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Abstract

The main aims of this study are to find out the trends in the (a) prevalence of undernutrition and severe anemia and (b) degree of association of undernutrition and severe anemia in children younger than 6 years in India with some socioeconomic variables. Using the Reproductive and Child Health Survey data, z score of weight for age and hemoglobin status were analyzed to understand the state and agewise variation and their association with the sociodemographic variables through logistic regression. The prevalence of malnutrition according to both the criteria was first seen to increase, attain a maximum value at some age between 12 and 48 months, and then decrease. Statewise distribution showed a close link between the stage of development and the prevalence of malnutrition—prevalence rate being less for developed states. The rates were also less for the Northeastern states of India. The regression analysis clearly points out that children with illiterate mothers, of lower age groups, or from low standard of living households are more prone to become malnourished. The economic growth alone is not sufficient for substantially reducing malnutrition. It is necessary to improve the rate of literacy, especially of women, to reduce the prevalence of malnutrition and anemia among children. It is not only economic development but also overall human development that is needed in India.

Keywords

Socioeconomic status, nutritional status, children younger than 6 years, anemia, India

Introduction

Health is an important aspect of human development. As children are the assets for future generation, the status of health of present-day children is a good indicator of human development.

During the past decade, India in particular and the world in general, has been undergoing rapid changes because of free market under the processes of liberalization, privatization, and

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globalization.¹ As a result of this change, improvement in India occurred in the fields of agriculture, education, technology, and so on. This has also resulted in a steep decline in the prevalence of undernutrition, but still, India has the highest prevalence of underweight children in the world, which is nearly twice as many as in sub-Saharan Africa. Out of every children younger than 3 years, one is malnourished in India.² In BIMARU (BIMARU consists of the states of Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh) states of India, half of the children are underweight.³ About 30% of Indian children are born with low birth weight (LBW), and signs of growth retardation become apparent by the age of 2 years for many of them. According to NFHS-2 (National Family Health Survey 2, India) data of 1998-1999, 47% of children younger than 3 years were moderately or severely underweight, though it has declined 5% to 6% from NFHS-1 of 1992-1993.⁴ Apart from India, similar situations have also been reported from others countries.^{5,6}

Like undernutrition, anemia is also a worldwide public health problem. It is estimated that globally 43% of children younger than 4 years are anemic.^{7,8} It is reported that globally 50% of anemia occurs because of iron deficiency.^{9,10} About half of the population in developing countries has anemia due to iron deficiency.¹¹ It is recognized that worldwide the leading cause of morbidity and mortality among preschool and adolescent children and women is anemia.^{12,13} Among children aged 0 to 6 months, anemia is not much prevalent as these children mainly depend on breast milk, which is rich in iron. But after 6 months, they require an additional source of iron to prevent this deficiency.¹⁴ Because of poverty, poor appetite from malnutrition or illness, or beliefs of maternal feeding practices, resulting in withholding of food practices, children do not receive sufficient quantities of iron-rich food.^{1,7,14,15} Iron deficiency among preschool children hampers proper brain development, and it is noticed that malnutrition makes the children more anemic.¹⁶

Both malnutrition and anemia among children retard physical as well as cognitive development and increase susceptibility to diseases. However, the prevalence of anemia among children is not so well projected as malnutrition. It is estimated that malnutrition causes child deaths via major diseases such as malaria, diarrhea, pneumonia, and measles. A total of 57% percent of deaths from malaria, 61% from diarrhea, 52% from pneumonia, and 45% from measles are because of malnutrition.

As a result of reforms since the 1990s, India has witnessed almost complete eradication of polio, a significant increase in literacy rate, and enrollment of both boys and girls in primary schools. However, the progress is still not satisfactory in service areas such as primary health care, community-based nutrition services, as well as child well-being and sanitation. On the other hand, poverty and hunger are the main causes of deficiency in child nutrition. It is observed that the incidence of child malnutrition is almost double that of poverty, with the highest rate in the poorest states, and the lowest rate not in the richest but in the middle-income states with progressive social and food security policies.¹⁷ Thus, poverty has a direct relationship with the nutritional status of the children, but there may be other regulatory factors as well. Malnutrition and anemia are associated with the ecological settings and different sociocultural perspectives such as mother's educational status, educational background of the family, mother's age, and standard of living of the household, and so on.

The main objectives of the study are as follows:

1. Prevalence and extent of undernutrition and severe anemia among children younger than 6 years in India.
2. Degree of association of undernutrition and severe anemia among children younger than 6 years and its distribution by age and gender.
3. Effect of some socioeconomic variables on the extent of undernutrition and severe anemia in children younger than 6 years.

Materials and Methods

Data Source and Statistical Analysis

The data on growth and nutritional status of children was accessed from the data of Reproductive and Child Health Survey (RCHS-second round) conducted in 2002–2003. The survey was coordinated by the International Institute for Population Sciences in collaboration with the Ministry of Health and Family Welfare. The sample covers Indian population living in 593 districts in 28 states and 7 Union territories. The RCHS data were collected from 5 07 622 eligible ever-married women (15–44 years) who were interviewed from 6 20 107 households.

Data relating to weight and age of 0- to 71-month old children of the sampled women were collected to compute the *z* scores of undernutrition through weight-for-age (WAZ) index. The data on the hemoglobin (Hb) level were also collected from the same children to assess the level of anemia.

z-Score value of “–2” was used as a cutoff point for estimation of prevalence rates.¹⁸ *z* Score is defined as the deviation of the value observed for an individual from the median of the reference population, divided by the standard deviation (SD) of the reference population, that is,

$$z \text{ score} = \frac{(\text{Observed value}) - (\text{Median of the reference population})}{\text{SD of the reference population}}$$

The reference population refers to the population of apparently normal children of age same as that of the selected children. The *z* scores are classified as “below normal” (less than –2), “normal” (–2 to less than +2), and “above average” ($\geq +2$) by the National Center for Health Statistics/World Health Organization. Classification of anemia has been done, following NFHS-2,³ as severely anemic (<7.0 g/dL), moderately anemic (7.0–9.9 g/dL), mildly anemic (10.0–10.9 g/dL), and normal (>10.9 g/dL). WAZ is primarily a composite index of HAZ (height for age) and WHZ (weight for height), that is, the indicator for both acute and chronic malnutrition. In the young children, low weight for age reflects low weight for height but in the later period, it reflects low height for age. Prevalence of malnutrition is also measured through percentage of children affected according to the criteria of *z* scores (WAZ) or Hb level.

The covariates are ethnicity, religion, sectors such as rural/urban, mother’s age at child birth, mother’s and father’s educational status, and standard-of-living index (SLI). To present relative and effective intervention, the risk of *z*-score value for undernutrition, severe anemia, and the child affected simultaneously by both undernutrition and severe anemia were regressed on socio-economic variables using categorical logistic regression analysis. Dependent variables are taken as binary. Children whose *z* scores are less than –2 are coded as “1” and those with *z* scores –2 or higher are coded as “0.” Similarly, severe anemia and simultaneously affected by both undernutrition and anemia are coded as “1” and others are coded as “0.” An estimated odds ratio of “1” indicates that the nature of dependent variable is no different from the reference category. If the estimated odds ratio is >1, the probability of becoming affected is more in this category compared with the reference category, and if it is <1, then it is just opposite to that of “>1” case.

Results

Table 1 and Figures 1A and 1B show the trends in the percentage of undernourished and anemic children by age. The percentage of undernourished children increases first up to 12 months, remains stable up to 36 months, and then decreases with a slight tilt upward after 60 months. This feature also remains more or less same for girls except that the percentage goes on increasing up

Table 1. Age Group–Wise Specific Percentage of Children Younger Than 6 Years in India by Gender According to Nutrition, Anemia, and Both Nutrition and Hemoglobin Status

Age Groups (Months)	N	Nutritional Status (Weight for Age)			Hemoglobin Status				Both Nutritional and Hemoglobin Status	
		Malnourished (Below -2SD; %)	Normal (-2SD to +2SD; %)	Overweight (Above +2SD; %)	Severe (<7.0 g/dL; %)	Moderate (7-9.9 g/dL; %)	Mild (10-10.9 g/dL; %)	Normal (>11.0 g/dL; %)	Mainourished and Severely Anemic ^a (%)	Normal and Not Severely Anemic ^b (%)
Boys										
0 to <3	2407	9.2	74.0	16.8	25.2	53.1	6.3	15.4	2.3	97.7
3 to <6	3542	17.9	79.5	2.6	24.8	58.3	4.5	12.3	5.1	94.9
6 to <9	4129	40.9	58.2	0.8	26.3	56.3	3.7	13.8	10.7	89.3
9 to <12	3889	56.6	43.3	0.2	30.2	53.4	3.6	12.9	17.8	82.2
12 to <24	15 863	58.2	41.1	0.7	30.9	51.6	4.1	13.5	18.8	81.2
24 to <36	17 832	57.6	41.9	0.4	23.8	57.2	5.8	13.2	15.3	84.7
36 to <48	18 067	50.4	49.2	0.4	19.2	60.4	7.4	13.0	11.3	88.7
48 to <60	19 121	48.9	50.8	0.3	14.7	62.8	8.7	13.7	8.2	91.8
60 to <72	19 776	49.9	49.6	0.4	13.0	63.3	9.8	14.0	7.3	92.7
Girls										
0 to <3	2202	7.1	70.8	22.2	23.5	54.4	5.4	16.8	1.9	98.1
3 to <6	3259	17.7	78.2	4.2	22.5	58.6	4.3	14.5	4.5	95.5
6 to <9	3985	36.7	62.0	1.3	25.1	58.1	4.1	12.8	9.4	90.6
9 to <12	3605	52.6	46.6	0.8	26.5	56.4	4.2	13.0	13.9	86.1
12 to <24	14 271	54.2	44.7	1.0	29.4	53.5	4.0	13.1	16.9	83.1
24 to <36	16 275	56.6	42.7	0.7	24.9	55.7	5.7	13.6	15.9	84.1
36 to <48	16 806	52.2	47.3	0.5	20.1	60.1	6.8	13.1	12.2	87.8
48 to <60	17 300	47.3	52.5	0.2	16.6	61.3	8.3	13.8	9.2	90.8
60 to <72	18 038	40.8	58.7	0.5	14.1	62.2	9.5	14.2	6.6	93.4

^aMalnourished and severely anemic (less than -2SD weight for age and <7.0 g/dL hemoglobin).

^bNormal and not severely anemic (greater than and equal to -2SD Weight for age and ≥7.0 g/dL hemoglobin).

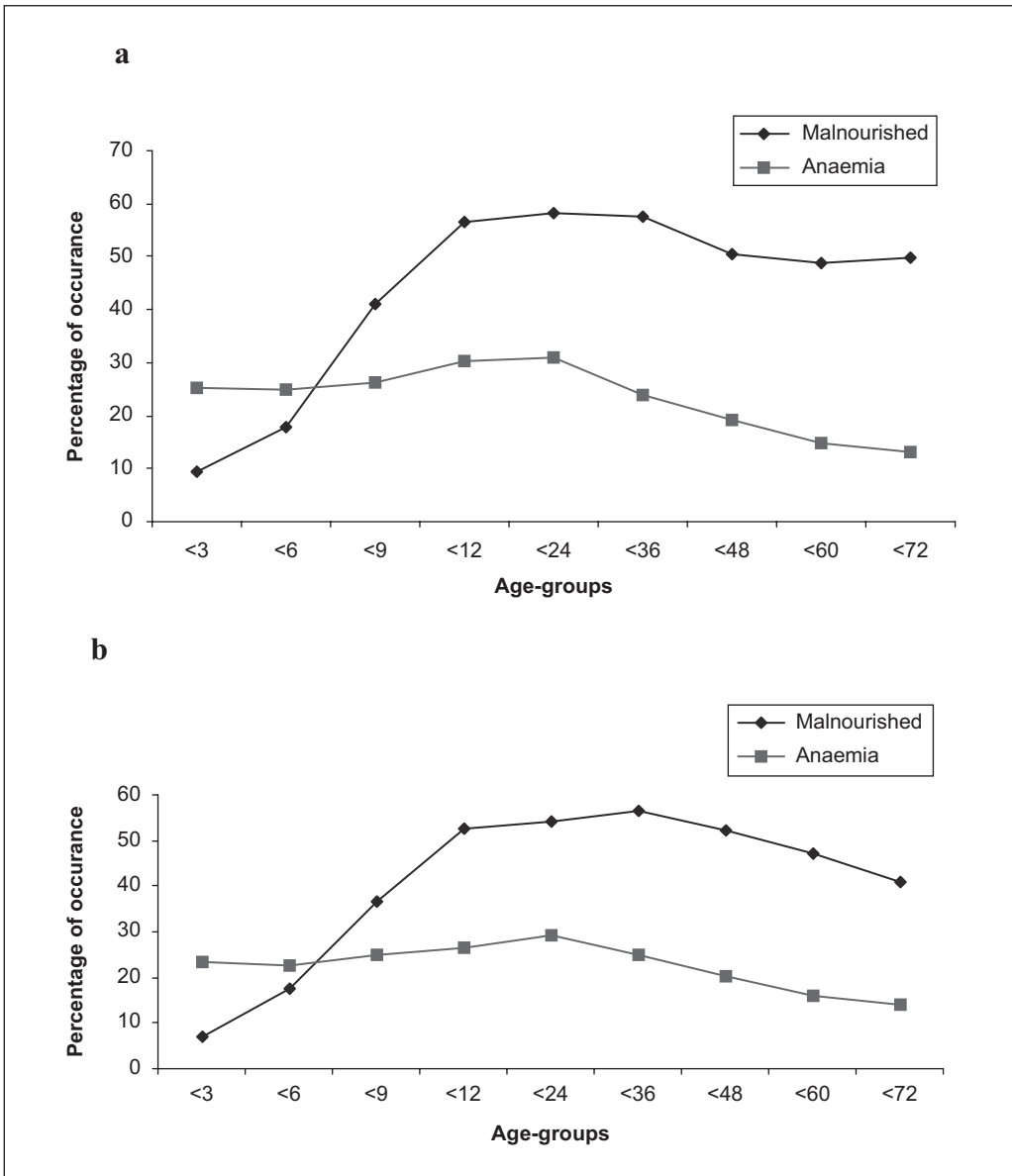


Figure 1. Percentage of malnourishment and anemia at different age groups of (A) boys and (B) girls

to 36 months and then decreases throughout the age range. Percentage of severe anemia among children also increases first up to 24 months and then decreases. The percentage of children affected by both undernutrition and anemia is restricted within 2% to 5% up to 6 months, but after 6 months the rate of prevalence increases (11% to 19%) up to 24 months, and then it gradually decreases.

Zonewise and statewide percentage distributions of different types of nutrition-deficient children younger than 6 years in India are shown in Table 2. The data reveal that in India, during the period 2002-2003, 50.3% boys and 47.4% girls were underweight, 20.8% boys and 21.2% girls

Table 2. Statewise and Zonewise Percentage Distribution of Different Types of Nutritional Status Among Children Younger Than 6 Years in India by Gender

Zones and States	Boys						Girls					
	Underweight			Severely Anemic			Underweight			Severely Anemic		
	N	Underweight	Severely Anemic	N	Underweight	Severely Anemic	N	Underweight	Severely Anemic	N	Underweight	Severely Anemic
Northeast	4254	24.8	12.5	2.9	15.7	12.2	3957	15.7	12.2	2.0	2.0	
Arunachal Pradesh	956	29.6	12.2	3.3	14.7	10.8	904	14.7	10.8	2.2	2.2	
Assam	1152	27.4	12.4	2.8	23.7	11.6	1046	23.7	11.6	2.9	2.9	
Manipur	1002	17.7	10.8	2.1	8.6	12.8	915	8.6	12.8	0.9	0.9	
Meghalaya	87	41.4	9.2	2.3	39.8	14.5	83	39.8	14.5	3.6	3.6	
Mizoram	311	22.2	9.3	1.9	9.8	6.5	336	9.8	6.5	0.9	0.9	
Nagaland	195	17.4	5.6	1.0	18.5	6.2	178	18.5	6.2	1.1	1.1	
Sikkim	375	20.8	22.1	4.8	10.2	22.2	315	10.2	22.2	2.5	2.5	
Tripura	176	36.4	19.3	5.1	16.7	18.3	180	16.7	18.3	2.2	2.2	
East	20 993	51.1	19.8	11.3	50.9	20.9	20 010	50.9	20.9	11.7	11.7	
Bihar	8751	54.0	21.6	13.1	55.5	24.1	8127	55.5	24.1	15.3	15.3	
Jharkhand	3635	55.5	18.8	12.3	54.1	18.3	3383	54.1	18.3	10.8	10.8	
Orissa	5559	46.9	21.4	10.5	45.0	21.4	5648	45.0	21.4	9.9	9.9	
West Bengal	3048	45.2	12.9	6.4	45.6	13.7	2852	45.6	13.7	6.5	6.5	
Central	31 656	57.9	20.1	13.0	55.3	20.7	29 326	55.3	20.7	12.9	12.9	
Madhya Pradesh	10 482	58.2	17.4	10.7	56.2	17.2	9719	56.2	17.2	10.3	10.3	
Chattisgarh	2845	50.5	25.2	13.5	47.2	25.2	2816	47.2	25.2	13.0	13.0	
Uttar Pradesh	18 329	59.5	20.9	14.2	56.1	22.0	16 791	56.1	22.0	14.3	14.3	
West	12 109	51.0	31.4	16.9	51.1	31.0	10 939	51.1	31.0	16.7	16.7	
Goa	167	34.1	7.2	4.2	34.0	8.6	162	34.0	8.6	3.7	3.7	
Gujarat	4804	51.0	36.4	20.1	50.7	36.3	4179	50.7	36.3	19.6	19.6	
Daman and Diu	266	44.0	28.9	14.7	41.5	30.2	258	41.5	30.2	11.2	11.2	
Dadra and Nagar Haveli	262	51.1	50.4	26.7	47.8	49.0	255	47.8	49.0	25.9	25.9	
Maharashtra	6610	51.7	27.8	14.6	52.4	27.3	6085	52.4	27.3	14.9	14.9	
North	22 899	47.8	20.1	10.8	42.8	20.7	19 365	42.8	20.7	10.3	10.3	
Haryana	5629	37.8	24.2	10.2	31.9	25.3	4501	31.9	25.3	9.1	9.1	
Himachal Pradesh	1288	40.0	16.5	7.9	34.6	16.6	1146	34.6	16.6	5.8	5.8	

(continued)

Table 2. (continued)

Zones and States	Boys				Girls			
	N	Underweight	Severely Anemic	Underweight and Severely Anemic	N	Underweight	Severely Anemic	Underweight and Severely Anemic
Jammu and Kashmir	767	22.4	3.4	0.4	738	20.7	4.6	0.9
Delhi	1244	35.5	17.8	6.8	1089	35.4	20.1	7.7
Punjab	3687	41.8	23.8	11.2	2939	36.2	22.9	10.0
Rajasthan	8330	59.5	19.1	12.8	7148	56.5	20.3	13.4
Chandigarh	58	44.8	29.3	15.5	72	26.4	29.2	6.9
Uttaranchal	1896	62.0	15.6	11.4	1732	45.6	16.0	9.5
South	12 294	42.4	18.0	8.2	11 719	37.2	17.9	7.4
Andhra Pradesh	2647	45.6	22.4	11.0	2469	38.0	22.0	9.7
Karnataka	2727	48.2	21.1	10.7	2609	43.8	19.3	9.7
Kerala	752	37.9	2.9	1.3	714	34.9	2.7	1.1
Tamil Nadu	5420	39.0	16.9	6.8	5209	34.3	17.7	6.3
Puducherry	478	39.2	14.4	5.6	718	33.6	14.8	5.6
Islands	421	33.3	18.0	2.9	425	28.2	10.4	3.5
Andaman and Nicobar	360	33.6	10.3	3.1	365	25.2	10.1	3.0
Lakshadweep	62	31.1	11.5	1.6	60	46.7	11.7	6.7
India	10 4626	50.3	20.8	11.6	95 741	47.4	21.2	11.4

were anemic, and the children who were suffering simultaneously from undernutrition and anemia were 11.6% of boys and 11.4% of girls. Irrespective of gender, states with low prevalence (<30%) of undernourished children were most of the states of Northeast India (excepting Meghalaya and Tripura) and Jammu and Kashmir. In case of anemia and undernutrition + anemia, states with low prevalence were also most of the states of Northeast India, Goa, Jammu and Kashmir, Kerala, and Andaman Islands for both sexes. It is also necessary to mention here that the rate of undernutrition was higher among boys than among girls in most of the states, though the difference was not so marked. In the Northeastern states, the difference between boys and girls was very high (Arunachal Pradesh 29.6:14.7, Manipur 17.7:8.6, Mizoram 22.2:9.8, Sikkim 20.8:10.2, and Tripura 36.4:16.7). Besides the Northeast zone, island zone also shows less prevalence for all the three indicators of nutritional deficiency. High-prevalent zone of undernutrition and severe anemia was the Central zone. Those states where more than 50% undernourished boys as well as girls are observed were Bihar (54.0%:55.5%), Jharkhand (55.5%:54.1%), Madhya Pradesh (MP; 58.2%:56.2%), Chattisgarh (50.5%:47.2%), Uttar Pradesh (59.5%:56.1%), Gujarat (51.0%:50.7%), Dadra and Nagar Haveli (51.1%:47.8%), Maharashtra (51.7%:52.4%), Rajasthan (59.5%:56.5%), and Uttaranchal (62.0%:45.6%). More than 25% severely anemic affected children both boys and girls were found in Chattisgarh (25.2%:25.2%), Gujarat (36.4%:36.3%), Dadra and Nagar Haveli (50.4%:49.0%), Maharashtra (27.8%:27.3%), and Chandigarh (29.3%:29.2%). The states where nearly 15.5% or more children were suffering simultaneously from both undernutrition and severe anemia were Gujarat (20.1%:19.6%), Dadra and Nagar Haveli (26.7%:25.9%), and Chandigarh (15.5% boys) only.

Table 3 provides information about the level of prevalence of undernutrition, anemia, and simultaneously affected by both undernutrition and anemia of children younger than 6 years in India by different categories of socioeconomic variables. It is seen that all the socioeconomic variables have been associated with the children's nutritional status. Analysis reveals that both boys and girls are affected more or less equally though girls are in a marginally better position. There is not much difference between rural and urban places. Mother's age is negatively related with the concentration of undernutrition and anemia. The result also shows that the affected percentage is maximum among the children of scheduled tribe (ST; non-Christian) families and is lowest in ST (Christian) families. Hindu (scheduled caste or SC), Muslims, Hindu ("Others"), and "Others" are in descending order of prevalence. Most conspicuous effect on the nutritional status of children has been found for mother's education and standard of living of the households. The percentage of malnourished children drastically reduces when the standard of living increases. There is also wide variation in the nutritional status of children over geographical regions. Central, East, and West zones have more than 50% undernourished children. In North and South zones, these percentages are 45% and 30%, respectively. The prevalence is very low in the Northeast (20.5%) and Island (30.8%) zones. In cases of anemia and simultaneously affected by both anemia and undernutrition, West zone shows the highest prevalence, followed by Central, East, and North zones. A sharp fall of the prevalence has been seen in the Islands and Northeast zones. All these findings have been seen to be strongly significant by the χ^2 tests.

To determine whether religion and caste have different effect on the nutritional status for different sociodemographic categories, we calculated the percentage distribution of undernutrition and severe anemia of children belonging to the different categories of variables for each religion and caste group (Table 4). The table shows that the general trend of relationship is similar when compared with Table 2. The remarkable feature is that among children of the ST (Christians) families, irrespective of the socioeconomic variables, the percentage of undernourished and anemic children are considerably low, and the difference of percentages between categories are high. Regarding zonal distribution, Northeast zone shows the lowest (17.3%) frequency, followed by Island zone (25.4%).

Table 3. Percentage Distribution of Malnourished (Weight for Age) and Anemic Children Younger Than 6 Years in India by Socioeconomic Groups

Variables	N	Nutritional Status (Weight for Age)			Hemoglobin Status			Both Nutritional and Hemoglobin Status		
		Malnourished	Not Malnourished (Normal)	P Value	Severely Anemic	Not Severely Anemic	P Value	Malnourished and Severely Anemic ^a	Normal and Not Severely Anemic ^b	P Value
Gender										
Boys	104 626	50.3	49.7	166.51 ^c	20.8	79.2	4.43 ^d	11.6	88.4	2.41
Girls	95 741	47.4	52.6		21.2	78.8		11.4	88.6	
Places										
Rural	146 818	50.6	49.4	658.91 ^c	21.4	78.6	72.56 ^c	12.0	88.0	156.21 ^c
Urban	53 549	44.1	55.8		19.7	80.3		10.0	90.0	
Age of mother										
15-24	71 592	50.4	49.6	111.35 ^c	23.5	76.5	449.21 ^c	12.7	87.3	171.93 ^c
25-34	107 675	47.8	52.1		19.6	80.4		10.8	89.2	
35+	21 100	49.1	50.9		19.1	80.9		11.0	89.0	
Mother's education										
Illiterate	107 362	55.1	44.9	3543.21 ^c	22.6	81.0	397.38 ^c	13.8	86.2	1211.07 ^c
Literate	93 005	41.8	58.2		19.0	77.4		8.8	91.2	
Father's education										
Illiterate	57 051	55.4	44.6	1350.51 ^c	22.7	79.7	149.53 ^c	13.8	86.2	408.01 ^c
Literate	143 316	46.3	53.7		20.3	77.3		10.6	89.4	
Religion and caste										
ST (non-Christian)	21 656	54.8	45.2	1891.55 ^c	24.9	75.1	504.22 ^c	14.8	85.2	679.04 ^c
Hindu (SC)	37 051	52.9	47.1		22.8	77.2		13.3	86.7	
Muslim	23 023	49.5	50.5		19.6	80.4		11.3	88.7	
Hindu (Others)	106 147	47.9	52.1		20.0	80.0		10.6	89.4	
Others	8646	38.8	61.3		21.6	78.4		9.6	90.4	
ST (Christian)	3844	24.1	75.9		13.0	87.0		4.0	96.0	
SLI										
Low	102 435	55.2	44.8	4028.16 ^c	22.5	77.5	427.03 ^c	13.6	86.4	1147.36 ^c
Medium	0820	45.5	54.4		20.5	79.5		10.5	89.5	
High	37 112	36.9	63.1		17.5	82.5		7.3	92.7	

(continued)

Table 3. (continued)

Variables	N	Nutritional Status (Weight for Age)			Hemoglobin Status			Both Nutritional and Hemoglobin Status			
		Not Malnourished (Normal)		P Value	Severely Anemic		P Value	Malnourished and Severely Anemic ^a		P Value	
		Malnourished	Not Malnourished (Normal)		Anemic	Not Severely Anemic		Anemic ^a	Not Severely Anemic ^b		
Zones											
Central	60 982	56.7	43.3	5341.39 ^c	20.4	79.6	2055.56 ^c	12.9	87.1	1838.29 ^c	
East	41 003	51.0	49.0		20.3	79.7		11.5	88.5		
West	23 048	51.0	49.0		31.2	68.8		16.8	83.2		
North	42 264	45.5	54.5		20.4	79.6		10.5	89.5		
South	24 013	39.8	60.2		17.9	82.1		7.8	92.2		
Island	846	30.8	69.3		10.4	89.6		3.2	96.8		
Northeast	8211	20.5	79.6		12.4	87.6		2.4	97.6		

Abbreviations: SC, scheduled caste; ST, scheduled tribe; SLL, standard-of-living index.

^aMalnourished and severely anemic (less than -2SD weight for age and <7.0 g/dL hemoglobin).

^bNormal and not severely anemic (greater than and equal to -2SD weight for age and ≥7.0 g/dL hemoglobin).

^cP < .01.

^dP < .05.

Table 4. Percentage Distribution of Malnutrition and Severe Anemia Among Children Younger Than 6 Years by Religion and Caste Among Different Socioeconomic Groups in India

Variables	Malnourished						Severe Anemia					
	Muslim	Hindu (SC)	ST (Non-Ch.)	ST (Ch.)	Hindu (Others)	Others	Muslim	Hindu (SC)	ST (Non Ch.)	ST (Ch.)	Hindu (Others)	Others
Gender												
Boys	51.5	54.4	56.9	27.2	48.9	40.6	19.4	22.4	25.0	12.6	19.9	21.8
Girls	47.3	51.3	52.7	20.9	46.7	36.4	19.9	23.2	24.8	13.5	20.2	21.4
Places												
Rural	50.7	54.0	55.5	24.8	50.0	39.9	18.8	22.9	24.9	14.0	20.6	23.3
Urban	47.8	49.2	49.0	20.8	42.5	36.0	20.8	22.5	24.8	8.6	18.6	17.6
Mother's age (years)												
15-24	51.0	53.1	55.8	31.9	49.1	41.3	22.2	24.8	27.4	16.8	22.3	26.6
25-34	48.8	52.5	54.8	23.9	46.7	37.5	18.6	21.6	23.4	11.9	18.8	19.1
35+	48.6	54.1	51.6	17.4	50.0	36.6	18.1	21.5	22.3	12.6	18.1	19.4
Mother's education												
Illiterate	53.6	56.8	57.0	31.6	55.1	45.9	20.7	23.7	25.3	17.9	21.6	27.5
Literate	43.2	45.0	48.6	20.5	41.8	35.2	18.0	21.1	23.7	10.7	18.7	18.8
Father's education												
Illiterate	54.3	56.5	57.8	33.1	55.7	45.7	20.5	23.0	24.9	16.4	22.2	27.4
Literate	46.6	50.9	52.1	21.8	45.8	36.7	19.1	22.7	24.8	12.2	19.5	19.9
SLI												
Low	55.5	57.2	57.2	26.6	55.2	47.9	20.7	23.5	25.2	13.9	21.7	26.0
Medium	47.0	46.8	48.1	20.2	45.7	41.2	19.6	22.3	24.5	12.0	19.9	22.6
High	40.4	39.7	38.6	16.7	37.0	31.1	17.3	19.2	20.7	9.4	17.1	18.2
Zones												
Central	57.2	60.5	59.3	50.6	54.8	43.8	21.0	22.6	19.5	9.2	19.7	17.6
East	53.6	54.4	53.3	57.7	48.6	39.5	18.0	23.0	23.7	25.1	19.1	16.2
West	47.3	53.5	62.4	60.0	46.9	49.9	30.5	33.4	39.2	39.0	28.4	26.3
North	43.4	48.3	54.1	46.2	45.7	37.5	17.8	23.1	20.3	27.7	19.1	23.8
South	38.4	42.7	44.8	39.4	39.0	35.7	16.3	20.0	23.8	21.2	17.5	12.1
Island	37.5	32.7	33.3	25.4	30.7	29.9	9.4	11.5	8.3	18.2	6.1	9.2
Northeast	32.0	23.5	24.2	17.3	17.6	15.5	9.2	12.7	14.9	10.4	14.8	12.5

Abbreviations: SC, scheduled caste; Ch., Christian; ST, scheduled tribe; SLI, standard of living index.

Table 5. Percentage of Malnourished Children Younger Than 6 Years According to Anemic/Nonanemic Status for Different Socioeconomic Variables in India

Variables	Severely Anemic		Not Severely Anemic		χ^2 Test
	N	Malnourished	N	Malnourished	P
Gender					
Boys	21 734	55.9	82 892	48.8	341.91 ^a
Girls	20 255	53.8	75 486	45.7	423.20 ^a
Residential status					
Rural	31 454	56.2	115 364	49.1	493.16 ^a
Urban	10 535	50.9	43 014	42.5	245.53 ^a
Mother's age (years)					
15-24	16 847	54.2	54 745	49.2	124.89 ^a
25-34	21 116	54.9	86 559	46.2	515.65 ^a
35+	4026	57.8	17 074	47.0	151.87 ^a
Mother's education					
Illiterate	24 310	61.0	83 052	53.4	440.20 ^a
Literate	17 679	46.5	75 326	40.6	199.35 ^a
Father's education					
Illiterate	12 961	60.7	44 090	53.9	187.07 ^a
Literate	29 028	52.3	114 288	44.8	522.33 ^a
Religion and caste					
ST (non-Christian)	5386	59.6	16 270	53.3	66.22 ^a
Hindu (SC)	8450	58.5	28 601	51.3	135.76 ^a
Muslim	4523	57.6	18 500	47.5	148.07 ^a
Hindu (others)	21 258	53.2	84 889	46.6	296.68 ^a
Others	1871	44.1	6775	37.3	29.35 ^a
ST (Christian)	501	30.7	3343	23.1	13.81 ^a
SLI					
Low	23 039	60.5	79 396	53.7	337.63 ^a
Medium	12 470	51.5	48 350	44.1	199.28 ^a
High	6480	41.9	30 632	35.9	82.77 ^a
Zones					
Central	12 441	63.4	48 541	54.9	290.02 ^a
East	8330	56.6	32 673	49.6	132.72 ^a
West	7200	53.8	15 848	49.8	31.28 ^a
North	8608	51.7	33 656	43.9	168.61 ^a
South	4305	43.6	19 708	39.0	31.25 ^a
Island	88	30.7	758	30.7	0.000
Northeast	1017	19.7	7194	20.5	0.42

Abbreviations: SC, scheduled caste; ST, scheduled tribe; SLI, standard-of-living index.

^aP < .01.

The aim of Table 5 is to show the association between undernutrition and severe anemia of children younger than 6 years in India. Illiteracy of mother has strong positive relationship with undernutrition and severe anemia of the children. This trend is also applicable for father's illiteracy, though its magnitude is less than that of mother's illiteracy. ST (Christian) always has least percentage of affected children than other religions and castes groups. The association between undernutrition and severe anemia in Central, West, and North zones is very high, as in these areas, more than 50% to 60% undernourished children are affected by severe anemia. All these results are statistically significant at 1% level by χ^2 tests. On the other hand, in Island and Northeast zones, association between undernutrition and anemia is more or less same.

The binary variables of the *z* scores of WAZ, severe anemia, and the undernutrition + anemia group as those children affected both by undernutrition and severe anemia have been subjected to categorical logistic regression to get the different types of nutritional status considering the selected sociodemographic background of 0- to 71-month-old children in India (Table 6). This result may be because of other intervening characteristics such as SLI, literacy, zone, and so on. Mother's age at childbirth, parents' educational status, and SLI show significant positive effect for all the three types of regressions. Among STs (non-Christian) and Hindus (SC), no difference is observed in respect of three dimensions of nutritional status, but the values for ST (Christians) and "Others" are markedly less than those of reference category and are statistically significant at 1% level. The only exception is in case of anemia, where "Others" has been found to be almost same with the reference group. Northeast zone is in the top position toward better health among children younger than 6 years for all the 3 nutritional indicators. This is followed by Islands. On the other hand, West zone shows about 87% children to be anemic and 54% children affected by both undernutrition and anemia.

Discussion

The study gives a grave signal of high percentage of children younger than 6 years suffering from undernutrition and severe anemia in India. The study also finds the influential socioeconomic variables on the level of nutritional deficiency through Hb level and weight-for-age measures.

India is a country having more than a billion people and accounting for nearly one sixth of world population. Among them, 17.5% constitute children younger than 6 years.² The present study reveals that 50.3% boys and 47.4% girls are underweight, 20.8% boys and 21.2% girls are severely anemic, and the percentage of boys and girls who are affected simultaneously by both undernutrition and severe anemia are 7.3% and 6.6%, respectively, during 2002-2003. But through national-level study of NFHS-1⁴ and NFHS-2,³ it is revealed that our present data shows 6% less children than NFHS-1 and 3% more than NFHS-2 study in case of undernutrition and 15% to 16% more than NFHS-2 study in case of severe anemia. The existing literatures show that among children younger than 6 years in India, gender inequality is not prominent. Statewise analysis shows that most of the states in Northeast India, Kerala, Goa, and so on, where status of women is high because of education, the prevalence of malnutrition, in general, is less than in other states. Girls in these states are also less malnourished than boys. Considering the above findings, we are of the same opinion as Osmani and Sen¹⁹ that malnutrition and gender is a complex phenomenon and is linked to women's empowerment and social status.

There are ample evidence that child malnutrition still persists in India: Comparing the two national-level studies of NFHS-2 and RCHS-2, which are at five years interval, it is found that undernutrition has increased by 2% though Standing Committee on Nutrition, Geneva²⁰ reported that the prevalence of malnutrition is decreasing by 1% per year. After independence, the nutritional problems in children were critical. These were because of poverty and poor access to and utilization of safe drinking water, sanitation, and health care. These are closely linked to low literacy and awareness also. Later on many multisectarian and multipronged programs have been taken up. These programs helped in promoting the health and nutritional status. India has achieved self-sufficiency in food production, and consequently, poverty rate has declined. After the 1990s, as a result of globalization and economic openness, both in the domestic and international sphere, there was an increase in the rate of economic growth. The number of people below the poverty line has declined from 55% in 1973-1974 to 36% in 1993-1994 to 26% in 1999-2000.²¹ Special supplementary nutrition efforts were made to promote the child nutritional status by providing Integrated Child Development Service (ICDS) and midday meal program. Through these interventions, in the past 5 decades, poverty and mortality rates have declined by 50% and fertility

Table 6. Results of Logistic Regression on the Status of Malnourishment and Anemia Among the Preschool Children in Respect of Socioeconomic Factors

Variables	Malnourishment of Children (Weight for Age)			Anemia of Children			Both Malnourishment and Anemia		
	Odds Ratio	95% Confidence Intervals		Odds Ratio	95% Confidence Intervals		Odds Ratio	95% Confidence Intervals	
		Lower Boundary	Upper Boundary		Lower Boundary	Upper Boundary		Lower Boundary	Upper Boundary
Gender									
Girls ^a	1.00			1.00			1.00		
Boys	1.14 ^b	1.121	1.162	0.98	0.959	1.002	1.03 ^c	1.003	1.060
Places									
Rural ^a	1.00			1.00			1.00		
Urban	1.04 ^b	1.017	1.065	1.04 ^b	1.014	1.073	1.08 ^b	1.049	1.129
Mother's age									
15-20 ^a	1.00			1.00			1.00		
25-34	0.94 ^b	0.919	0.955	0.82 ^b	0.799	0.837	0.85 ^b	0.831	0.882
35+	0.89 ^b	0.861	0.919	0.78 ^b	0.752	0.813	0.82 ^b	0.781	0.863
Mother's education									
Illiterate ^a	1.00			1.00			1.00		
Literate	0.79 ^b	0.771	0.806	0.85 ^b	0.828	0.874	0.74 ^b	0.712	0.764
Father's education									
Illiterate ^a	1.00			1.00			1.00		
Literate	0.93 ^b	0.909	0.952	0.97 ^c	0.942	0.995	0.96 ^c	0.928	0.991
Religion and caste									
ST (non-Christian) ^a	1.00			1.00			1.00		
Hindu (SC)	0.98	0.945	1.014	1.02	0.981	1.063	1.01	0.966	1.067
Muslim	0.95 ^c	0.916	0.991	0.86 ^b	0.823	0.903	0.90 ^b	0.849	0.953
Hindu (others)	0.93 ^b	0.895	0.953	0.89 ^b	0.862	0.927	0.87 ^b	0.832	0.910
Others	0.79 ^b	0.744	0.829	1.00	0.943	1.069	0.88 ^b	0.734	1.063
ST (Christian)	0.80 ^b	0.733	0.882	0.86 ^b	0.768	0.963	0.88	0.734	1.063

(continued)

Table 6. (continued)

Variables	Malnourishment of Children (Weight for Age)			Anemia of Children			Both Malnourishment and Anemia		
	Odds Ratio	Lower Boundary	Upper Boundary	Odds Ratio	Lower Boundary	Upper Boundary	Odds Ratio	Lower Boundary	Upper Boundary
SLI									
Low ^a	1.00			1.00			1.00		
Medium	0.77 ^b	0.751	0.787	0.92 ^b	0.893	0.944	0.82 ^b	0.794	0.853
High	0.58 ^b	0.557	0.593	0.79 ^b	0.757	0.820	0.60 ^b	0.569	0.633
Zones									
Central ^a	1.00			1.00			1.00		
East	0.77 ^b	0.747	0.786	0.98	0.948	1.010	0.85 ^b	0.820	0.886
West	0.91 ^b	0.883	0.940	1.87 ^b	1.802	1.934	1.54 ^b	1.477	1.611
North	0.75 ^b	0.734	0.773	1.06 ^b	1.028	1.096	0.91 ^b	0.877	0.951
South	0.59 ^b	0.569	0.606	0.90 ^b	0.870	0.941	0.65 ^b	0.622	0.693
Island	0.49 ^b	0.422	0.570	0.56 ^b	0.445	0.696	0.32 ^b	0.216	0.469
Northeast	0.22 ^b	0.204	0.233	0.60 ^b	0.557	0.653	0.19 ^b	0.160	0.218
Constant		1.784 ^b			0.360 ^b			0.218 ^b	
χ^2		10042.043 ^b			3188.662 ^b			3910.709 ^b	

Abbreviations: SC, scheduled caste; ST, scheduled tribe; SLI, standard-of-living index.

^aReference category.^b $P < .01$.^c $P < .05$.

rate by 40%. But reduction of undernutrition in children has occurred only by 20%,²² and anemia is still prevailing at a high level.

Data from our present study show that the prevalence of undernutrition among children increases from the beginning, whereas prevalence of anemia first decreases for 6 months and then starts rising. This may be because of late introduction of complementary food. One of the reasons for interstate nutritional differences may be the variation in the time of introduction of supplementary food. For example, in Delhi, Himachal Pradesh, and Punjab, supplementary food is introduced too early causing obesity, whereas in Uttar Pradesh, Madhya Pradesh, Rajasthan, and Orissa it is given much later. Kerala, Island zones, and most of the states of Northeast India introduce supplementary food well in time. This may be because of the high literacy rates of these states compared with the other states of India.

The study also provides information about the impact of different socioeconomic factors on nutritional status. It is seen that Kerala, Northeast, and Island zones of India and, ethnically, the children of ST (Christians) families always show very good nutritional status than other castes and religious families. From literature survey, it has been found that the Northeast zone is inhabited by 78.9% Christians who are basically more literate than the average Indian people. Also, female literacy is highest among them. Besides Christianity, all the states of Northeast India have relatively higher female literacy as well as overall higher literacy level than other states. Women's autonomy of ST (Christians) is greater than other religious and caste groups in India.²³ We also found that SLI of ST (Christians) is above that of the ST (non-Christians). In Lakshadweep and Andaman Islands also, female literacy is 81.56% and 75.29% respectively.² But in Lakshadweep, Muslims constitute 94% of the population, and in the Andaman Islands, Hindus constitute 69% of the population. These findings help us understand why some regions and some community groups have low prevalence of malnutrition and anemia. It is not economy but literacy that is more important in determining the health status of children.

We may thus conclude that the economic growth alone is not sufficient for substantially reducing malnutrition. It is necessary to improve the status of literacy, especially of female literacy, to reduce the prevalence of malnutrition and anemia among children.

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