Child Malnutrition and Minimum Dietary Diversity across Indian States: A Comparative Analysis

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ABSTRACT

India, the most populous country in the world, faces a significant burden of child malnutrition. Despite economic progress, India continues to host one of the largest numbers of undernourished individuals globally. Approximately 12 per cent of the Indian population was undernourished in 2024. In the same year, 37.4 million children under five were stunted in India, and 18.7 per cent suffered from wasting, which is among the highest rates in the world. India faced the burden of child malnutrition, the highest in the world and is significantly higher than that of many sub-Saharan African countries. Malnutrition contributes significantly to the disease burden among children, with more than fifty percent of deaths among children under five in the world related to undernutrition, specifically in the low and middle-income countries, including India. Significant regional disparities in Minimum Dietary Diversity (MDD) were observed across India. MDD was associated with lower odds of wasting but showed a positive association with stunting, whereas its relationship with underweight was not statistically significant. Female children, higher household wealth, and maternal education significantly reduced the likelihood of child malnutrition, highlighting the importance of socioeconomic and educational factors in improving nutritional outcomes.

INTRODUCTION

Adequate nutrition is the consumption and utilisation of sufficient energy and nutrients to sustain health and nutritional well-being. For optimal growth, neurological and cognitive development, and a long, healthy life, adequate nutrition is crucial in the early years.

India, the most populous country in the world, faces a significant burden of child malnutrition. Despite economic progress, India continues to host one of the largest numbers of undernourished individuals globally. Approximately 12 per cent of the Indian population was undernourished in 2024. In the same year, 37.4 million children under five were stunted in India, and 18.7 per cent suffered from wasting, which is among the highest rates in the world (*The State of Food Security and Nutrition in the World*, 2025). Economic implications of malnutrition are also substantial. It is estimated that every one-dollar investment in nutrition interventions can generate up to sixteen dollars in economic returns (Micha et al., 2020). Malnutrition imposes high economic costs. India is estimated to lose around 2.6 per cent of its GDP due to malnutrition (Nugent, Levine and Hale).

The key elements of children's good nutrition are adequate meals and the availability of foods of the right quality and quantity. Encouraging moms to breastfeed exclusively for the first six months and to start age-appropriate, safe, responsive, and nutritionally enough supplemental feeding at six months is an easy way to achieve optimal baby and young child feeding. A low-nutrient diet is the root cause of malnourishment. Malnutrition has many varied and complex causes, many of which are linked to poverty, limited access to essential services, and mothers' lack of understanding. Malnutrition during a child's first two years of life causes physical and cognitive deficits that are mostly irreversible. If a child survives, they may experience a lifetime of terrible side effects, such as heightened susceptibility to illnesses, delayed development, reduced growth, and even blindness that

keeps kids from succeeding in school and from going for meaningful jobs as adults, which eventually results in decreased production and income. According to the World Health Organisation, malnutrition manifests in four comprehensive types, viz. stunting, wasting, underweight and overweight, measured by standardised anthropometric measures viz. height for age, weight for height, and weight for age, and weight for height indexes, respectively. A lack of calories and protein available to the body's tissues is known as stunting or chronic protein-energy malnutrition. It is brought on by either chronic and recurrent illness or insufficient food consumption over an extended period of time. Acute protein energy malnutrition, often known as wasting, is the inadequate nutrition brought on by recent disease episodes, diarrhoea in particular, or severe food scarcity. Stunting, or low height for age, is a result of illnesses and undernutrition that have slowed a child's growth from birth. Children who are underweight or underweight for their age may exhibit wasting, or low weight-height, which might be a sign of stunting, acute weight loss, or both.

A stunted child has a low height for age, which is a result of illnesses and malnutrition that have stunted the child's growth since birth. Youngsters who are underweight for their age (underweight) can be a sign of stunting, acute weight loss, or both. Malnutrition is determined by several biological, social, cultural, economic, and morbidity factors, such as age, birth weight, duration of breastfeeding, gender of the family head, place of residence, type of house, toilet facilities, education level of the mother and father, caregiver, frequency of cough and diarrhoea, and consumption of milk and dairy products (Tharakan & Suchindran, 1999). Children from families with higher and middle-class incomes were less likely to be wasted, underweight, or stunted, and children of working mothers were less likely to be wasted than children of mothers who did not work (Siddiqa et al., 2023). Mother's education has a significant, favourable impact on children's health (Lakshmanasamy, 2022). The majority of the changes in child nutrition can be attributed to maternal body mass index, education, and household economic status; the incidence of stunting and underweight has decreased by 7 and 6 percentage points, respectively (Nie et al., 2019). Significant risk factors for childhood undernutrition include the kid's age, whether the child has a fever or diarrhoea, the kind of birth, the mother's education level and BMI, the wealth of the household, and the number of children under five in the home (Khanam et al., 2019). The nutritional status of children and the level of maternal awareness are significantly improved by nutrition education (Prasetyo et al., 2023).

Improvements in women's dietary diversity, self-esteem, and the pace of a child's dietary diversity all have a major impact on the child's nutritional health (Banu et al., 2023). The likelihood of malnutrition rises sharply with the number of one's siblings, the mother's poor level of education, inappropriate food consumption, etc. (Chakraborty & Ghosh, 2020). Poverty, poor child-feeding practices, a lack of nutrition knowledge among nursing mothers or other caregivers, and inadequate healthcare facilities have been identified as the most important risk factors for malnutrition (Ijarotimi, 2013). The issue of minimum dietary diversity (MDD) and minimum acceptable diet (MAD) among children has been widely examined in the Indian context using large-scale survey data and localised studies. The prevalence of MDD and MAD in India remains critically low at 25% and 10.5%, respectively, with maternal education, maternal BMI, and household wealth emerging as significant determinants(Jaleel et al., 2025). Similarly, (Jain et al., 2022), using NFHS-4 data, highlighted substantial regional disparities, reporting that only 19.8% of children met the MDD criteria, with pronounced clustering of poor dietary diversity in states like Rajasthan and Uttar Pradesh. (Rai et al., 2022) Further examined temporal trends and observed persistently high levels of minimum dietary diversity failure (MDDF), particularly in rural areas and among socially advantaged groups, indicating structural and socio-cultural influences on child feeding practices. In addition, Saha et al., 2022), established a strong link between dietary diversity and child growth outcomes, demonstrating that consumption of animal-source foods significantly reduces the risk of stunting, although less than one-fourth of children in India receive a diversified diet. (Vashist et al., 2024) Based on primary data from rural Gurugram, reported that only 14% of children achieved minimum dietary diversity and less than 10% met MAD standards, with maternal awareness and healthcare counselling playing a crucial role in improving feeding practices. Furthermore,(Sihag et al., 2026), emphasised the importance of nutritional knowledge and household food expenditure patterns in shaping intra-household dietary outcomes, particularly among farming communities in Haryana.

Purpose of the study

I. To study the status of child Malnutrition in the Indian States.

II. To study the acceptable minimum diet diversity in different states.

RESEARCH METHODOLOGY

Data and method

The two cross-sectional data sets from the national family health survey, NFHS-4 (2015–16) and NFHS-5 (2019–20), were used in the current investigations. The NFHS offers cross-sectional data and encompasses a nationally representative sample. The National Family Health Survey (NFHS) is administered by the Ministry of Health and Family Welfare of the Government of India. The data collected from these surveys are extensively employed to develop national public health interventions and inform national public health policy.

The child malnutrition analysis was based on a sample of 2,05,642 children aged 0–59 months with valid anthropometric data. The analysis of Minimum Dietary Diversity (MDD) was conducted among 62,253 children aged 6–23 months who had complete information on dietary intake and complementary feeding practices in the NFHS-5 (2019–21) dataset.

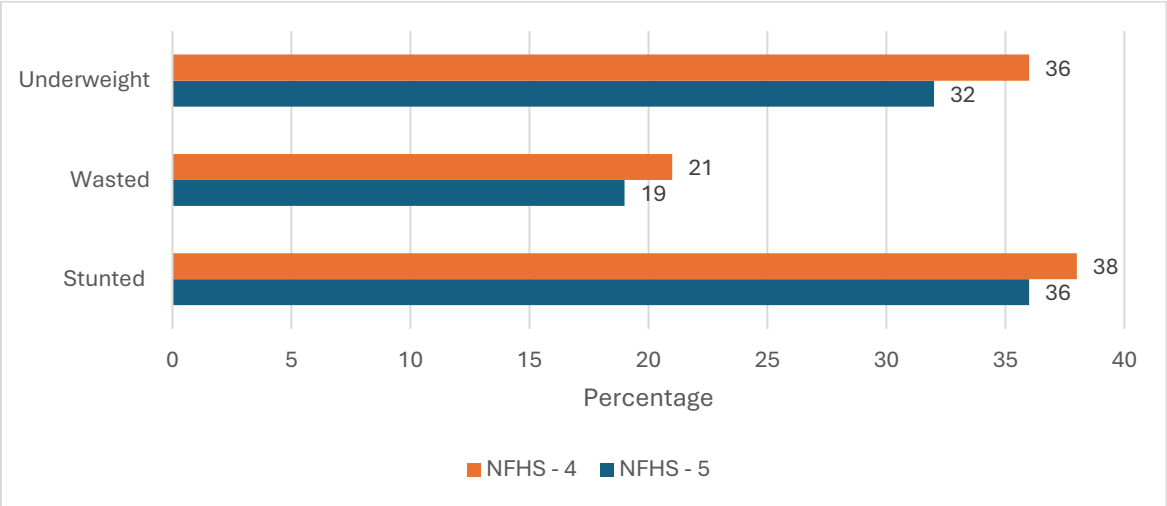
To study the status of child Malnutrition in India, the methodology given by WHO has been used. This methodology consists of two steps. In the first step, the study identifies the undernutrition or overnutrition level of children. Undernutrition is measured by stunting, wasting, and being underweight, while overnutrition is measured by being overweight. Stunted **(**Length/height-for-age ≤−2 SD and ≥−3 SD of the median), Wasted **(**Weight-for-length/height ≤−2 SD and ≥−3 SD of the median), **U**nderweight (Weight-for-age <−2 SD and ≥−3 SD of the median) (WHO)

For the second objective, adopt the WHO's infant and young child feeding (IYCF) guidelines as internationally recognised supplementary feeding guidelines tools (WHO 2021). The eight food categories, which are given by WHO, are as follows:

(1) mother breast milk (2) roots, grains, plantains and tubers (3) seeds, nuts and pulses (peas, lentils and beans) (4) dairy products like yogurt, cheese, milk and infant formula (5) flesh foods, fish, meat, poultry (6) fruits & vegetables containing vitamin A (7) eggs (8) other vegetable & fruits. The data on these food categories was gathered by NFHS, consumed by a child in the last 24 hours, from the child's mother, by using a structured questionnaire. If a child eats one food item from all categories in the last 24 hours, then one value is assigned to that category for that child and otherwise zero if they do not eat. After this, the scores are summed up to get the diet diversity score (DDS), which ranges from 0 to 8. If a child consumed five or more foods, then he was assigned minimum dietary diversity (MDD)

RESULTS AND FINDINGS

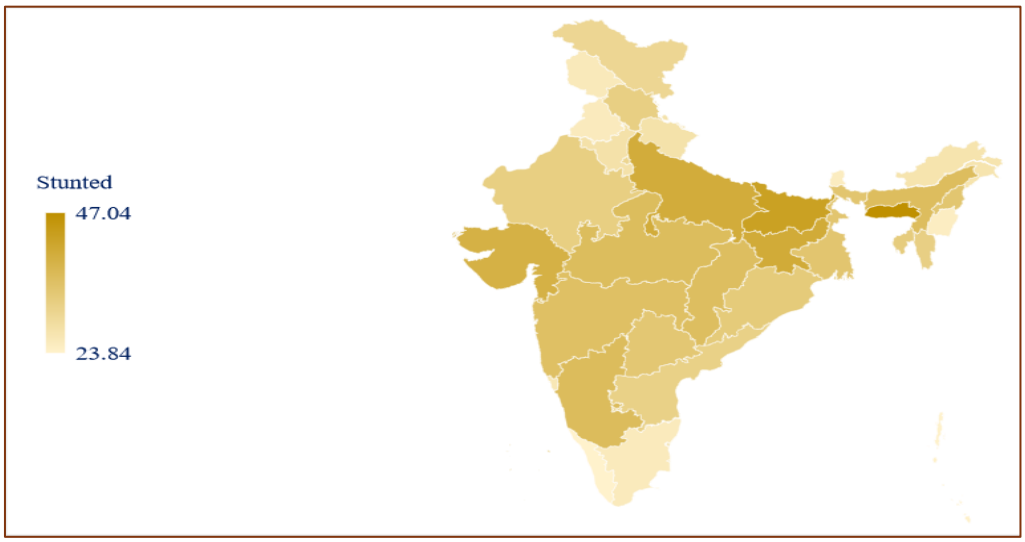
Figure:1 Percentage of children under 5 affected by stunting, wasting, and underweight in India



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

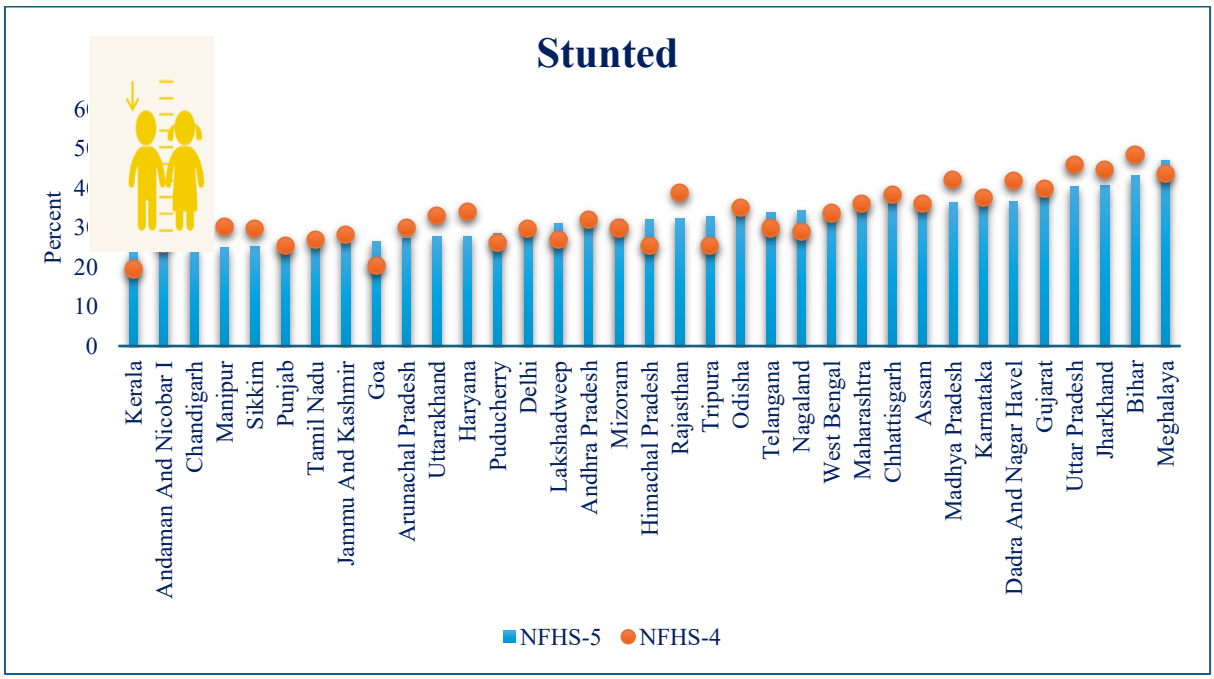
Figure 1: The percentage of Indian children under five who suffer from stunting, wasting, and underweight. From NFHS-4 to NFHS-5, wasting shows a significant decrease of (2), although stunting and underweight show very slight improvements (4 and 2).

Figure 2: Percentage of Children under 5 affected by Stunting in India, NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

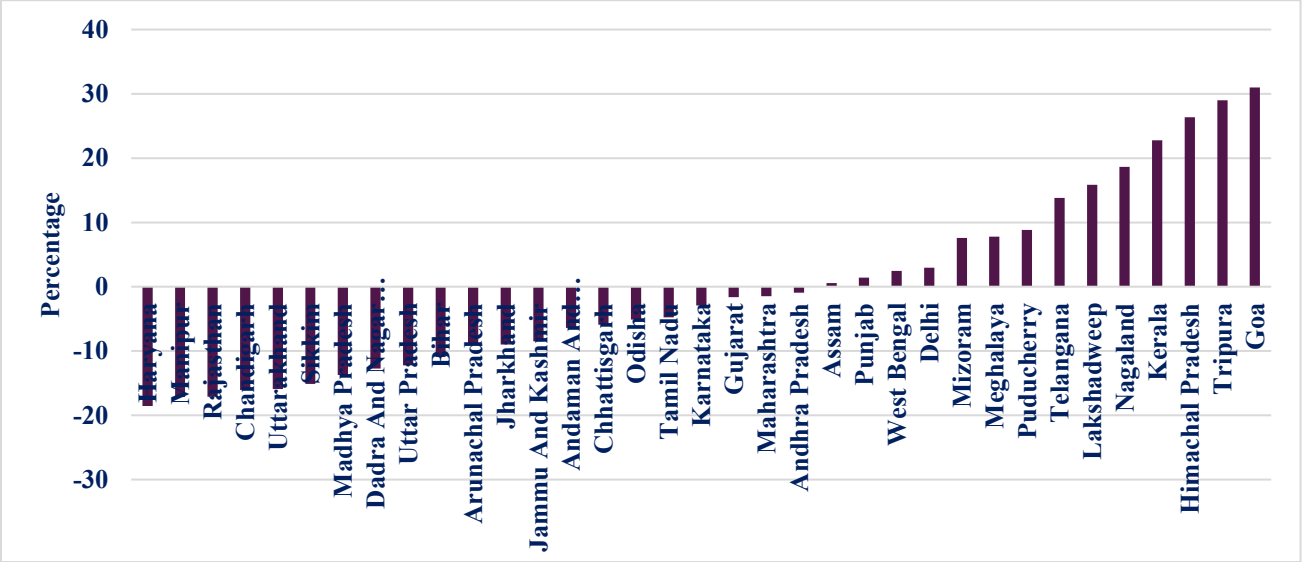
Figure 3: Trends of Stunting in Children Under Five Years old in India, NFHS-4 to NFHS-5



based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Figure 3 illustrates the patterns of stunting in children under five in India during NFHS-4 and NFHS-5. Meghalaya and Bihar had the highest number of stunted children, while Kerala had the lowest number of stunted children in NFHS-5 in India, while Andaman & Nicobar Island had the lowest and Dadra & Nagar Haveli had the highest number of stunted children. In all states, the government tried to reduce stunting in children under age 5 children but in some states, i.e. Goa, Tripura, Himachal Pradesh, Kerala, Nagaland, Lakshadweep, Telangana, Puducherry, Meghalaya, Mizoram, Delhi, West Bengal, Punjab, the number of stunted children increased from NFHS-4 to NFHS-5 in India.

Figure 5 Percentage Change in Stunted Children Under 5 Years between NFHS-4 and NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

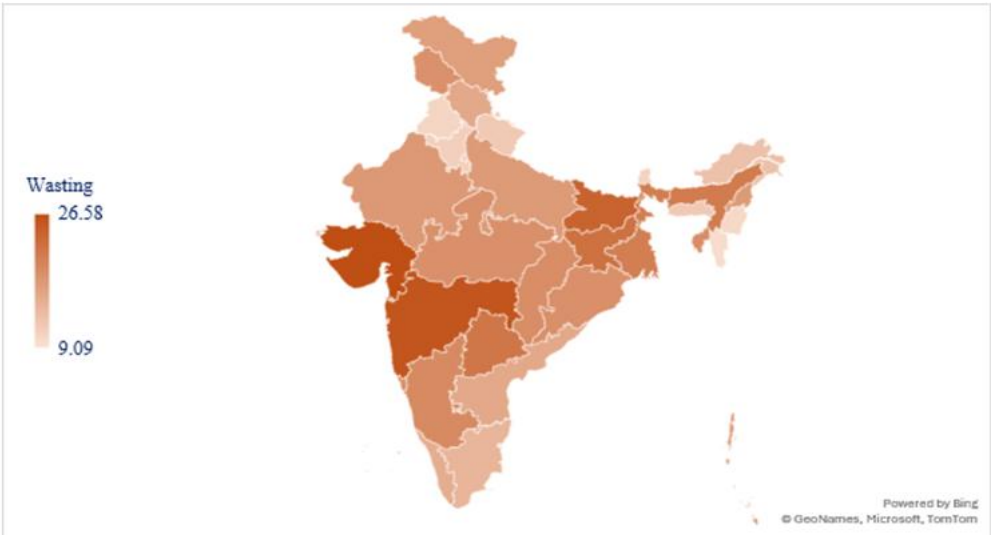
Table 1: The percentage change in stunting among children under five years old between NFHS-4 and NFHS - 5

State	NFHS - 4	NFHS - 5	Change	NFHS - 4	NFHS- 5
Andaman & Nicobar	25.81	24.15	-6.43	H	H
Andhra Pradesh	31.97	31.67	-0.94	VH	VH
Arunachal Pradesh	29.91	27.2	-9.06	H	H
Assam	36.12	36.33	0.58	VH	VH
Bihar	48.33	43.04	-10.95	VH	VH
Chandigarh	29.21	24.52	-16.06	H	H
Chhattisgarh	38.42	36.15	-5.91	VH	VH
Dadra And Nagar Havel	41.87	36.53	-12.75	VH	VH
Delhi	29.74	30.62	2.96	H	VH
Goa	20.21	26.47	30.97	H	H
Gujarat	39.87	39.23	-1.61	VH	VH
Haryana	34.09	27.77	-18.54	VH	H
Himachal Pradesh	25.41	32.11	26.37	H	VH
Jammu And Kashmir	28.27	25.87	-8.49	H	H
Jharkhand	44.66	40.64	-9.00	VH	VH
Karnataka	37.61	36.52	-2.90	VH	VH

Kerala	19.42	23.84	22.76	M	H
Lakshadweep	26.83	31.08	15.84	H	VH
Madhya Pradesh	42.22	36.42	-13.74	VH	VH
Maharashtra	36.15	35.62	-1.47	VH	VH
Manipur	30.1	24.94	-17.14	VH	H
Meghalaya	43.64	47.04	7.79	VH	VH
Mizoram	29.81	32.07	7.58	H	VH
Nagaland	28.95	34.34	18.62	H	VH
Odisha	34.92	33.14	-5.10	VH	VH
Puducherry	26.21	28.53	8.85	H	H
Punjab	25.25	25.6	1.39	H	H
Rajasthan	38.86	32.22	-17.09	VH	VH
Sikkim	29.62	25.14	-15.12	H	H
Tamil Nadu	27	25.71	-4.78	H	H
Telangana	29.8	33.91	13.79	H	VH
Tripura	25.43	32.81	29.02	H	VH
Uttar Pradesh	45.92	40.31	-12.22	VH	VH
Uttarakhand	32.88	27.65	-15.91	VH	H
West Bengal	33.58	34.41	2.47	VH	VH

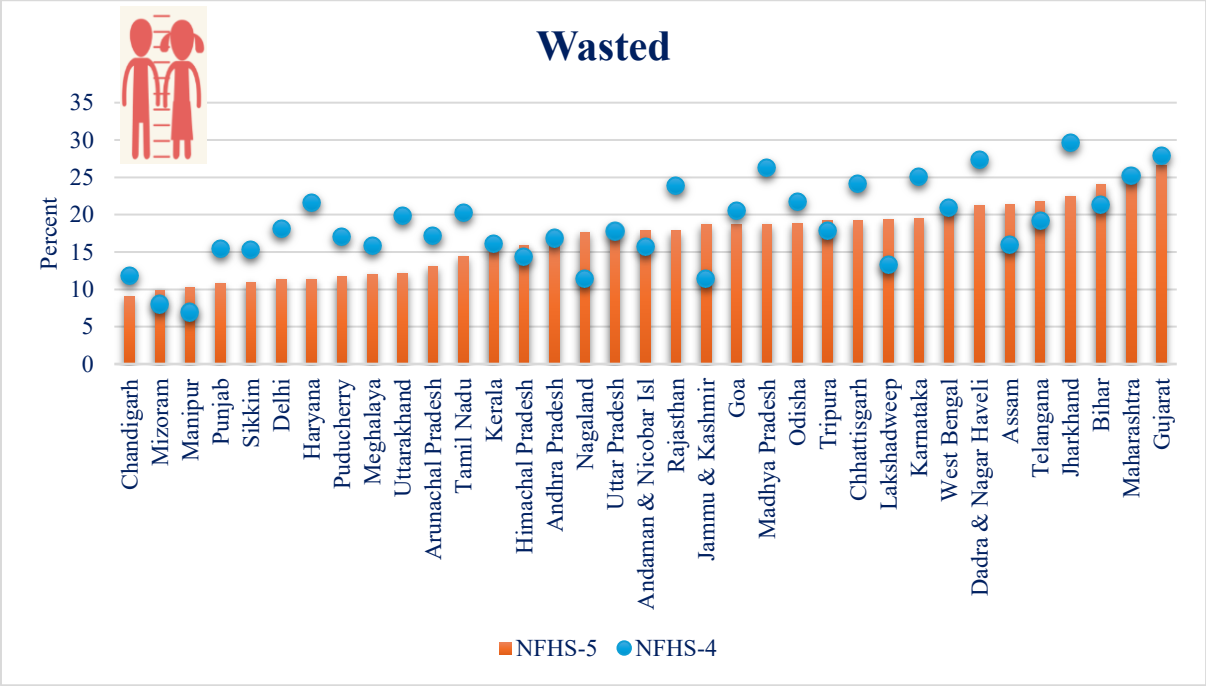
Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Figure 7: Percentage of Indian Children Under Five Affected by Wasting, NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

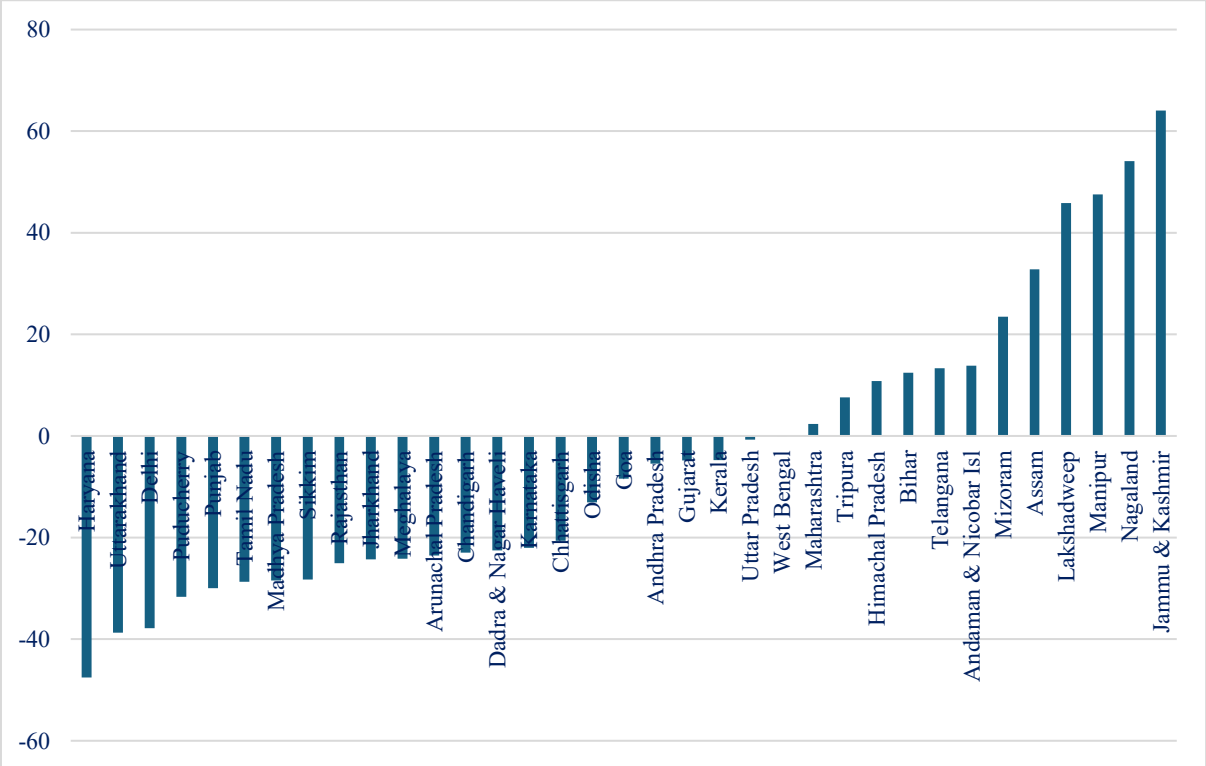
Figure 8: Percentage of Children under 5 affected by Wasting in India, NFHS-4 & NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Figure 8 shows that I state and UTs of India, Gujarat and Maharashtra had the most wasted children, Mizoram had the fewest, Chandigarh had the fewest, and Dadra & Nagar Haveli had the most. The highest progress was made by Haryana in reducing the number of children affected by wasting from NFHS-4 to NFHS-5, i.e., 47.52 per cent. Mizoram, Assam, Lakshadweep, Manipur, Nagaland, and Jammu & Kashmir were the states with the lowest performance, where childhood wasting in NFHS-5 grew rather than decreased.

Figure 9: Percentage Change in Wasted Children Under 5 Years between NFHS-4 and NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

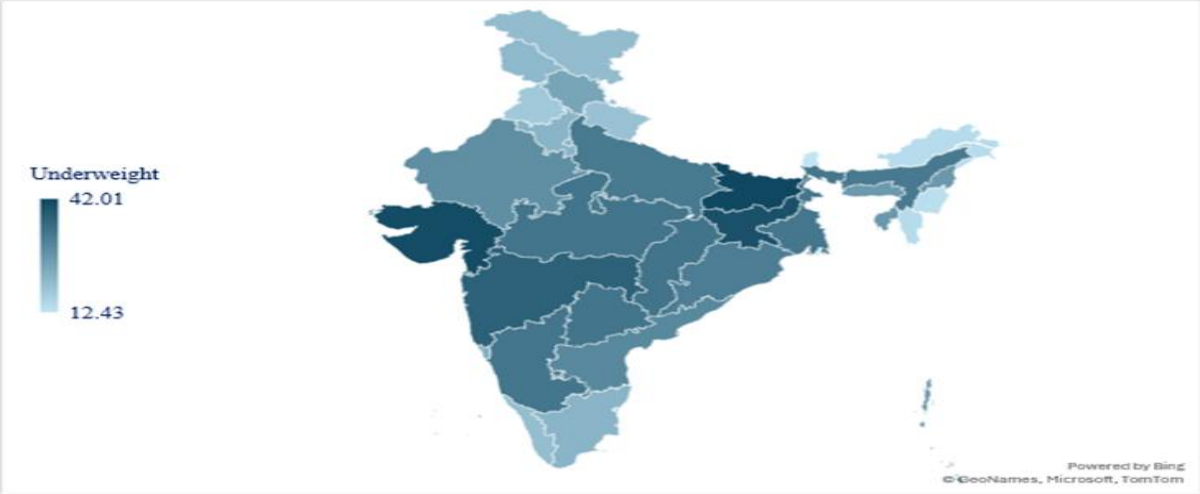
Table 2: The percentage change in wasted among children under five years old between NFHS-4 and NFHS - 5

State	NFHS – 5	NFHS - 4	Change	NFHS- 5	NFHS - 4
Andaman & Nicobar Island	17.84	15.67	13.84	VH	VH
Andhra Pradesh	15.94	16.86	-5.45	VH	VH
Arunachal Pradesh	13.12	17.16	-23.54	H	VH
Assam	21.3	16.04	32.79	VH	VH
Bihar	24.04	21.38	12.44	VH	VH
Chandigarh	9.09	11.8	-22.96	M	H
Chhattisgarh	19.18	24.16	-20.61	VH	VH
Dadra & Nagar Haveli	21.19	27.34	-22.49	VH	VH
Delhi	11.3	18.18	-37.84	H	VH
Goa	18.75	20.47	-8.40	VH	VH
Gujarat	26.58	27.92	-4.79	VH	VH
Haryana	11.35	21.63	-47.52	H	VH
Himachal Pradesh	15.9	14.35	10.80	VH	H
Jammu & Kashmir	18.7	11.4	64.03	VH	H
Jharkhand	22.46	29.66	-24.27	VH	VH
Karnataka	19.52	25.03	-22.01	VH	VH
Kerala	15.38	16.15	-4.76	VH	VH
Lakshadweep	19.31	13.24	45.84	VH	H
Madhya Pradesh	18.75	26.21	-28.46	VH	VH
Maharashtra	25.77	25.18	2.34	VH	VH
Manipur	10.24	6.94	47.55	H	M
Meghalaya	12	15.82	-24.14	H	VH
Mizoram	9.89	8.01	23.47	M	M
Nagaland	17.63	11.44	54.10	VH	H
Odisha	18.87	21.71	-13.08	VH	VH
Puducherry	11.66	17.06	-31.65	H	VH
Punjab	10.79	15.41	-29.98	H	VH
Rajasthan	17.84	23.81	-25.07	VH	VH

Sikkim	10.93	15.24	-28.28	H	VH
Tamil Nadu	14.44	20.26	-28.72	H	VH
Telangana	21.83	19.26	13.34	VH	VH
Tripura	19.16	17.81	7.58	VH	VH
Uttar Pradesh	17.64	17.77	-0.73	VH	VH
Uttarakhand	12.14	19.81	-38.71	H	VH
West Bengal	20.92	20.91	0.04	VH	VH

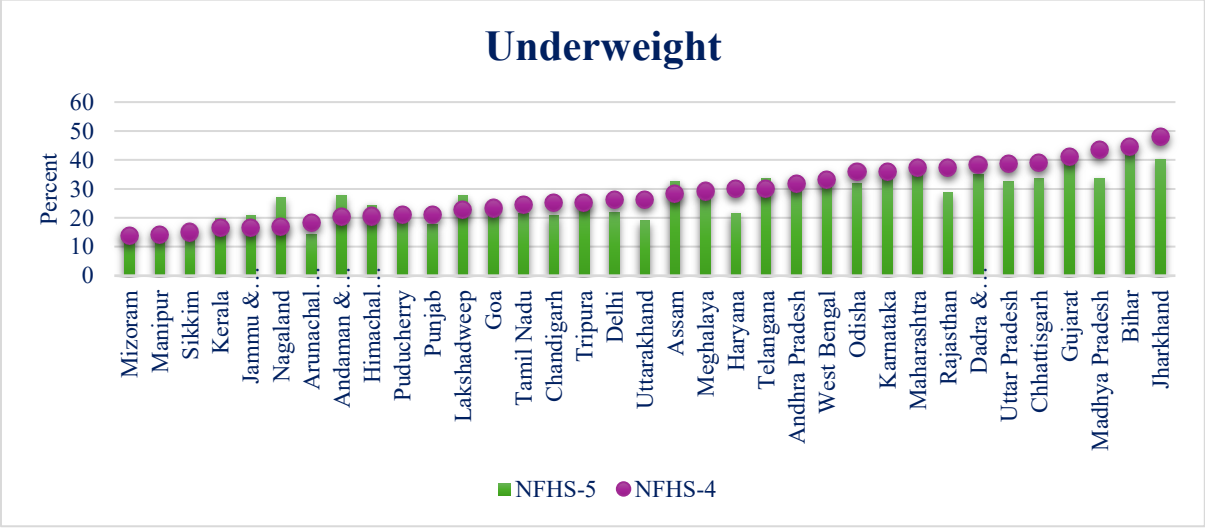
Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Figure 11: Percentage of Indian Children Under Five Affected by Underweight, NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Figure 12: Children under 5 affected by Underweight in India, NFHS-4 & NFHS-5

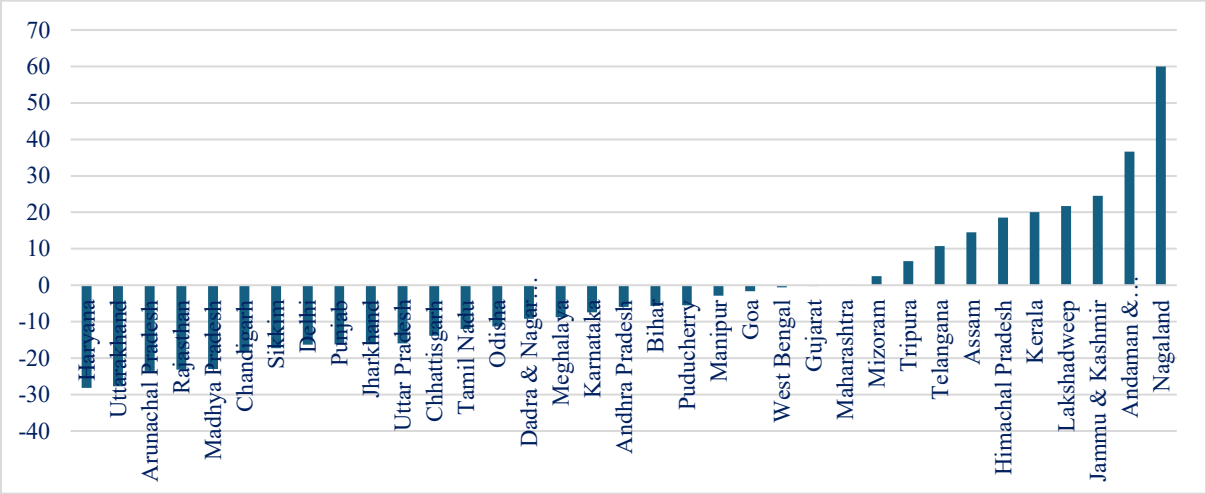


Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Figure 12 shows that Bihar and Gujrat had the highest percentage of underweight children and Manipur and Arunachal Pradesh had the lowest percentage of underweight children in NFHS-5 in India while Puducherry had

the lowest and Dadra & Nagar Haveli had the highest percentage of underweight children in UT's. Haryana made the most improvement, reducing underweight children by 28.16 points, while Nagaland performed the worst, increasing underweight children by 60 points between NFHS-4 and NFHS-5 in India.

Figure 13: Percentage Change in Underweight Children Under 5 Years between NFHS-4 and NFHS-5



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Table 3: The percentage change in Underweight among children under five years old between NFHS-4 and NFHS - 5

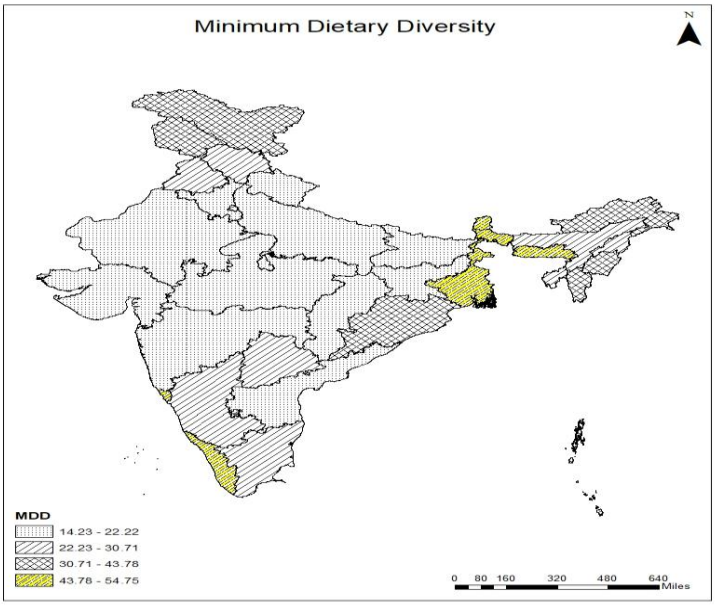
State	NFHS - 5	NFHS - 4	Change	NFHS - 5	NFHS - 4
Andaman & Nicobar Island	27.7	20.28	36.59	VH	VH
Andhra Pradesh	29.85	31.74	-5.95	VH	VH
Arunachal Pradesh	14.11	18.44	-23.48	H	VH
Assam	32.55	28.43	14.49	VH	VH
Bihar	42.01	44.54	-5.68	VH	VH
Chandigarh	20.65	25.28	-18.31	VH	VH
Chhattisgarh	33.72	39.15	-13.87	VH	VH
Dadra & Nagar Haveli	34.87	38.41	-9.22	VH	VH
Delhi	21.89	26.17	-16.35	VH	VH
Goa	22.97	23.36	-1.67	VH	VH
Gujarat	41.17	41.28	-0.27	VH	VH
Haryana	21.63	30.11	-28.16	VH	VH
Himachal Pradesh	24.42	20.6	18.54	VH	VH
Jammu & Kashmir	20.74	16.66	24.49	VH	VH
Jharkhand	40.23	48.01	-16.20	VH	VH
Karnataka	33.26	35.95	-7.48	VH	VH
Kerala	19.8	16.5	20.00	VH	VH

Lakshadweep	27.56	22.65	21.68	VH	VH
Madhya Pradesh	33.45	43.44	-23.00	VH	VH
Maharashtra	37.19	37.17	0.05	VH	VH
Manipur	13.63	14.04	-2.92	H	H
Meghalaya	26.63	29.2	-8.80	VH	VH
Mizoram	14.2	13.86	2.45	H	H
Nagaland	26.88	16.8	60.00	VH	VH
Odisha	31.84	35.9	-11.31	VH	VH
Puducherry	20	21.17	-5.53	VH	VH
Punjab	17.78	21.23	-16.25	VH	VH
Rajasthan	28.66	37.3	-23.16	VH	VH
Sikkim	12.43	15.03	-17.30	H	VH
Tamil Nadu	21.64	24.59	-12.00	VH	VH
Telangana	33.44	30.19	10.77	VH	VH
Tripura	27.03	25.35	6.63	VH	VH
Uttar Pradesh	32.67	38.86	-15.93	VH	VH
Uttarakhand	19.01	26.31	-27.75	VH	VH
West Bengal	33.09	33.29	-0.60	VH	VH

Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

Minimum diet diversity

Figure 14: Percentage of children under 6 to 23 months who received a minimum diet diversity



Source: based on the author's calculation using NFHS (2015 -16) and NFHS (2019 -21)

This map highlights substantial regional disparities in Minimum Dietary Diversity (MDD) among children aged 6–23 months in India. The Northeastern region reported the highest prevalence of MDD, with states such as Sikkim, Meghalaya, Manipur, and Ladakh performing considerably better than the national average, reflecting the role of diversified traditional diets and greater consumption of nutrient-rich foods. The Southern region also showed relatively higher dietary diversity, particularly in Kerala, Goa, and Karnataka, which may be associated with better maternal education, healthcare utilisation, and public health infrastructure. In contrast, the Northern and Central regions recorded comparatively low levels of MDD, especially in Uttar Pradesh, Rajasthan, Haryana, Bihar, and Madhya Pradesh, indicating poor complementary feeding practices and continued dependence on cereal-based diets. The Western region displayed mixed performance, as Goa reported high MDD prevalence, whereas Gujarat and Maharashtra showed relatively lower levels despite stronger economic development. The Eastern region exhibited moderate variation, with West Bengal and Odisha performing better than Bihar and Jharkhand. In adjusted model, Minimum Dietary Diversity (MDD) showed mixed associations with child malnutrition indicators. Children receiving adequate dietary diversity had higher odds of stunting (OR = 1.116, $p < 0.01$), while they were less likely to experience wasting (OR = 0.925, $p < 0.05$). However, the association between MDD and underweight was not statistically significant (OR = 1.013, $p > 0.05$). Female children were consistently less likely to suffer from stunting, wasting, and underweight compared to male children. Household wealth status emerged as a strong protective factor, as the likelihood of malnutrition declined significantly with improvement in economic status. Similarly, maternal education showed a significant negative association with all forms of malnutrition, particularly among children of highly educated mothers. Rural residence was associated with lower odds of underweight, whereas its effect on stunting was marginal and on wasting was statistically insignificant. Overall, the findings highlight the important role of socioeconomic status and maternal education in shaping child nutritional outcomes.

CONCLUSION

Despite significant economic growth and progress, child malnutrition remains a critical health concern in India. The study shows that minimum dietary diversity (MDD) plays a significant role in shaping child nutritional outcomes by reducing the likelihood of wasting; its relationship with stunting is more nuanced and warrants further research. There was no significant association between MDD and underweight, which suggests that dietary diversity may not fully capture the nature of malnutrition alone. The findings suggest the need for more targeted, region-specific nutrition policies and efforts to improve dietary diversity and reduce child malnutrition in India. The government should aim to enhance mothers' education, decrease socioeconomic disparities, and increase access to health services and better nutrition among high-burden states. Such a comprehensive and targeted approach is needed for accelerating progress towards reducing child malnutrition and achieving the child health and nutrition-related Sustainable Development Goals 2030.

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