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RESEARCH ARTICLE

Age-appropriate feeding practices and their association with undernutrition among children aged 6–23 months in aspirational districts of India: a multinomial analysis

Itishree Pradhan, Binayak Kandapan and Jalandhar Pradhan*

Department of Humanities and Social Sciences, National Institute of Technology, Rourkela, India
*Corresponding author. Email: jpp_pradhan@yahoo.co.uk

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Abstract

'Health and nutrition' is one among the five areas covered by the Aspirational District Programme in India, which aims to achieve the Sustainable Development Goals (SDGs). The reduction of undernutrition in under-five children has remained a major focus of the SDGs, especially at the ages of 6–23 months as this affects child development. This study used National Family Health Survey 2015–16 data to examine appropriate feeding practices and their associations with undernutrition among children aged 6–23 months in the 124 aspirational districts of India. Multinomial logistic regression analysis was used to analyse the association between feeding practices and undernutrition, adjusting for covariates. A total of 13,851 children aged 6–23 months were included in the analysis. Child nutritional outcomes, and children receiving the recommended minimum dietary diversity (MDD), minimum meal frequency (MMF) and minimum acceptable diet (MAD), were poorer in the aspirational compared with non-aspirational districts. However, the proportions of children who continued to breastfed, i.e. currently breastfeeding and the proportion of children who were receiving appropriate breastfeeding, i.e. receiving complementary feeding, in addition to breast milk, were higher in the aspirational districts. Appropriate breastfeeding and MDD were found to be associated negatively with undernutrition. While the continuation of breastfeeding increased the odds of children being undernourished, appropriate breastfeeding lowered the odds. The significant predictors of undernourishment among the study children were the child being male, of higher birth order, older and of smaller than average birth size; mother's lower educational level, mother's lower BMI of mothers and being a teenage mother; and poor household drinking water, sanitation facilities and lower economic status. This study suggests that educating mothers, especially illiterate and poor mothers, about appropriate breastfeeding and dietary diversity could help prevent and reduce child undernutrition in the aspirational districts of India.

Keywords: Feeding practices; Undernutrition; Aspirational districts

Introduction

Good nutrition is essential for the growth and development of a child, as well as their lifelong well-being (UNICEF, 2019). When an individual's diet is inappropriate, or if they fail to receive the required amounts of nutrients, this results in malnutrition. An excessive intake of nutrients results in overnutrition, and a deficiency leads to undernutrition (Shetty, 2006). To improve nourishment and end all types of malnutrition, various targets were set in 2015 in the Sustainable Development Goals (SDGs) (UNICEF, 2018). Controlling childhood diseases and reducing malnutrition among children under five years of age are among the SDG targets (Meshram *et al.*, 2018).

While overnutrition is becoming more prevalent in developed countries, undernutrition remains a major public health concern in developing countries (Tzioumis & Adair, 2014). The number of undernourished children continues to rise worldwide, and in 2018 nearly 200 million under-five children suffered from chronic or acute malnutrition (UNICEF, 2019). Of the world regions, South Asia has the highest number of undernourished people (255 million) (Grebmer, *et al.*, 2020), with 33.2% and 14.9% under-five children being stunted and wasted, respectively (UNICEF *et al.*, 2020). Of the 107 countries included in the 2020 Global Hunger Index (GHI) report, India recorded the highest prevalence of wasting among under-five children (17.3%), and the prevalence of stunting was 34.7%. India ranks 94th in the GHI, far below its neighbouring countries of Pakistan (88th), Bangladesh (75th), Nepal (73rd) and Sri Lanka (64th) (Grebmer *et al.*, 2020).

People can suffer from nutritional deficiencies at all ages, but in India the prevalence of undernutrition among children less than 36 months is higher than among older children (Meshram *et al.*, 2018). The effect of undernutrition is more extreme among children aged 6–23 months because of the irreversible damage that can occur during this period (Mya *et al.*, 2018). Short-term consequences include excessive illness, premature death, developmental delays and financial burdens for sick children; while long-term consequences can be poor physical and mental health, which may hinder the improvement of the overall social system too (Mya *et al.*, 2019). Proper nutrition during early childhood is crucial (Chandwani *et al.*, 2015), as it lays the foundation for good health throughout life, and at the national economic level ensures a good human workforce. The period from conception to 2 years of age is considered a 'critical window' for children's good growth, health and behavioural and cognitive development (De Onis & Branca, 2016). Optimal nutrition throughout this period helps reduce morbidity and mortality (Reinbott, *et al.*, 2015), decrease the risk of chronic disease in later life and promote good overall growth and development (Meshram *et al.*, 2018).

Poor infant and young child feeding (IYCF) practices are a major threat to India's social and economic development (Rajesh & Bhavana, 2016). Appropriate IYCF practices during the early childhood period are crucial for the prevention of irreversible developmental problems among children (Dasgupta *et al.*, 2014). Studies of IYCF have focused on breastfeeding and complementary feeding (Rajesh & Bhavana, 2016) and the measurements of IYCF practices include: type, quality and the texture of food given; nutrient density, frequency of feeding and dietary diversified of a given food; and how the food is fed to a child (Srivastava & Sandhu, 2006). In India, more than 90%, 75% and 60% of 6–23 months children do not meet the World Health Organization's (WHO) IYCF guidelines for a Minimum Acceptable Diet (MAD), Minimum Dietary Diversity (MDD) and Minimum Meal Frequency (MMF), respectively (IIPS & ICF, 2017).

Over the last four decades, the Government of India has introduced various nutrition intervention programmes, and these are all still in operation. However, India still faces a major challenge with undernutrition (Black *et al.*, 2013). The factors associated with child undernutrition in India are well-documented at the household, child and maternal levels. These include unfavourable household socioeconomic condition (Rajesh & Bhavana, 2016); illiteracy among mothers, low birth weight and lack of dietary diversity (Meshram, *et al.*, 2018); receiving less than the minimum recommended children's meals, multiple episodes of diarrhoea during the first 0–24 months of life (Mosites *et al.*, 2017); low maternal body mass index (BMI), unimproved sanitation and drinking water sources and low family wealth (Harding *et al.*, 2018); and inappropriate dietary intake or inefficient biological utilization, and various internal and external environmental factors (Yadav & Dubey, 2017). Also, children's place of residence, geographic location and climatic conditions can indirectly influence these factors (Agho, *et al.*, 2019).

Many studies have been carried out on child undernutrition in India at the state, district and regional levels, as well geographical location. However, studies among India's 'aspirational districts' are few (Kumar *et al.*, 2019). The Government of India launched the transformation of Aspirational District Programme (ADP) in January 2018 to address the issue of socioeconomic

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inequalities across India's districts by improving the performance of districts in pockets of underdevelopment. In India, there is a massive gap between the most advanced and least advanced regions, and this appears to be increasing with time, with disparities across states as well as within states. The ADP aims at inclusive development for all, with special reference to the underdeveloped areas of the nation, and is expected to improve the HDI rank of the country, as well as help achieve the SDGs. Under ADP a total of 124 districts out of the total 718 districts (the under-developed ones from 28 states) were identified based on a composite index comprising citizens' economic status, health and nutrition, educational status and basic amenities. The ADP is a major step towards improving the existence of all people in India, and the future prospects of the Indian economy (Mehta *et al*., 2018). It aims to decrease inequalities by encouraging growth in the least evolved regions of the nation (Kapoor & Green, 2020). Accordingly, the programme covers five vast sectors, particularly education, health and nutrition, agriculture and water resources, monetary inclusion and skill development and basic infrastructure (NITI Aayog, 2018). Of these, the highest weight (30%) has been given to health and nutrition.

Child malnutrition, and providing an adequate diet to 6–23 months children by promoting IYCF practices, are among several important health and nutrition indicators. This study aimed to investigate the IYCF practices among the aspirational districts of India and assess their associations with undernutrition among children aged 6–23 months, as well as identify the common socioeconomic, maternal and individual characteristics associated with undernutrition in these children.

Methods

Data

This study used data from the fourth round of the National Family Health Survey (NFHS-4), i.e. the India Demographic and Health Survey (DHS), conducted in 2015–16. This used the two-stage stratified sampling method for sample selection. The heights and weights of children aged 0–59 months, women aged 15–49 years and men aged 15–54 years were measured (IIPS & ICF, 2017). The survey collected data for 259,627 children aged 0–59 months. However, this study was based on a total of 13,851 children aged 6–23 months, which is representative for the 124 aspirational districts. Five of the 124 aspirational districts were newly formed at the time of NFHS-4 and separate data were not available for these in the survey. Therefore, to make the data representative for these five districts as well, data from the districts from which these five were carved out were used as a proxy for the newly formed districts.

The sample selection criteria were as follows: youngest children living with a mother whose height and weight were measured, and the measurements were within plausible limits, i.e. if height, weight or age information were not provided, or the value was not missing but was not possible, as the *z*-scores are sensitive to changes in age. A flow chart showing sample selection is presented in Figure 1.

Dependent variables

Three anthropometric indicators, i.e. stunting (height-for-age), wasting (weight-for-height) and underweight (weight-for-age), were used to assess the undernutrition status of children aged 6–23 months (Agho *et al*., 2019). Stunting and wasting are measures of chronic and acute nutritional deficiencies, respectively, and underweight refers to the composite measure of both acute and chronic statuses. In DHS surveys, these indicators are evaluated using WHO child growth standards, which are expressed in standard deviations (SD or *Z*-scores) from the mean of the standard population (WHO, 2019). For this study, child's level of undernutrition was considered as the outcome variable. The levels had four ordinal categories: well-nourished (>−1SD), mildly

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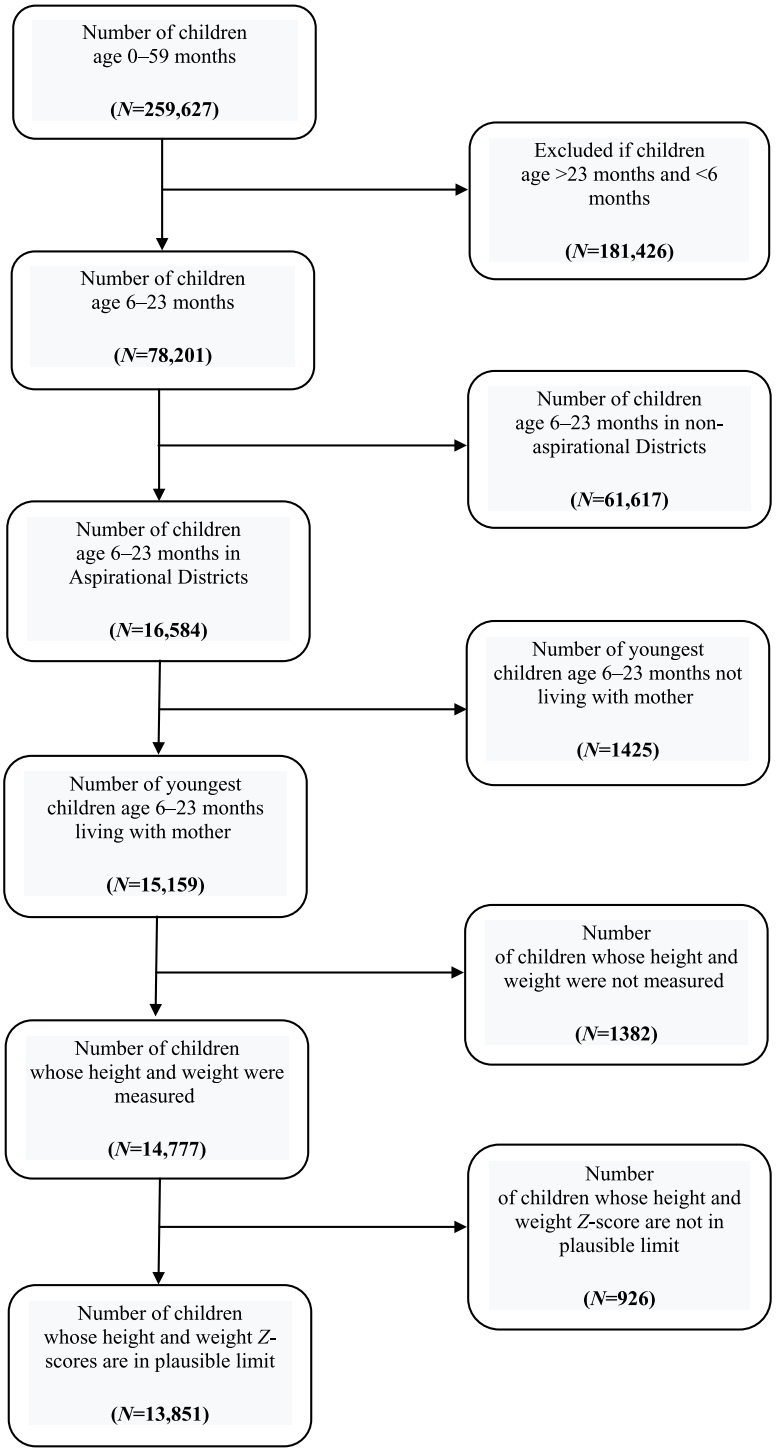

Figure 1. Flow chart showing the selection of the study sample.

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undernourished (–2SD to –1SD), moderately undernourished (–3SD to –2SD) and severely undernourished (less than –3SD). For instance, for wasting, a child is said to be well-nourished if his/her weight-for-height *Z*-score is above –1SD from the median of the reference population of the WHO child growth standard. Similarly, if a child with a weight-for-height *Z*-score is in the interval –2SD to –1SD, –3SD to –2SD or less than –3SD, the child is classified as mildly, moderately or severely wasted, respectively (WHO, 2009).

Independent variables

The WHO and United Nations Children's Fund (UNICEF) have built up a worldwide technique for assessing IYCF practices (Reinbott *et al*., 2015). In this study, five IYCF indicators were used as independent variables: continuing breastfeeding, appropriate breastfeeding, MDD, MMF and MAD. The WHO definitions were used, as follows:

Continuing breastfeeding: a child was 'continuing breastfeeding' if he/she was still breastfed.

Appropriate breastfeeding: a child was 'appropriately breastfed' if he/she received breast milk and solid, semi-solid or soft foods on the day before the interview (WHO, 2009).

Minimum dietary diversity (MDD): a child achieved minimum dietary diversity if he/she received food from four or more food of the following groups on the day before the interview: (i) infant formula, milk other than breast milk, cheese or yogurt or other milk products; (ii) grains or roots, including porridge or gruel and fortified baby food; (iii) vitamin A-rich fruit and vegetables; (iv) other fruit and vegetables; (v) eggs; (vi) meat, poultry, fish, shellfish or organ meats; (vii) beans, peas, lentils or nuts; and (viii) foods made with oil, fat, ghee or butter (WHO, 2009).

Minimum meal frequency (MMF): a child had the 'minimum meal frequency' if he/she received solid, semi-solid or soft foods (also including milk feeds for non-breast children) a minimum number of times on the day before the interview. For breastfeeding children, this was receiving solid or semi-solid food at least twice a day for infants aged 6–8 months and at least three times a day for children aged 9–23 months. For non-breastfeeding children this was receiving solid or semi-solid food or milk feeds at least four times a day (WHO, 2009).

Minimum acceptable diet (MAD): a child had a 'minimum acceptable diet' if he/she had both MDD and MMF, i.e. had MDD and MMF the day before the interview. For non-breastfed children, this was those who received other milk or milk products at least twice a day and had at least MDD and MMF during the previous day (WHO, 2009).

Child, mother and household characteristics were included as covariates. The child characteristics included age, sex (male and female), birth order (1, 2, 3 and 4+), perceived size at birth (average, smaller than average and larger than average) and having diarrhoea or fever in the 2 weeks preceding the survey. Maternal characteristics included age at child birth, educational level (no education/primary/secondary/higher) and nutritional status (healthy weight/thin/overweight, based on BMI). Household characteristics included place of residence (rural/urban) and social group (Scheduled Caste [SC], Scheduled Tribe [ST], Other Backward Caste [OBC] and non-SC/ST/OBC.

Statistical analysis

The descriptive characteristics of the respondents and their IYCF practices and prevalence and severity levels of undernutrition were described employing national sampling weights. The association of IYCF practices and the severity level of undernutrition were assessed using multinomial logistic regression analysis adjusting for child, maternal and household's socioeconomic characteristics. Multicollinearity was tested for among the IYCF practice variables, as well as the covariates. One of two variables was considered if a high correlation was found between them. Furthermore, the 'stepwise backward elimination method' (Harrell, 2015) was used to retain all the significant factors from both IYCF practice indicators and covariates. After completing

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the backward elimination procedure, only factors that were significantly associated with any of the undernutrition levels were retained. Stata/SE software version 12.0 was used for all statistical analyses. The multinomial logistic regression model results are presented as adjusted odds ratios (AOR) with 95% confidence intervals to determine the factors associated with undernutrition among 6–23 months children in aspirational districts of India.

Results

Characteristics of sample

The study sample included 13,851 children aged 6–23 months. Their characteristics, and those of their mothers and households, are shown in Table 1. Children were segregated into the three age groups 6–11, 12–17 and 18–23 months, with shares of 34.40%, 33.51% and 32.1%, respectively; 51.3% were male and 48.7% were female. About 68% of the children were of average perceived birth size, and 34.8% were of 3 or higher birth order. Only 13.9% had a preceding birth interval of 4 years or more, and 34.2% were first-born children. The prevalences of fever and diarrhoea in the last 2 weeks preceding the survey were 14.8% and 17.9%, respectively.

Nearly half (46.2%) of the mothers were aged 20–24 years at the time of their youngest child's birth; 39.4% had no formal education, and only 7% had a higher educational level; nearly 15.2% were working mothers; 36.2% were thin (BMI$<$18.5 kg/m^2); and about 59.4% had mass media exposure, i.e. to radio, newspapers or magazines and television.

The household characteristics indicated that 14.6% of the children were living in urban areas of India's aspirational districts. About 36.6% were from marginalized communities, i.e. from SC or ST communities, and more than three-quarters (77.3%) were from Hindu households. Nearly 88.9% of households had access to improved drinking water facilities; 68.2% had an unimproved sanitation facility and 5.7% had an improved sanitation facility but shared this with other households. Less than two-fifths (16.5%) of the children were living in households using clean cooking fuel. More than two-fifths (42.7%) were from the poorest wealth quintile.

Prevalence of mild, moderate and severe undernutrition

Table 2 shows the prevalences of different severities of stunting, wasting and underweight by IYCF practices among the sample children. The prevalences of all three forms of undernutrition were markedly higher among children in aspirational districts than non-aspirational districts (Figure 2), and the relative differences were significantly greater for moderate and severe levels of undernutrition. They were also higher among the children who were continuously and appropriately breastfed. Compared with children who had achieved MDD, MMF and MAD, the prevalences of wasting and underweight were higher among those who had not achieved MDD, MMF and MAD. However, for stunting, the prevalence was higher for children who had achieved these. Overall, the relative differences in the prevalences of stunting, wasting and underweight between children who had and those who had not achieved MDD, MMF and MAD were markedly greater the higher the severity level.

Factor associated with stunting

Table 3 summarizes the adjusted odds ratios (AORs) for the association between the predictor variables and mild, moderate and severe stunting. Children who continued breastfeeding were more likely to be mildly, moderately or severely stunted than those who were not. However, the odds of being severely stunted among the appropriately breastfed children were 20% lower than among those who were not appropriately breastfed (AOR=0.8; 95% CI: 0.685–0.933). Children who achieved MDD (at least four food groups) were significantly less likely to be severely

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Table 1. Percentage distribution of children aged 6–23 months by selected individual, maternal and household covariates, 2015–16, *N*=13,851

Child specific		Maternal		Household	
Characteristic	*n* (%)	Characteristic	*n* (%)	Characteristic	*n* (%)
Age group (months)		Age at child's birth (years)		Place of residence	
6–11	4763 (34.4)	<20/teenager	1829 (14.51)	Urban	2083 (14.56)
12–17	4708 (33.51)	20–24	6158 (46.2)	Rural	11,768 (85.44)
18–23	4380 (32.1)	25–29	3837 (26.35)	Social group	
Sex		≥30+	2027 (12.94)	SC	2479 (20.38)
Male	7090 (51.3)	Highest educational level		ST	3355 (16.25)
Female	6761 (48.7)	No education	5398 (39.38)	OBC	5574 (45.57)
Birth order		Primary	2053 (14.44)	Non-SC/ST/ OBC	2443 (17.8)
1	4678 (33.99)	Secondary	5470 (39.17)	Religion	
2	4182 (31.16)	Higher	930 (7.01)	Hindu	10,169 (77.31)
3	2467 (17.53)	Marital status		Muslim	2388 (17.96)
4+	2524 (17.32)	Married/living with partner	13,715 (99.14)	Christian	778 (1.64)
Size at birth		Divorced/widowed/separated	136 (0.86)	Other[a]	516 (3.09)
Average	9443 (68.08)	Working status		Source of drinking water	
Smaller than average	1693 (12.61)	Not working	1997 (84.83)	Unimproved	1898 (11.08)
Larger than average	2446 (19.32)	Working	384 (15.17)	Improved	11,216 (88.92)
Preceding birth interval of child		Health & nutrition education received during pregnancy/breastfeeding		Sanitation facility	
First born	4708 (34.21)	None	7729 (56.03)	Unimproved	8626 (68.24)
<2 years	2228 (17.04)	Only during pregnancy	995 (7.45)	Shared improved facility	776 (5.72)
2–4 years	4811 (34.82)	Only during breastfeeding	466 (3.47)	Not shared improved facility	3734 (26.04)
≥4 years	2104 (13.93)	During both pregnancy and breastfeeding	4661 (33.05)	Cooking fuel	
Diarrhoea in 2 weeks before survey		Mass media exposure		Solid	11,656 (83.47)
No	11,919 (85.17)	Not exposed	5547 (40.6)	Clean	2195 (16.53)
Yes	1918 (14.83)	Exposed	8304 (59.4)	Wealth index	
Fever in 2 weeks before survey		BMI status		Poorest	5741 (42.66)
No	11,419 (82.12)	Healthy weight	8121 (57.44)	Poorer	3460 (24.91)
Yes	2420 (17.88)	Thin	4772 (36.24)	Middle	2271 (15.86)
		Overweight	912 (6.33)	Richer	1460 (10.1)
				Richest	919 (6.47)

[a]Other includes Sikh, Buddhist/Neo-Buddhist and Jain.Source: authors' estimation using NFHS 2015–16 data.

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Table 2. Prevalence of undernutrition among children aged 6–23 months in aspirational districts by IYCF practices, India, 2015–16

	Stunting (height-for-age)			Wasting (weight-for-height)			Underweight (weight-for-age)		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
Currently breastfeeding									
No	22.98	20.78	17.87	26.29	15.32	6.37	30.99	22.58	10.65
	[20.84, 25.13]	[18.71, 22.85]	[15.92, 19.82]	[24.05, 28.54]	[13.49, 17.16]	[5.12, 7.61]	[28.63, 33.35]	[20.44, 24.71]	[9.08, 12.22]
Yes	23.29	21.71	19.81	29.23	17.57	10.17	32.09	26.63	13.98
	[22.55, 24.04]	[20.99, 22.44]	[19.11, 20.51]	[28.43, 30.03]	[16.9, 18.24]	[9.64, 10.7]	[31.27, 32.91]	[25.85, 27.41]	[13.37, 14.59]
Appropriately breastfed									
No	22.93	19.24	18.44	26.75	17.12	10.44	31.86	24.81	12.86
	[21.7, 24.17]	[18.08, 20.4]	[17.3, 19.58]	[25.45, 28.05]	[16.02, 18.23]	[9.54, 11.33]	[30.49, 33.23]	[23.54, 26.08]	[11.88, 13.85]
Yes	23.42	22.8	20.17	29.98	17.42	9.4	32.02	26.86	13.98
	[22.56, 24.28]	[21.95, 23.64]	[19.36, 20.98]	[29.05, 30.9]	[16.65, 18.18]	[8.81, 9.99]	[31.08, 32.97]	[25.97, 27.76]	[13.28, 14.68]
Received MDD									
No	23.28	21.28	19.94	28.73	17.37	10.35	31.46	26.96	14.00
	[22.5, 24.07]	[20.52, 22.03]	[19.2, 20.68]	[27.89, 29.56]	[16.67, 18.07]	[9.78, 10.91]	[30.6, 32.32]	[26.14, 27.78]	[13.36, 14.64]
Yes	23.14	23.06	18.08	29.67	17.08	7.15	34.18	22.78	11.91
	[21.53, 24.75]	[21.45, 24.66]	[16.61, 19.55]	[27.93, 31.42]	[15.65, 18.52]	[6.16, 8.13]	[32.37, 35.99]	[21.18, 24.38]	[10.68, 13.15]
Received MMF									
No	23.26	21.15	19.98	28.90	17.61	10.17	31.56	26.20	14.40
	[22.38, 24.15]	[20.29, 22.01]	[19.14, 20.82]	[27.95, 29.85]	[16.81, 18.41]	[9.53, 10.8]	[30.59, 32.54]	[25.28, 27.13]	[13.66, 15.14]
Yes	23.25	22.43	18.91	28.91	16.80	9.00	32.69	26.14	12.20
	[22.09, 24.4]	[21.29, 23.57]	[17.84, 19.98]	[27.67, 30.15]	[15.78, 17.82]	[8.22, 9.78]	[31.41, 33.97]	[24.94, 27.34]	[11.3, 13.09]
Received MAD									
No	23.45	21.32	19.64	28.88	17.46	9.96	31.72	26.33	13.85
	[22.71, 24.19]	[20.61, 22.03]	[18.95, 20.33]	[28.09, 29.67]	[16.8, 18.12]	[9.44, 10.48]	[22.71, 24.19]	[20.61, 22.03]	[18.95, 20.33]
Yes	21.24	24.66	19.11	29.11	15.84	7.49	34.58	24.60	11.09
	[18.93, 23.55]	[22.23, 27.09]	[16.9, 21.33]	[26.55, 31.67]	[13.78, 17.89]	[6.01, 8.97]	[18.93, 23.55]	[22.23, 27.09]	[16.9, 21.33]

Figures in brackets are 95% confidence intervals.
Source: authors' estimation using NFHS 2015–16 data.

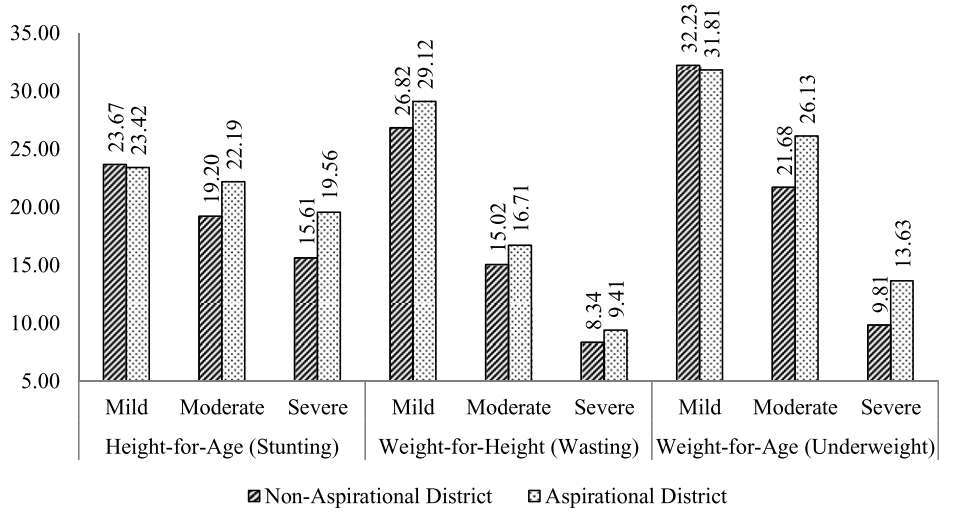

Figure 2. Prevalence of undernutrition by severity among children aged 6–23 months in aspirational and non-aspirational districts of India, 2015–16.

stunted compared with children who did not achieve MDD (AOR=0.784; 95% CI: 0.672–0.915). However, none of the levels of stunting was associated with MMF or MAD.

Higher age groups and higher birth orders were both significantly associated with higher odds of moderate or severe stunting. Female children were 33% less likely to be stunted compared with their male counterparts (AOR=0.674; 95% CI: 0.602–0.755). Children who were smaller than average at birth had significantly higher odds of being moderately or severely stunted than children of normal or larger size at birth. Mother's age and educational level were significantly positively associated with moderate and severe stunting in their children, i.e. with an increase in mother's age or educational level, the odds of moderate or severe stunting among their children decreased. Children whose mothers were thin had higher odds of being stunted for all three severity levels. Children of the SC community were more likely to be moderately or severely stunted than children of other communities, followed by ST children. Children born in a household practising Islam had higher odds of being moderately (AOR=1.206; 95% CI: 1.033–1.409) or severely stunted (AOR=1.298; 95% CI: 1.103–1.528) compared with other religions. Children living in households with unimproved sanitation facilities had higher odds of being severely stunted. Children who belonged to the richest households were 47% (AOR=0.368, 95% CI: 0.33–0.41) less likely to be moderately stunted compared with children of the poorest households. The odds of being severely stunted decreased with a shift in wealth quintile from a lower to a higher one.

Factor associated with wasting

Table 4 indicates that children who were continuing breastfeeding had significantly higher odds of moderate or severe wasting than children who had discontinued breastfeeding. However, children who were appropriately breastfed were 25% less likely (AOR=0.747; 95% CI: 0.628–0.888) to be severely wasted compared with children who were not appropriately breastfed. No associations were established between wasting and other IYCF indicators, i.e. MDD, MMF and MAD. Children aged 18–23 months had lower odds (AOR=0.841; 95% CI: 0.728–0.972) of being moderately wasted compared with children aged 6–11 months. Female children were significantly less likely to be severely wasted compared with their male counterparts. Children with birth order 4 or higher and of smaller size at birth had significantly higher odds of severe wasting. Having

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Table 3. Multinomial logistic regression analysis showing factors associated with mild, moderate and severe stunting among children aged 6–23 months in aspirational districts of India, 2015–16

	Mild stunting AOR [95% CI]	Moderate stunting AOR [95% CI]	Severe stunting AOR [95% CI]
IYCF practices			
Currently breastfeeding			
No (Ref.)			
Yes	1.232* [1.019, 1.490]	1.260* [1.031, 1.540]	1.491*** [1.210, 1.838]
Appropriately breastfed			
No (Ref.)			
Yes	0.933 [0.814, 1.071]	0.964 [0.831, 1.118]	0.800** [0.685, 0.933]
Received MDD			
No (Ref.)			
Yes	0.892 [0.777, 1.025]	0.924 [0.802, 1.065]	0.784** [0.672, 0.915]
Child characteristics			
Age (months)			
6–11 (Ref.)			
12–17	1.715*** [1.509, 1.949]	2.247*** [1.954, 2.583]	2.743*** [2.352, 3.198]
18–23	2.202*** [1.916, 2.532]	3.878*** [3.348, 4.491]	6.078*** [5.190, 7.119]
Sex			
Male (Ref.)			
Female	0.929 [0.838, 1.029]	0.965 [0.867, 1.074]	0.674*** [0.602, 0.755]
Birth order			
1 (Ref.)			
2	1.111 [0.972, 1.269]	1.096 [0.949, 1.267]	1.107 [0.949, 1.293]
3	1.151 [0.968, 1.368]	1.353*** [1.131, 1.619]	1.339** [1.107, 1.619]
4+	1.093 [0.891, 1.341]	1.419** [1.151, 1.749]	1.501*** [1.207, 1.865]
Size at birth			
Average (Ref.)			
Smaller than average	0.98 [0.829, 1.158]	1.342*** [1.141, 1.579]	1.442*** [1.218, 1.708]
Larger than average	0.821** [0.720, 0.937]	0.830** [0.722, 0.954]	0.871 [0.751, 1.009]
Maternal characteristics			
Age child's birth (years)			
<20/teenager (Ref.)			
20–24	0.841* [0.713, 0.993]	0.785** [0.661, 0.933]	0.85 [0.706, 1.023]
25–29	0.816* [0.670, 0.995]	0.702*** [0.571, 0.864]	0.710** [0.569, 0.887]
30+	0.812 [0.637, 1.034]	0.689** [0.535, 0.886]	0.714* [0.548, 0.931]

(*Continued*)

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Table 3. (*Continued*)

	Mild stunting AOR [95% CI]	Moderate stunting AOR [95% CI]	Severe stunting AOR [95% CI]
Educational level			
No education (Ref.)			
Primary	0.852 [0.720, 1.007]	0.891 [0.755, 1.052]	0.715*** [0.600, 0.852]
Secondary	0.931 [0.811, 1.070]	0.789** [0.684, 0.910]	0.666*** [0.573, 0.773]
Higher	0.86 [0.671, 1.101]	0.693* [0.519, 0.925]	0.555*** [0.397, 0.776]
Nutritional status			
Healthy weight (Ref.)			
Thin	1.248*** [1.115, 1.395]	1.349*** [1.202, 1.513]	1.321*** [1.171, 1.490]
Overweight	0.792* [0.640, 0.979]	0.818 [0.643, 1.040]	0.645** [0.484, 0.860]
Household characteristics			
Social group			
SC (Ref.)			
ST	0.972 [0.814, 1.161]	0.779** [0.650, 0.934]	0.837 [0.694, 1.009]
OBC	0.914 [0.791, 1.055]	0.769*** [0.665, 0.889]	0.771*** [0.662, 0.898]
Non-SC/ST/OBC	0.794* [0.663, 0.952]	0.631*** [0.522, 0.764]	0.634*** [0.517, 0.778]
Religion			
Hindu (Ref.)			
Muslim	1.11 [0.957, 1.288]	1.206* [1.033, 1.409]	1.298** [1.103, 1.528]
Christian	1.266 [0.847, 1.893]	1.152 [0.745, 1.782]	0.944 [0.577, 1.544]
Other[a]	1.051 [0.778, 1.420]	0.988 [0.711, 1.373]	1.233 [0.885, 1.717]
Source of drinking water			
Unimproved (Ref.)			
Improved	1.066 [0.905, 1.257]	1.161 [0.977, 1.380]	1.242* [1.034, 1.491]
Sanitation facility			
Unimproved (Ref.)			
Improved – Shared	1.469*** [1.169, 1.845]	1.098 [0.858, 1.406]	0.937 [0.707, 1.241]
Improved – Not shared	0.987 [0.846, 1.152]	0.768** [0.651, 0.905]	0.740** [0.617, 0.888]
Cooking fuel			
Solid (Ref.)			
Clean	0.774** [0.644, 0.931]	0.858 [0.702, 1.049]	0.963 [0.767, 1.208]
Wealth index			
Poorest (Ref.)			
Poorer	0.984 [0.854, 1.133]	1.049 [0.910, 1.209]	0.772*** [0.665, 0.897]
Middle	0.873 [0.731, 1.043]	0.917 [0.763, 1.103]	0.611*** [0.499, 0.748]
Richer	0.954 [0.746, 1.220]	0.793 [0.604, 1.040]	0.477*** [0.350, 0.650]
Richest	0.952 [0.694, 1.306]	0.533** [0.364, 0.780]	0.389*** [0.254, 0.597]

Figures in brackets are 95% confidence intervals; *$p<0.05$; **$p<0.01$; ***$p<0.001$.
[a]Other includes Sikh, Buddhist/Neo-Buddhist and Jain.
Source: authors' estimation using NFHS 2015–16 data.

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Table 4. Multinomial logistic regression analysis showing factors associated with mild, moderate and severe wasting among children aged 6–23 months in aspirational districts of India, 2015–16

	Mild wasting AOR [95% CI]	Moderate wasting AOR [95% CI]	Severe wasting AOR [95% CI]
IYCF practices			
Currently breastfeeding			
No (Ref.)			
Yes	1.151 [0.972, 1.364]	1.264* [1.029, 1.552]	1.915*** [1.468, 2.499]
Appropriately breastfed			
No (Ref.)			
Yes	1.03 [0.907, 1.169]	0.961 [0.830, 1.114]	0.747*** [0.628, 0.888]
Received MDD			
No (Ref.)			
Yes	1.037 [0.918, 1.171]	1.148 [0.992, 1.329]	0.837 [0.684, 1.025]
Child characteristics			
Age (months)			
6–11 (Ref.)			
12–17	1.091 [0.968, 1.229]	0.99 [0.862, 1.138]	1.078 [0.909, 1.278]
18–23	1.127 [0.999, 1.272]	0.841* [0.728, 0.972]	0.842 [0.701, 1.012]
Sex			
Male (Ref.)			
Female	0.986 [0.900, 1.080]	0.91 [0.815, 1.015]	0.825** [0.719, 0.946]
Birth order			
1 (Ref.)			
2	1.082 [0.959, 1.221]	0.89 [0.769, 1.030]	0.912 [0.755, 1.101]
3	1.184* [1.018, 1.376]	0.968 [0.808, 1.159]	1.081 [0.860, 1.358]
4+	1.330** [1.114, 1.586]	1.091 [0.888, 1.341]	1.603*** [1.246, 2.063]
Size at birth			
Average (Ref.)			
Smaller than average	1.058 [0.918, 1.219]	1.229* [1.044, 1.448]	1.325** [1.086, 1.618]
Larger than average	0.922 [0.818, 1.038]	1.007 [0.874, 1.160]	0.967 [0.808, 1.157]
Diarrhoea in 2 weeks before survey			
No (Ref.)			
Yes	1.319*** [1.153, 1.509]	1.310*** [1.119, 1.534]	1.348** [1.108, 1.640]
Fever in 2 weeks before survey			
No (Ref.)			
Yes	1.045 [0.922, 1.185]	1.161* [1.003, 1.344]	0.951 [0.786, 1.150]

(*Continued*)

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Table 4. (*Continued*)

	Mild wasting AOR [95% CI]	Moderate wasting AOR [95% CI]	Severe wasting AOR [95% CI]
Maternal characteristics			
Age at child's birth			
<20/teenager (Ref.)			
20–24	1.004 [0.867, 1.163]	1.125 [0.940, 1.346]	0.985 [0.788, 1.233]
25–29	0.918 [0.771, 1.094]	1.240* [1.004, 1.532]	1.033 [0.792, 1.347]
30+	0.865 [0.698, 1.071]	1.251 [0.972, 1.610]	0.92 [0.672, 1.261]
Nutritional status			
Healthy weight (Ref.)			
Thin	1.362*** [1.234, 1.503]	1.583*** [1.411, 1.777]	1.531*** [1.327, 1.768]
Overweight	0.825 [0.676, 1.007]	0.727* [0.558, 0.946]	0.749 [0.533, 1.052]
Household characteristics			
Social group			
SC (Ref.)			
ST	1.046 [0.895, 1.222]	1.268** [1.059, 1.518]	1.517*** [1.222, 1.884]
OBC	0.935 [0.827, 1.058]	1.001 [0.863, 1.162]	0.966 [0.801, 1.166]
Non-SC/ST/OBC	0.807** [0.688, 0.948]	0.932 [0.767, 1.134]	0.915 [0.713, 1.174]
Religion			
Hindu (Ref.)			
Muslim	0.851* [0.747, 0.969]	0.806** [0.687, 0.946]	0.761** [0.619, 0.935]
Christian	0.541** [0.364, 0.803]	0.601* [0.382, 0.944]	0.612 [0.354, 1.059]
Other[a]	0.788 [0.588, 1.056]	1.21 [0.891, 1.642]	1.294 [0.903, 1.854]
Sanitation facility			
Unimproved (Ref.)			
Improved – Shared	1.019 [0.829, 1.253]	0.837 [0.645, 1.088]	0.858 [0.610, 1.207]
Improved – Not shared	0.94 [0.818, 1.079]	0.660*** [0.552, 0.789]	0.789* [0.631, 0.986]
Wealth index			
Poorest (Ref.)			
Poorer	0.862* [0.765, 0.972]	0.734*** [0.637, 0.846]	0.680*** [0.568, 0.815]
Middle	0.943 [0.813, 1.093]	0.770** [0.642, 0.924]	0.745* [0.591, 0.939]
Richer	0.819* [0.674, 0.996]	0.778* [0.609, 0.995]	0.805 [0.593, 1.094]
Richest	0.713** [0.555, 0.916]	0.88 [0.648, 1.194]	0.884 [0.600, 1.302]

Figures in brackets are 95% confidence intervals; *$p<0.05$; **$p<0.01$; ***$p<0.001$.
[a]Other includes Sikh, Buddhist/Neo-Buddhist and Jain.
Source: authors' estimation using NFHS 2015–16 data.

diarrhoea in the last 2 weeks preceding the survey was associated with significantly higher odds of mild, moderate and severe wasting. However, having fever was statistically significantly associated with higher odds of moderate wasting only. Compared with children of well-nourished and

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overweight mothers, children of thin mothers were more likely to be moderately or severely wasted. Scheduled Tribe children had higher odds of being moderately or severely wasted than children of other social groups. Non-SC/ST/OBC children had lower odds of being mildly, moderately or severely wasted; however, no statistically significant association was established. Children living in households practising Hinduism were more likely to be moderately wasted compared with children of households practising other religions. Having improved sanitation facilities that was not shared with other households lowered the odds of moderate and severe wasting among the children by 34% (AOR=0.841; 95% CI: 0.728–0.972) and 21% (AOR=0.789; 95% CI: 0.631–0.986), respectively. Children from the poorest households were more susceptible to all the three severity levels of wasting than children of other wealth quintile households.

Factor associated with being underweight

Table 5 indicates children who continued to be breastfed were more likely to be mildly, moderately or severely underweight compared with children who had discontinued breastfeeding. However, children who were appropriately breastfed were 18% less likely (AOR=0.817; 95% CI: 0.682–0.979) to be severely underweight compared with those who were not appropriately breastfed. Children who achieved the MDD were less likely to be moderately underweight (AOR=0.819, 95% CI: 0.708–0.949)

Higher age group and male sex were significant predictors of moderate or severe underweight among the children aged 6–23 months. The odds of moderate and severe underweight among female children were 22% (AOR=0.782; 95% CI: 0.702–0.871) and 25% (AOR=0.749; 95% CI: 0.656–0.856), respectively, less than those of their male counterparts. Children born at higher birth order had significantly higher odds of being mildly or severely underweight than children of lower birth order. In the 2 weeks preceding the survey, children who had diarrhoea were 39% (AOR=1.393; 95% CI: 1.196–1.622) and 36% (AOR=1.366; 95% CI: 1.136–1.643) more likely to be moderately and severely underweight, respectively, compared with children who did not. The odds of mild, moderate and severe underweight were significantly higher among the children born to adolescents, and lower for the children born to women aged 30+ years. The higher the educational level of the mother, the lower the odds of their child being moderately or severely underweight. The odds of being severely underweight were 38% (AOR=0.618, 95% CI: 0.41–0.932) lower among children born to women with a higher educational level than among children born to women with no education.

Children residing in rural areas were statistically significantly less susceptible to moderate underweight (AOR=0.778, 95% CI: 0.655–0.924). Children belonging to non-SC/ST/OBC communities were significantly less likely to be underweight compared with children of other communities. Children living in households practising a religion other than Hinduism, Islam and Christianity had higher odds of being severely underweight. Children belonging to households with access to improved drinking water facilities had higher odds of being moderately underweight. The higher the wealth quintile, the lower the odds of being mildly, moderately or severely underweight. It is appalling that the odds of being severely underweight among the children living in the richest quintile households were 70% lower (AOR=0.298, 95% CI: 0.179–0.497) than for children living in the poorest quintile households.

Discussion

This study examined the prevalence of undernutrition among children aged 6–23 months in the aspirational districts of India, which are the poorest performing districts with relatively poor child nutritional status. In addition, it examined the factors associated with stunting, wasting and underweight by severity level, i.e. mild, moderate and severe, among these children, and by IYCF indicators at the child, maternal and household level.

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Table 5. Multinomial logistic regression showing factors associated with mild, moderate and severe underweight among children aged 6–23 months in aspirational districts of India, 2015–16

	Mild underweight AOR [95% CI]	Moderate underweight AOR [95% CI]	Severe underweight AOR [95% CI]
IYCF practices			
Currently breastfeeding			
No (Ref.)			
Yes	1.366*** [1.140, 1.638]	1.572*** [1.289, 1.916]	1.718*** [1.341, 2.201]
Appropriately breastfed			
No (Ref.)			
Yes	0.941 [0.821, 1.077]	0.886 [0.766, 1.025]	0.817* [0.682, 0.979]
Received MDD			
No (Ref.)			
Yes	1.029 [0.903, 1.173]	0.819** [0.708, 0.949]	0.858 [0.716, 1.028]
Child characteristics			
Age (months)			
6–11 (Ref.)			
12–17	1.132 [0.999, 1.283]	1.516*** [1.322, 1.740]	1.822*** [1.528, 2.174]
18–23	1.443*** [1.263, 1.647]	2.107*** [1.823, 2.434]	3.035*** [2.535, 3.635]
Sex			
Male (Ref.)			
Female	0.988 [0.895, 1.092]	0.782*** [0.702, 0.871]	0.749*** [0.656, 0.856]
Birth order			
1 (Ref.)			
2	1.174* [1.032, 1.336]	1.003 [0.870, 1.157]	1.036 [0.861, 1.248]
3	1.270** [1.075, 1.501]	1.154 [0.964, 1.382]	1.463*** [1.171, 1.828]
4+	1.413*** [1.155, 1.729]	1.574*** [1.275, 1.943]	2.140*** [1.659, 2.762]
Size at birth			
Average (Ref.)			
Smaller than average	1.067 [0.905, 1.258]	1.378*** [1.164, 1.632]	1.902*** [1.570, 2.304]
Larger than average	0.780*** [0.688, 0.885]	0.857* [0.748, 0.983]	0.844 [0.708, 1.006]
Diarrhoea in 2 weeks before survey			
No (Ref.)			
Yes	1.125 [0.972, 1.303]	1.393*** [1.196, 1.622]	1.366*** [1.136, 1.643]
Maternal characteristics			
Age at child's birth (years)			
<20/teenager (Ref.)			
20–24	0.845* [0.720, 0.993]	0.927 [0.778, 1.105]	0.83 [0.668, 1.030]
25–29	0.745** [0.616, 0.902]	0.876 [0.711, 1.079]	0.670** [0.516, 0.870]
30+	0.607*** [0.480, 0.769]	0.720* [0.559, 0.926]	0.587*** [0.432, 0.798]

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Table 5. (*Continued*)

	Mild underweight AOR [95% CI]	Moderate underweight AOR [95% CI]	Severe underweight AOR [95% CI]
Educational level			
No education (Ref.)			
Primary	1.034 [0.879, 1.216]	0.921 [0.778, 1.091]	0.665*** [0.538, 0.821]
Secondary	1.03 [0.900, 1.180]	0.786** [0.681, 0.908]	0.681*** [0.571, 0.812]
Higher	0.861 [0.680, 1.091]	0.602*** [0.454, 0.798]	0.618* [0.410, 0.932]
Nutritional status			
Healthy weight (Ref.)			
Thin	1.215*** [1.086, 1.360]	1.733*** [1.542, 1.948]	2.007*** [1.745, 2.308]
Overweight	0.763** [0.629, 0.925]	0.573*** [0.446, 0.736]	0.542** [0.370, 0.795]
Household characteristics			
Place of residence			
Urban (Ref.)			
Rural	1.026 [0.879, 1.198]	0.778** [0.655, 0.924]	0.831 [0.655, 1.055]
Social group			
SC (Ref.)			
ST	0.997 [0.834, 1.191]	1.029 [0.854, 1.239]	1.149 [0.931, 1.419]
OBC	0.956 [0.831, 1.099]	0.937 [0.808, 1.086]	0.722*** [0.605, 0.862]
Non-SC/ST/OBC	0.758** [0.638, 0.900]	0.718*** [0.594, 0.870]	0.583*** [0.456, 0.744]
Religion			
Hindu (Ref.)			
Muslim	1.074 [0.934, 1.236]	0.89 [0.762, 1.040]	0.921 [0.756, 1.123]
Christian	0.88 [0.592, 1.308]	0.886 [0.579, 1.358]	0.561 [0.314, 1.001]
Other[a]	1.306 [0.967, 1.764]	1.057 [0.752, 1.486]	1.494* [1.025, 2.178]
Source of drinking water			
Unimproved (Ref.)			
Improved	1.113 [0.948, 1.307]	1.271** [1.066, 1.515]	1.142 [0.928, 1.405]
Sanitation facility			
Unimproved (Ref.)			
Improved – Shared	1.01 [0.811, 1.258]	0.818 [0.636, 1.051]	0.736 [0.523, 1.036]
Improved – Not shared	0.768*** [0.663, 0.888]	0.672*** [0.570, 0.791]	0.581*** [0.465, 0.727]
Wealth index			
Poorest (Ref.)			
Poorer	0.969 [0.845, 1.113]	0.804** [0.696, 0.930]	0.645*** [0.541, 0.768]
Middle	0.874 [0.740, 1.034]	0.694*** [0.578, 0.832]	0.488*** [0.384, 0.620]
Richer	0.782* [0.630, 0.970]	0.592*** [0.464, 0.756]	0.358*** [0.251, 0.511]
Richest	0.648** [0.491, 0.855]	0.446*** [0.320, 0.622]	0.298*** [0.179, 0.497]

Figures in brackets are 95% confidence intervals; *$p<0.05$; **$p<0.01$; ***$p<0.001$.
[a]Other includes Sikh, Buddhist/Neo-Buddhist and Jain.
Source: authors' estimation using NFHS 2015–16 data.

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According to UNICEF (2019), globally, 820,000 children's lives could be saved each year by breastfeeding. The present study observed that, while the current breastfeeding status of children aged 6–23 months (children who continued breastfeeding) was significantly associated with higher odds of being undernourished (stunted, wasted or underweight), being 'appropriately breastfed' was significantly associated with lower odds of being severely undernourished. This may be because a child's 'current breastfeeding status' does not capture any complementary feeding practices, whereas 'appropriate breastfeeding' does. Physiological and pathological factors, such as rapid growth, limited gastric capacity and frequent exposure to pathogens, significantly raise the nutritional requirements of children under the age of 2 years (Sanin *et al*., 2018). To meet these evolving nutritional requirements, infants and young children are recommended to continue breastfeeding as well as receive adequate and safe complementary foods for up to at least 2 years (Davalgi & Vidya, 2015).

The present study found that, in the aspirational districts of India, about a quarter (22.6%) of children 6–23 aged months who continued to be breastfed were not receiving any complementary food. It also found that children receiving the recommended MDD had significantly higher odds of severe stunting and moderate underweight. This finding is inconsistent with studies conducted in Sri Lanka (Perkins *et al*., 2018) and Bangladesh (Zongrone *et al*., 2012), which found that none of the three anthropometric indicators was associated with achieving MDD among children aged 6–23 months, and that achieving MDD was associated with higher odds of being stunted among children aged 0–23 months.

The present study did not find any association between having a MMF and the nutritional status of children, and this is consistent with a cross-country analysis carried out in fourteen countries which suggested there was no relationship between MMF and stunting (Marriott *et al*., 2012). In contrast, Aguayo *et al.* (2016), in their study in India, found a significant association between MMF and stunting. Unlike Marriott *et al*., (2012), this study did not find any significant association between MAD and the three anthropometric indices. The possible reason for the differences (lower odds and higher odds) in the association of IYCF practices with the anthropometric indicators found in this study is that the NFHS survey collected information on the feeding practices based on a 24-hour recall period and assumed it to be the common dietary pattern of the case/child. However, food consumption patterns vary day by day; hence, they might not represent all children (Mya *et al*., 2019).

This study observed that older children in the age group 6–23 months had higher odds of being undernourished than their younger counterparts. It was also notable that the odds of being moderately or severely stunted or underweight were markedly higher among the older children than their younger peers (see Tables 3 and 5). For instance, children aged 12–17 months and 18–23 months had 2.7- and 6.1-times higher odds of being severely stunted, respectively. This may result from the more frequent exposure of older children to their surroundings, which can increase the likelihood of catching infections and exposure to childhood diseases, either through the consumption of unsafe drinking water, contaminated foods or inadequate sanitation facilities (Akombi *et al*., 2017). Inadequate feeding practices may also be regarded as a significant reason for the differences in odds of being stunted or underweight between younger and older children. Another possible reason may be that, even though children were fed diversified foods, these might have met the nutritional requirements of younger children but not those of older children, because after 6 months, children grow rapidly and their nutritional requirements increase.

Female children had significantly lower odds of being severely undernourished (stunted, wasted or underweight) compared with their male counterparts. This finding has been corroborated by cross-sectional studies in Nigeria (Akombi *et al*., 2017), Iran (Kavosi *et al*., 2014) and Indonesia (Ramli *et al.,* 2009). However, this finding is inconsistent with the findings of some other studies, such as that conducted in Uttar Pradesh State, India, by Singh *et al.* (2016), and Bain *et al.* (2013)'s review of sub-Saharan Africa, which suggested that undernutrition was more likely in female than male children.

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Child's birth order and perceived size at birth were also found to be significant predictors of the nutritional status of children aged 6–23 months. Birth order of 4 and above and smaller size at birth were significantly associated with higher odds of being moderately or severely undernourished (stunted, wasted and underweight). Having fever in the 2 weeks preceding the survey was only significantly associated with higher odds of moderate wasting. Meanwhile, having diarrhoea in the 2 weeks preceding the survey was significantly associated with higher odds of moderate and severe wasting, and underweight, but no association was observed for stunting. This finding may be attributed to the fact that diarrhoea reduces appetite, increases catabolism, impairs intestinal absorption and directs essential nutrients away from growth and towards an immune response, which leads to growth failure or weight loss among children (Black *et al.*, 2013).

Mother's age at the child's birth was a significant predictor for undernutrition among children aged 6–23 months. Children born to teenage mothers were at higher risk of being undernourished. The odds of being stunted were higher for children born to mothers in the lower age groups. A study in urban Bangladesh also found a significant association between mother's age at a child's birth and the child's nutritional status (Ahsan *et al.*, 2017). Mother's educational level is a significant determinant of the nutritional status of children. The lower the educational level of the mother, the higher the odds of their child being undernourished. This can be attributed to the fact that, compared with mothers with no formal education and lower educational levels, mothers with higher educational levels may have a better understanding of nutrition, and may have a better chance of being exposed to nutrition-related education through mass media, books, leaflets and magazines (Yeshalem *et al.*, 2017). This finding coincides with a study in the Philippines (Rohner *et al.*, 2013).

Household characteristics play a vital role in determining a child's nutritional status. In this study, the results indicated that severe undernutrition was higher among children in rural areas. However, the multinomial logistic regression analysis showed that those living in rural areas had lower odds of being moderately underweight than their urban counterparts. This result is contrary to the findings of a cross-sectional study carried out in Pakistan (Tariq *et al.*, 2018). Unlike other studies in Myanmar (Mya *et al.*, 2019) and in Pakistan (Tariq *et al.*, 2018), this study did not find any association between place of residence and stunting and underweight among children. While wasting and underweight were more prevalent among ST children, stunting was more prevalent among SC children. The odds of being moderately stunted were significantly higher for children of the SC community than other children, and the odds of being moderately or severely wasted were higher for children belonging to ST households. This finding is consistent with those of Meshram *et al.* (2018), i.e. that SC and ST children are more susceptible to undernutrition.

Children belonging to households practising the Islam religion had higher odds of being moderately or severely stunted. Meanwhile, children from Hindu households were more likely to be wasted than children of households practising religions other than Hinduism. This may be attributed to the diversity in feeding practices across religions. Furthermore, the sample size for households practising Christianity or other religions was far too small (Table 1) and may have been inadequate for representing the respective populations. Like a study in Ghana (Miah *et al.*, 2016), this study also found a significant association between religion and undernutrition among children. In India, the death of 19 in every 100,000 population has been attributed to unsafe water and poor sanitation and hygiene services (UNDP, 2020). Contrary to the findings of Victora *et al.* (2010), the findings of this study suggest a significant association between an improved sanitation facility and children's nutritional outcome. Children living in households accessing improved sanitation facilities that were not shared with other households were significantly less likely to be moderately or severely undernourished (stunted, wasted and underweight). However, if a child was living in a household with improved sanitation facilities shared with other households, then the odds of being mildly stunted were 1.47 times higher than for a child living in a household with unimproved or no sanitation facility. The use of clean cooking fuel was significantly associated with lower odds of being mildly stunted among children aged 6–23 months. The odds of being

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severely undernourished were considerably higher among the children belonging to the poorest households.

The findings of the present study are consistent with those carried out in India (Meshram *et al.*, 2018), Bangladesh (Ahsan *et al.*, 2017) and three disadvantaged districts in East African (Agho *et al.*, 2019). According to UNICEF (2019), about 80% of children aged 6–23 months from the poorest households are not fed the minimum recommended diverse diet for healthy growth and brain development; and the present findings also suggest that the achievement of MDD is also markedly lower (15.3%) among the children of the poorest households compared with those of other households, and this may be one of the possible reasons for higher odds of undernutrition among children in the poorest households.

Conclusions

The findings of this study indicate that children living in India's aspirational districts are performing much more poorly than their non-aspirational counterparts in terms of anthropometric indicators. Male children, those of higher birth order and those who are smaller at birth are at high risk of being undernourished. Mothers of lower educational level and lower BMI, and teenage mothers, are at increased risk of having children aged 6–23 months with undernutrition. Hence, educating mothers about feeding practices and monitoring their children's nutritional status are needed in India's aspirational districts. SC and ST children, those of households practising Hinduism and the poorest households need to be monitored for better child nutritional outcomes. The study findings also stress the importance of improved sanitation facilities that are not shared with other households. The introduction of complementary food to infants is a must once a child completes their sixth month, with continued breastfeeding after 6 months not helping them meet their increased nutritional requirements at that stage of growth, but appropriate breastfeeding does. That is, children who are appropriately breastfed, i.e. breastfed as well as receiving complementary food, are significantly less likely to be undernourished compared with children who are not. Achieving MDD at the ages of 6–23 months lowers the odds of being undernourished. Hence, this study suggests that educating mothers about appropriate breastfeeding and MDD is needed to combat child undernutrition in the aspirational districts of India. This study recommends the introduction of nutritional education programmes for mothers with IYCF guidelines.

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References

Agho KE, Akombi BJ, Ferdous AJ, Mbugua I and Kamara JK (2019) Childhood undernutrition in three disadvantaged East African Districts: a multinomial analysis. *Bio-Med Central Pediatrics* **19**(118), 1–11.

Aguayo VM, Nair R, Badgaiyan N and Krishna V (2016) Determinants of stunting and poor linear growth in children under 2 years of age in India: an in-depth analysis of Maharashtra's comprehensive nutrition survey. *Maternal & Child Nutrition* **12**(1), 121–140.

Ahsan KZ, Arifeen SE, Al-Mamun MA, Khan SH and Chakraborty N (2017) Effects of individual, household and community characteristics on child nutritional status in the slums of urban Bangladesh. *Archives of Public Health* **75**(9), 1–13.

Akombi BJ, Agho KE, Hall JJ, Wali N and Renzaho AM (2017) Stunting, wasting and underweight in Sub-Saharan Africa: a systematic review. *International Journal of Environmental Research and Public Health* **14**(863), 10–18.

https://doi.org/10.1017/S0021932021000596 Published online by Cambridge University Press

Bain LE, Kum Awah P, Geraldine N, Kindong NP, Sigal Y, Bernard N and Tanjeko AT (2013) Malnutrition in Sub-Saharan Africa: burden, causes and prospects. *Pan African Medical Journal* **15**(120), 1–9.

Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, De Onis M *et al.* (2013) Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* **382**(9890), 427–451.

Chandwani H, Prajapati A, Rana B and Sonaliya K (2015) Assessment of infant and young child feeding practices with special emphasis on IYCF indicators in a field practice area of Rural Health Training Centre at Dabhoda, Gujarat, India. *International Journal of Medical Science and Public Health* **4**(10), 1414–1419.

Dasgupta A, Parthasarathi R, Prabhakar RV, Biswas R and Geethanjali A (2014) Assessment of under nutrition with Composite Index of Anthropometric Failure (CIAF) among under-five children in a rural area of West Bengal. *Indian Journal of Community Health* **26**(2), 132–138.

Davalgi S and Vidya GS (2015) A study to know infant & young child feeding practices of mothers attending mother and child health clinic at a tertiary care teaching hospital, Davangere, India. *International Journal of Community Medicine and Public Health* **2**(4), 478–483.

De Onis M and Branca F (2016) Childhood stunting: a global perspective. *Maternal & Child Nutrition* **12**(1), 12–26.

Grebmer KV, Bernstein J, Wiemers M, Acheampong K, Hanano A, Higgins B *et al.* (2020) *2020 Global Hunger Index: One Decade to Zero Hunger: Linking Health and Sustainable Food Systems.* Concern Worldwide, Bonn, Welthungerhilfe and Dublin.

Harding KL, Aguayo VM and Webb P (2018) Factors associated with wasting among children under five years old in South Asia: implications for action. *PLoS One* **13**(7), 1–17.

Harrell Jr FE (2015) *Regression Modeling Strategies: With Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis*. Springer International Publishing, Switzerland.

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

Kapoor A and Green M (2020) *Aspirational Districts Programme Shifts the Focus Back on Development*. URL: https://economictimes.indiatimes.com/news/economy/policy/aspirational-districts-programme-shifts-the-focus-back-on development/articleshow/78142193.cms

Kavosi E, Rostami ZH, Kavosi Z, Nasihatkon A, Moghadami M and Heidari M (2014) Prevalence and determinants of under-nutrition among children under six: a cross-sectional survey in Fars province, Iran. *International Journal of Health Policy and Management* **3**(2), 71–76.

Kumar A, Jeeva JC, Sarkar A, Sahoo B and Srivastava SK (2019) Nutritional status of children in the Aspirational Districts of Odisha, India. *International Journal of Current Microbiology and Applied Sciences* **8**(12), 1910–1915.

Marriott BP, White A, Hadden L, Davies JC and Wallingford JC (2012) World Health Organization (WHO) infant and young child feeding indicators: associations with growth measures in 14 low-income countries. *Maternal & Child Nutrition* **8**(3), 354–370.

Mehta AK, Bhide S, Kumar A and Shah A (2018) *Poverty, Chronic Poverty and Poverty Dynamics. Policy Imperatives.* Springer Nature Singapore Pte Ltd, Singapore.

Meshram II Rao K, Balakrishna N, Harikumar R, Arlappa N and Sreeramakrishna K (2018) 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.

Miah RW, Apanga PA and Abdul-Haq Z (2016) Risk factors for undernutrition in children under five years old: evidence from the 2011 Ghana Multiple Indicator Cluster Survey. *Journal of AIDS & Clinical Research* **7**(7), 1–10.

Mosites E, Dawson-Hahn E, Walson J, Rowhani-Rahbar A and Neuhouser ML (2017) Piecing together the stunting puzzle: a framework for attributable factors of child stunting. *Paediatrics and International Child Health* **37**(3), 158–165.

Mya KS, Kyaw AT and Tun T (2018) *Feeding Practices and Nutritional Status of Children Age 6–23 Months in Myanmar: Further Analysis of the 2015–16 Demographic and Health Survey.* ICF, Rockville, MD, USA.

Mya KS, Kyaw AT and Tun T (2019) Feeding feeding practices and nutritional status of children age 6–23 months in Myanmar: a secondary analysis of the 2015–16 Demographic and Health Survey. *PLoS One* **14**(1), 1–13.

NITI Aayog (2018) *Strategy for New India@75.* National Institution for Transforming India, Aayog, New Delhi.

Perkins JM, Jayatissa R and Subramanian S (2018) Dietary diversity and anthropometric status and failure among infants and young children in Sri Lanka. *Nutrition* **55**(56), 76–83.

Rajesh D and Bavana D (2016) A study on infant feeding practices in the urban slums: a cross sectional study: a cross sectional study. *International Journal of Contemporary Pediatrics* **3**(2), 350–354.

Ramli, Agho KE, Inder KJ, Bowe SJ, Jacobs J and Dibley MJ (2009) Prevalence and risk factors for stunting and severe stunting among under-fives in North Maluku province of Indonesia. *BMC Pediatrics* **9**(64), 1–10.

Reinbott A, Kuchenbecker J, Herrmann J, Jordan I, Muehlhoff E, Kevanna O and Krawinkel M (2015) A child feeding index is superior to WHO IYCF indicators in explaining length-for-age Z-scores of young children in rural Cambodia. *Paediatrics and International Child Health* **35**(2), 124–134.

Rohner F, Woodruff BA, Aaron GJ, Yakes EA, Lebanan MO, Rayco-Solon P and Saniel OP (2013) Infant and young child feeding practices in urban Philippines and their associations with stunting, anemia, and deficiencies of iron and vitamin A. *Food and Nutrition Bulletin* **34**(2), S17–S34.

Sanin KI, Islam MM, Mahfuz M, Ahmed AS, Mondal D, Haque R and Ahmed T (2018) Micronutrient adequacy is poor, but not associated with stunting between 12–24 months of age: a cohort study findings from a slum area of Bangladesh. *PoLS One* **13**(3), 1–17.

Shetty P (2006) Malnutrition and Undernutrition. *Medicine* **34**(12), 524–529.

Singh H, Chaudhary V, Joshi HS, Upadhyay D, Singh A and Katyal R (2016) Sociodemographic correlates of nutritional status of under-five children. *Journal of Medical Sciences and Research* **7**, 44–49.

Srivastava N and Sandhu A (2006) Infant and child feeding index. *Indian Journal of Pediatrics* **73**, 767–769.

Tariq J, Sajjad A, Zakar R, Zakar MZ and Fischer F (2018) Factors associated with undernutrition in children under the age of two years: secondary data analysis based on the Pakistan Demographic and Health Survey 2012–2013. *Nutrients* **10**(676), 1–20.

Tzioumis E and Adair LS (2014) Childhood dual burden of under and overnutrition in low- and middle-income countries: a critical review. *Food and Nutrition Bulletin* **35**(2), 230–243.

UNDP (2020) *Human Development Report 2020: The Next Frontier – Human Development and the Anthropocene.* United Nations Development Programme, New York.

UNICEF (2018) *Levels and Trends in Child Malnutrition.* eSocialSciences.

UNICEF (2019) *The State of the World's Children 2019. Children, Food and Nutrition: Growing Well in a Changing World.* United Nations Children's Fund, New York.

UNICEF, WHO and World Bank (2020) *Levels and Trends in Child Malnutrition: Key Findings of the 2020 Edition*. World Health Organization, Geneva. URL: https://data.unicef.org/resources/jme-report-2020/

Victora CG, De Onis M, Hallal PC, Blossner M and Shrimpton R (2010) Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics* **25**(3), e473–e480.

WHO (2009) *Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students and Allied Health Professionals.* World Health Organization, Geneva.

WHO (2019) *Nutrition Landscape Information System (NLIS) Country Profile Indicators: Interpretation Guide.* World Health Organization, Geneva.

Yadav P and Dubey BN (2017) Nutritional problems among children in urban slum area. *Man in India* **97**(2), 349–362.

Yeshalem DM, Tafere TE and Abitew DB (2017) Infant and young child feeding practice among mothers with 0–24 months old children in Slum areas of Bahir Dar City, Ethiopia. *International Breastfeeding Journal* **12**(26), 2–9.

Zongrone A, Winskell K and Menon P (2012) Infant and young child feeding practices and child undernutrition in Bangladesh: insights from nationally representative data. *Public Health Nutrition* **15**(9), 1697–1704.

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