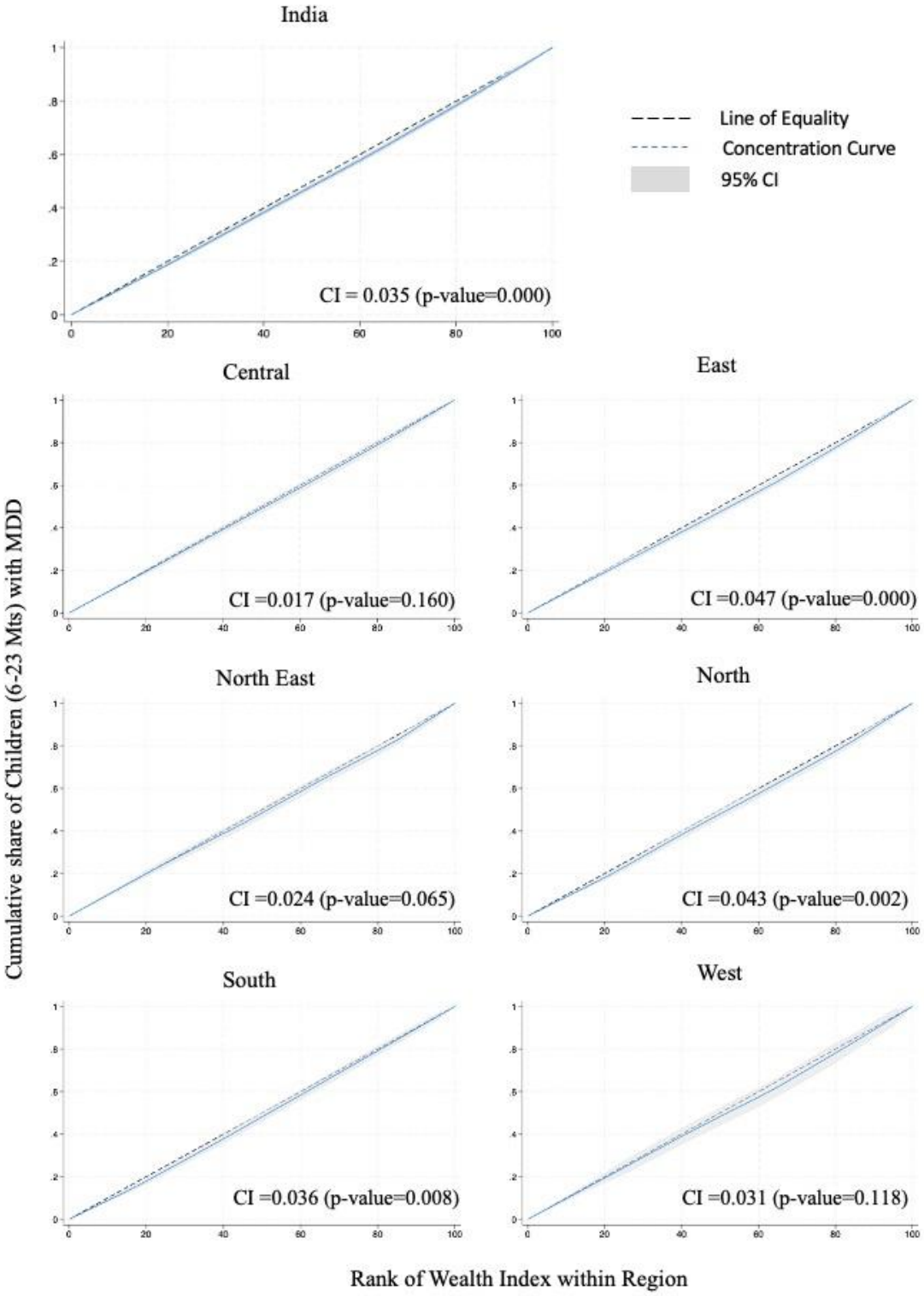
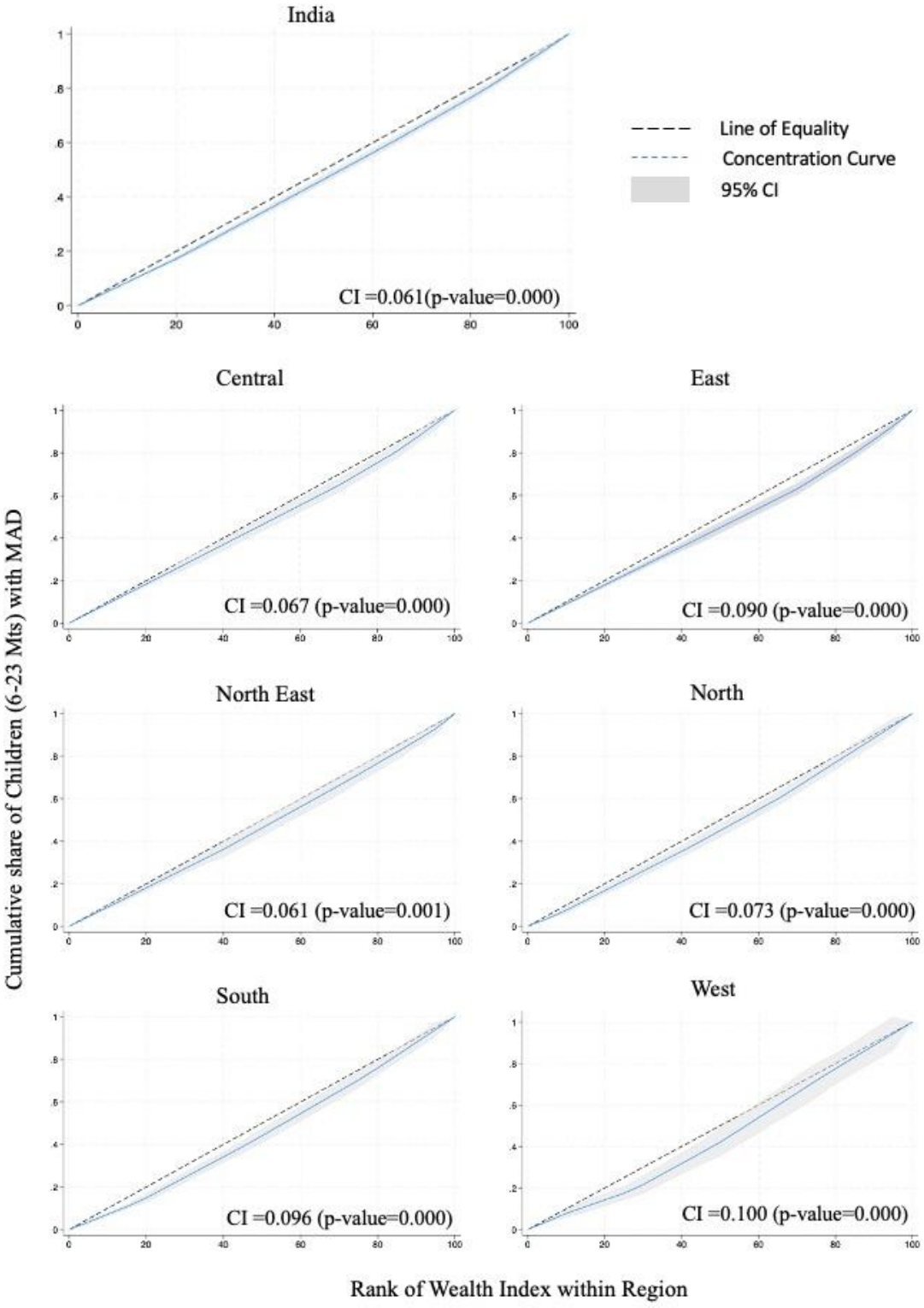


Figure 9: The concentration curve of income-related inequality in Minimum Acceptable Diet among children aged 6-23 months in India and its regions.



4. Discussion

This study elucidates the spatial heterogeneity, underlying determinants, and economic disparities that shape IYCF practices across India. The findings demonstrate that inadequate dietary adequacy characterised by limited consumption of fruits, vegetables, and animal-source foods combined with insufficient meal frequency, continues to restrict young children's access to essential macro- and micronutrients. Such deficits are well-documented contributors to nutrient insufficiencies and chronic undernutrition among Indian children (23-26). Evidence consistently indicates that nutritional deprivation during the complementary feeding period has enduring consequences. Growth faltering originating in utero and persisting through the first 18 months of life becomes largely irreversible, with high rates of stunting relapse among children who were stunted at birth (27-29). These patterns underscore the need for preventive strategies targeting women of reproductive age and children under two years, particularly during the critical 6–24-month window when interventions are most effective (27, 30-33).

4.1 Regional Variation and Behavioural Constraints in Feeding Practices

Marked regional heterogeneity was observed across all major IYCF indicators. Early initiation of breastfeeding remains suboptimal nationwide, with the Central region exhibiting the lowest level. In India many mothers introduce mixed feeding by two months, due to the perceived breastmilk insufficiency, pressure from work overload often exacerbated by the limited involvement of fathers in domestic and childcare tasks, and misconceptions such as the belief that infants require supplemental water, especially during summers (34-36).

Deficits in complementary feeding practices are even more pronounced. Only half of children receive solid or semi-solid foods at the recommended age, and slightly more than one-third meet the minimum meal frequency. Delayed initiation is driven by cultural norms suggesting that complementary foods should be introduced only after 12 months, and by the misconception that crying is indicative of readiness for solid foods (35, 37). Dietary diversity and adequacy remain particularly poor, with the lowest levels observed in regions where cultural restrictions limit consumption of animal-source foods, notably the North, West, and Central regions. Conversely, the comparatively high intake of sweetened beverages in the South reflects broader dietary transitions and increasing market penetration among young children.

Knowledge constraints further hinder optimal feeding practices. Many caregivers rely on advice from elder family members, whose recommendations are rooted in tradition rather than evidence. In some settings, negative perceptions of interactions with health workers create uncertainty and diminish maternal confidence in making informed nutrition decisions (35, 38).

4.2 Determinants of Dietary Adequacy among Children aged 6-23 months

The determinants of dietary adequacy among children aged 6–23 months illustrate multifaceted interactions between socioeconomic disadvantage, maternal attributes, and region-specific contexts. At the national level, children from OBC households and those residing in the poorest wealth quintiles exhibited significantly diminished odds of achieving MDD. Maternal education emerged as one of the strongest predictors of adequate feeding, consistent with well-documented pathways linking education to enhanced nutritional knowledge, caregiving capacity, and health-seeking behaviours. Larger household size and higher birth order further reduced the likelihood of dietary adequacy, reinforcing the notion that resource dilution and competing caregiving responsibilities constrain optimal feeding.

Interestingly, maternal overweight status was positively associated with both MDD and MAD. Although maternal overweight is often conceptualised as an indicator of nutritional risk, within this context it may reflect comparatively greater household food security. The positive association between older child age and dietary adequacy likely reflects both delayed initiation of complementary feeding and the natural diversification of diets as children age.

Regional analyses added further nuance, revealing substantial variation in the predictors of MAD across India. Cultural norms, ecological conditions, and local food markets contributed to these regional differences. Positive associations between non-Hindu religious affiliation and dietary adequacy in the South, East, and Northeast may reflect more permissive dietary patterns toward animal-source foods. Conversely, poverty and low maternal education remained robust predictors of inadequate diets across nearly all regions.

4.3 Socioeconomic Inequalities in Complementary Feeding

Wealth-related inequality in complementary feeding adequacy is relatively modest but exhibits a clear pro-rich pattern. At the national level, children from wealthier households demonstrate higher odds of achieving both MDD and MAD, with the Western region displaying the most pronounced gradient. Nonetheless, the limited magnitude of wealth differentials indicates that inadequate dietary adequacy remains pervasive across all economic tiers. This finding suggests that entrenched cultural norms surrounding complementary feeding, insufficient maternal nutrition knowledge, and suboptimal caregiving practices exert substantial influence on feeding behaviours even among non-poor households, thereby moderating the effect of economic advantage on child diet quality.

4.4 Policy and Programmatic Implications

This study's findings carry important implications for India's food and nutrition policies. The early onset and near irreversibility of linear growth faltering underscore the necessity of prioritising interventions beginning at preconception and continuing through the first 1,000 days of life. Furthermore, the substantial regional variability observed in IYCF practices necessitates a dual policy approach that pairs national guidelines with regionally adapted strategies sensitive to local food cultures and caregiving environments. Although economic inequities persist, the pervasive inadequacy of complementary feeding across all wealth groups underscores the need for universal interventions, complemented by targeted measures for those experiencing the greatest disadvantage. To effectively address both structural constraints and behavioural barriers, policy efforts should focus on improving the quality of counselling provided by frontline workers, and promoting culturally resonant recipes that leverage locally accessible foods.

4.5. Strength and Limitations of the Study

This study leverages the most recent nationally representative dataset, providing robust, large-scale, population-based estimates of IYCF practices in India. The application of standardised WHO and UNICEF indicators enhances comparability with national and global research, thereby strengthening the validity and policy relevance of the findings. By disaggregating results across six geographic regions, the study also demonstrates substantial regional heterogeneity, identifying both areas of progress and those requiring further focus. Moreover, the inclusion of a broad set of sociodemographic, anthropometric, and nutritional covariates in the regression analysis enriches the understanding of determinants shaping dietary diversity and diet adequacy among children aged 6–23 months. Notwithstanding these strengths, several limitations must be acknowledged. First, the cross-sectional design restricts causal inference between explanatory factors and feeding outcomes. Second, the reliance on maternal 24-hour dietary recall may introduce recall bias and may not accurately capture feeding practices. Additionally, contextual determinants such as cultural norms, food availability, and household food insecurity were not measured, limiting a comprehensive understanding of barriers to optimal feeding.

4.6 Conclusion

This study highlights persistent gaps in optimal IYCF practices across India and demonstrates that these inadequacies are closely tied to early growth faltering and subsequent growth

trajectories. The pronounced regional heterogeneity, socioeconomic stratification, and cultural diversity documented herein show that feeding practices are not merely individual choices but are embedded within wider social structures shaped by class, gender, and identity. Accordingly, addressing suboptimal feeding in India demands more than technical nutritional remedies; it requires comprehensive behavioural and social-science–informed strategies that engage with the cultural rationalities and structural realities shaping how caregivers understand, prioritise, and enact feeding practices.

Declarations

Ethics approval and consent to participate: Not applicable

Clinical trial number: Not Applicable

Human Ethics and Consent to Participate declarations: Not Applicable

Consent for publication: Yes

Availability of data and materials: The study used data available in public domain that can be obtained post registration from; https://dhsprogram.com/methodology/survey/survey-display-541.cfm

Competing interests: None

Funding: None

Authors' contribution: Concepts, design – AJCP, BTM, NA;
Literature search, data Analysis – AJCP, JJ, BTM, AKP;
Manuscript preparation- AKP, BTM, AJCP, JJ, NA;
Manuscript editing, and manuscript review- AJCP, BTM, NA

Acknowledgements: The authors gratefully acknowledge the financial support by SRM School of Public Health, Faculty of Medicine and Health Sciences, SRM Institute of Science and Technology, Chengalpattu, Tamil Nadu, India, for bearing the defrayed cost of publishing this article.

References

1. WHO. Malnutrition: WHO; 2024 [Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition.
2. UNICEF, WHO, WBG. Levels and trends in child malnutrition. Washington DC: UNICEF, WHO, World Bank; 2025.
3. Benjamin-Chung J, Mertens A, Colford JM, Jr., Hubbard AE, van der Laan MJ, Coyle J, et al. Early-childhood linear growth faltering in low- and middle-income countries. Nature. 2023;621(7979):550-7.

4. Tran LM, Nguyen PH, Young MF, Martorell R, Ramakrishnan U. The relationships between optimal infant feeding practices and child development and attained height at age 2 years and 6-7 years. Matern Child Nutr. 2024;20(3):e13631.
5. UNICEF Wa. Indicators for assessing infant and young child feeding practices: definitions and measurement methods. Geneva: World Health Organization and the United Nations Children's Fund (UNICEF); 2021.
6. Jaleel A, Surya Goud CS, Shankar S, Venkatesh K. Nourishing the future: exploring the factors influencing minimum diet diversity and minimum acceptable diet among Indian children aged 6–23 months. Journal of Public Health. 2023.
7. Pérez-Escamilla R, Tomori C, Hernández-Cordero S, Baker P, Barros AJD, Bégin F, et al. Breastfeeding: crucially important, but increasingly challenged in a market-driven world. Lancet (London, England). 2023;401(10375):472-85.
8. Oddy WH, Kendall GE, Blair E, De Klerk NH, Stanley FJ, Landau LI, et al. Breast feeding and cognitive development in childhood: a prospective birth cohort study. Paediatric and perinatal epidemiology. 2003;17(1):81-90.
9. Kramer MS, Aboud F, Mironova E, Vanilovich I, Platt RW, Matush L, et al. Breastfeeding and child cognitive development: new evidence from a large randomized trial. Arch Gen Psychiatry. 2008;65(5):578-84.
10. UNICEF. How many children are there in India? 2025 [Available from: https://data.unicef.org/how-many/how-many-children-under-18-are-there-in-india/.
11. UNICEF. UN report highlights great strides for India in under-five child survival 2025 [Available from: https://www.unicef.org/india/press-releases/un-report-highlights-great-strides-india-under-five-child-survival.
12. IIPS, ICF. National Family Health Survey -5. Mumbai: International Institute of Population Sciences; 2021.
13. Preethi V, Hemalatha V, Arlappa N, Thomas MB, Jaleel A. Trends and predictors of severe and moderate anaemia among children aged 6–59 months in India: an analysis of three rounds of National Family Health Survey (NFHS) data. BMC public health. 2024;24(1):2824.
14. Sarna A, Porwal A, Ramesh S, Agrawal PK, Acharya R, Johnston R, et al. Characterisation of the types of anaemia prevalent among children and adolescents aged 1-19 years in India: a population-based study. The Lancet Child & adolescent health. 2020;4(7):515-25.
15. GBDS. The burden of child and maternal malnutrition and trends in its indicators in the states of India: the Global Burden of Disease Study 1990-2017. The Lancet Child & adolescent health. 2019;3(12):855-70.
16. Investigators M-EN. Childhood stunting in relation to the pre- and postnatal environment during the first 2 years of life: The MAL-ED longitudinal birth cohort study. PLoS medicine. 2017;14(10):e1002408.
17. Das SK, Burma AD, Amudhan S, Mishra V, Mahapatra P, Ashok A, et al. Do children in India grow well into adolescents? Longitudinal analysis of growth transitions from Young Lives panel survey in India. Public health. 2022;202:18-25.
18. Rehman AM, Gladstone BP, Verghese VP, Muliyil J, Jaffar S, Kang G. Chronic growth faltering amongst a birth cohort of Indian children begins prior to weaning and is highly prevalent at three years of age. Nutrition Journal. 2009;8(1):44.
19. Petrikova I. The role of complementary feeding in India's high child malnutrition rates: findings from a comprehensive analysis of NFHS IV (2015-2016) data. Food Secur. 2022;14(1):39-66.

20. Nguyen PH, Avula R, Headey D, Tran LM, Ruel MT, Menon P. Progress and inequalities in infant and young child feeding practices in India between 2006 and 2016. Matern Child Nutr. 2018;14 Suppl 4(Suppl 4):e12663.
21. Kakwani NC. Measurement of Tax Progressivity: An International Comparison. The Economic Journal. 1977;87(345):71-80.
22. O'Donnell O, O'Neill S, Van Ourti T, Walsh B. conindex: Estimation of concentration indices. The Stata journal. 2016;16(1):112-38.
23. Yadav K, Ramaswamy G, Puri S, Vohra K, Achary T, Jaiswal A, et al. Prevalence and determinants of anemia due to micronutrient deficiencies among children aged 12-59 months in India-Evidence from Comprehensive National Nutrition Survey, 2016-18. PLOS global public health. 2024;4(1):e0002095.
24. Gawande K, Jha N, Bhadoria AS, Saxena G, Yadav S. Micro-Nutrient Deficiencies Among Children in India. Journal of Medical Evidence. 2021;2(2).
25. Venkatesh U, Sharma A, Ananthan VA, Subbiah P, Durga R. Micronutrient's deficiency in India: a systematic review and meta-analysis. Journal of nutritional science. 2021;10:e110.
26. Madhari RS, Boddula S, Ravindranadh P, Jyrwa YW, Boiroju NK, Pullakhandam R, et al. High dietary micronutrient inadequacy in peri-urban school children from a district in South India: Potential for staple food fortification and nutrient supplementation. Maternal & Child Nutrition. 2020;16(S3):e13065.
27. Benjamin-Chung J, Mertens A, Colford JM, Hubbard AE, van der Laan MJ, Coyle J, et al. Early-childhood linear growth faltering in low- and middle-income countries. Nature. 2023;621(7979):550-7.
28. Ross ES, Krebs NF, Shroyer ALW, Dickinson LM, Barrett PH, Johnson SL. Early growth faltering in healthy term infants predicts longitudinal growth. Early Human Development. 2009;85(9):583-8.
29. De Sanctis V, Soliman A, Alaaraj N, Ahmed S, Alyafei F, Hamed N. Early and Long-term Consequences of Nutritional Stunting: From Childhood to Adulthood. Acta bio-medica : Atenei Parmensis. 2021;92(1):e2021168.
30. Cooke R, Goulet O, Huysentruyt K, Joosten K, Khadilkar AV, Mao M, et al. Catch-Up Growth in Infants and Young Children With Faltering Growth: Expert Opinion to Guide General Clinicians. Journal of pediatric gastroenterology and nutrition. 2023;77(1):7-15.
31. Goodwin ET, Buel KL, Cantrell LD. Growth Faltering and Failure to Thrive in Children. American family physician. 2023;107(6):597-603.
32. Mertens A, Benjamin-Chung J, Colford JM, Coyle J, van der Laan MJ, Hubbard AE, et al. Causes and consequences of child growth faltering in low-resource settings. Nature. 2023;621(7979):568-76.
33. Sithamparapillai K, Samaranayake D, Wickramasinghe VP. Timing and pattern of growth faltering in children up-to 18 months of age and the associated feeding practices in an urban setting of Sri Lanka. BMC Pediatrics. 2022;22(1):190.
34. Olkaba BF, Alemayahu AA, Dukale YH, Yote NY, Wolde AI, Tura MR, et al. Understanding perceptions and practices of mothers toward infant and young child feeding in Toke Kutaye districts: Community-based qualitative study. Nutrition. 2024;126:112508.
35. Burns J, Emerson JA, Amundson K, Doocy S, Caulfield LE, Klemm RDW. A Qualitative Analysis of Barriers and Facilitators to Optimal Breastfeeding and Complementary Feeding Practices in South Kivu, Democratic Republic of Congo. Food and nutrition bulletin. 2016;37(2):119-31.

36. Gebremariam KT, Zelenko O, Hadush Z, Mulugeta A, Gallegos D. Exploring the challenges and opportunities towards optimal breastfeeding in Ethiopia: a formative qualitative study. International Breastfeeding Journal. 2020;15(1):20.
37. Lakhanpaul M, Roy S, Benton L, Lall M, Khanna R, Vijay VK, et al. Why India is struggling to feed their young children? A qualitative analysis for tribal communities. 2022;12(7):e051558.
38. Mohlala TB, Mathunjwa SN, Legodi HM, Mataboge MS. Exploring the infant feeding experiences of mothers living in selected Tshwane informal settlements: a qualitative study. South African Journal of Clinical Nutrition. 2023;36(3):118-25.

Annexture 1: Indicators of infant and young child feeding practices in the geographic regions in India, 2019-21

Sl. No.	Indicator	Weighted Sample (n)	India	East	West	South	North-East	Central	North
1	Early Initiation of Breast Feeding (EIBF)	83,415	42.05	42.47	48.17	54.52	52.52	28.64	44.60
2	Exclusively Breastfed for the first three days after birth (EBF3D)	81,124	84.44	86.60	82.98	88.70	90.48	80.67	82.27
3	Exclusive Breastfeeding under Six months (EBF)	21,836	63.71	61.47	68.56	60.99	60.99	64.26	66.27
4	Continued Breast Feeding 12-23 months (CBF)	40,527	80.51	87.45	76.15	69.63	89.97	82.19	78.66
5	Introduction of solid, semi-solid and soft foods 6-8 months (ISSSF)	10,619	49.38	52.51	52.66	61.83	56.91	36.57	48.71
6	Minimum Dietary Diversity 6-23 months (MDD)	63,081	22.67	29.45	17.27	28.22	27.54	15.49	19.86
7	Minimum Meal Frequency 6-23 months (MMF)	63,081	35.10	38.11	29.87	39.21	31.68	30.82	38.40
8	Minimum Acceptable Diet 6-23 months (MAD)	63,081	10.91	14.87	7.79	13.51	10.87	6.86	10.69
9	Egg and/or flesh food consumption 6-23 months (EFF)	63,081	20.44	28.68	13.78	34.88	30.17	9.83	9.47
10	Sweet Beverage Consumption 6-23 months (SwB)	63,081	21.02	17.03	23.17	28.07	18.80	19.43	21.81
11	Zero vegetable or fruit consumption 6-23 months (ZVF)	63,081	52.14	44.77	54.58	50.73	52.60	58.88	52.92