Original Research Article

Childhood undernutrition inequalities in Empowered Action Group states of India: evidence from NFHS, 2006-2016

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ABSTRACT

Background: Child undernutrition is a major public health problem in many low and middle income countries and malnutrition alone accounted for 45% (3 million deaths annually) deaths among under-five children. Malnutrition is the concealed cause of one out of every two such deaths. A study was undertaken to examine the trends, determinants and socioeconomic-related inequalities in childhood undernutrition in Empowered Action Group (EAG) states, India. The secondary data of the two rounds of National Family Health Survey, NFHS-3 (2005-06) and NFHS-4 (2015-16) comprising of 16,802 and 128,400 children aged 0-59 months respectively was analysed.

Methods: Non-linear Fairlie decomposition was used to identify and quantify the separate contribution of different socioeconomic characteristics in gap of childhood malnutrition between 2006 and 2016.

Results: Results show that the prevalence of undernutrition has decreased in EAG states during the last one decade, but the prevalence of wasting is remained almost same as 10 years back. The decomposition analysis shows that maternal education, household wealth and place of residence were contributing to socioeconomic inequality in childhood undernutrition from 2006 to 2016.

Conclusions: There is a need to adopt different strategies of health policy intervention. It is important to have policies towards improving female literacy in the EAG states because maternal education plays a vital role in child health and literacy rate is very low among women in EAG states. The existence of a functional health insurance system and increasing universal coverage are recommended to mitigate child undernutrition, so that the vulnerable and deprived populations who are not able to access health care facilities, can easily access health care services for early detection and treatment of undernutrition without any financial constraint.

Keywords: Childhood undernutrition, EAG States, Decomposition analysis, Inequalities

INTRODUCTION

Child undernutrition is a major public health problem in many low- and middle-income countries. In these countries, malnutrition alone has an account of 45% deaths among under-five children, which is estimated at 3 million deaths yearly. Malnutrition is the concealed cause of one out of every two such deaths.^{1,2} It is not equally distributed throughout the world. Disparities in

health outcomes between poor and rich are increasingly attracting attention from researchers and policy makers.^{3,4} Socioeconomic inequality in malnutrition refers to the degree to which childhood malnutrition rate differs between more or less socially and economically advantaged groups. At a more global level, Wagstaff and Watanabe provided evidence on socioeconomic inequality in malnutrition across 20 developing countries.⁵ Other relevant across country studies include

those of who describe total inequality, and who describe inequalities between urban and rural populations.⁶ The latter two studies, nevertheless, provide no evidence on socioeconomic inequality within developing countries.

Moreover, a number of study have found consistent divergence in the prevalence of malnutrition along the lines of age, sex and birth size of children.⁷⁻¹⁰ As well, on that point are consistent findings in child malnutrition studies that households' wealth, usually measured in increments in household material standards which was connected with childhood nutritional status.^{11,12} It is argued that children from the poorest households are stunted or underweight compared to children from the richest households.¹³ Higher rates of stunting and underweight have been associated with children who reside in rural areas than those in urban areas.^{6,14} Further, the level of mother's educational attainment is persistently associated with child malnutrition.^{15,16} Regarding access to health care services, it has been proven that children from households having difficulty in accessing health care services suffer from considerably higher levels of childhood malnutrition.^{17,18}

In Indian society, the inequality has been characterized by its deep roots into the diversity of cultures, languages, caste and religion. This diversity has created divergence in the population in the matter of economic and familial characteristics. If inequalities are arising due to alteration in the level of efforts made by individuals of different background then morally admissible, but if inequalities are due to circumstances which are beyond the control of an individual, such as region, caste, religion, sex, ethnicity and so on, then it will be unethical and unacceptable. This study updates and enlarges the evidence of percentage changes in undernutrition and socioeconomic inequality in undernutrition during the last decade by using the secondary data of National Family Health Survey-3 (NFHS-3) (2005-6) and National Family Health Survey-4 (NFHS-4) (2015-16) of India's 8 demographically backward empowered action group (EAG) states, viz., Bihar, Chattisgarh, Madhya Pradesh, Rajasthan, Orissa, Jharkhand, Uttar Pradesh and Uttarakhand.^{19,20}

METHODS

The present study presents analysis and results based on the secondary data of the two successive rounds of the National Family Health Survey data which are conducted during 2006 (NHFS-3) and 2016 (NFHS-4).^{19,20} The NFHSs is a large-scale, cross-sectional, multiround survey which is nationally representative sample of households throughout India. It has been conducted under the stewardship of the Ministry of Health and Family Welfare, Government of India. The survey provides information on demographic and health parameters as well as data on various socioeconomic and program dimension, which are critical for implementing the desired changes in demographic and health parameters

The sampling design was based on a two-stage sample design. In the first stage enumeration areas (EAs) were drawn from census files. In the second stage, for each selected EA a household sample was drawn from the listing of households. This study was based on Empowered Action Group (EAG) states. The number of eligible women in EAG states (in the age group 15-49 years) interviewed were 20,668 and 147,049 in NFHS-3 and NFHS-4 respectively. The analysis of this study was based on 16,802 and 128,400 children aged 0-59 months from NFHS-3 and NFHS-4 respectively with valid anthropometric component in which weight and measurement recorded in the two consecutive survey. Children whose length/height information was missing or invalid were excluded.

Outcome variables

The present study measures three outcome variables, namely, stunting, wasting and underweight.

Stunting: Stunting is an indicator of linear growth retardation relatively uncommon in the first few months of life. However, it becomes more common as children get older. Children with height-for-age scores below minus two standard deviations (z-score <-2SD) from the median of the reference population are considered short for their age or stunted.

Wasting: Wasting indicates body mass in relation to body length. Children whose weight-for height z-scores are below minus two standard deviations (z-score <-2SD) from the median of the reference population are considered wasted (i.e. too thin for their height) which implies that they are acutely undernourished otherwise they are not wasted.

Underweight: Underweight is a composite index of stunting and wasting. This means children may be underweight if they are either stunted or wasted, or both. In a similar manner child may be underweight, when their z-score is lower than two standard deviations.

Defining predictor variables

Important explanatory variables in the present study were based on the previous studies and data available in the data set. Further these variables were categorized into four categories namely child characteristics, maternal characteristics, household characteristics and community characteristics. Child characteristics included in the analysis were sex of the child, age of child, breastfeeding duration, baby size at birth, place of birth delivery, immunization status of child, birth order, birth interval and child was wanted or unwanted. Maternal characteristics included in the analysis were mother's age at birth, mother's education, Mother's body mass index (BMI). Community characteristics included in the analysis were the place of residence and EAG states.

Statistical analysis

To meet the objective, bivariate and multivariate analysis are carried out to estimate the levels and trends of childhood undernutrition by different socioeconomic and demographic characteristics. Chi-square at the 0.05 level is used to check the statistical association between the outcome and predictor variables in the bivariate analysis. Non-linear Fairlie decomposition method of binary outcome variables were used to identify and quantify the separate contribution of different socioeconomic characteristics in gap of childhood malnutrition between 2006 and 2016.²¹ All statistical analysis was done using Excel, R-CRAN and STATA 13 after adjusting survey design and sampling weight.

RESULTS

Trends in childhood undernutrition in EAG state, India

Results from Figure 1 indicates that the prevalence of undernutrition has decreased in EAG, states during last one decade (2006 to 2016) while the prevalence of wasting remained almost same as 10 years back. The stunting decreased nearly 8% from 52.2% during 2006 to 44.0% during 2016. The prevalence of underweight declined from 48.3% in 2006 to 40.5% in 2016.

Figure 1: Trends in prevalence of stunting, wasting and underweight among children under 5 years of age in EAG states, India, 2006-2016

Socioeconomic differentials in childhood undernutrition

Table 1 represent the socioeconomic differentials in childhood undernutrition by selected socioeconomic characteristics in EAG states, India 2006 to 2016. The prevalence of stunting (15.7%), wasting (5.8%) and underweight (16.1%) in EAG states has dropped during 2006 to 2016. The prevalence of stunting, wasting and underweight were associated with wealth quintile and mother's education.

Table 1: Percentage of children below 5 years of age who were undernutrition by selected socioeconomic characteristics in EAG states, India 2006-2016.

Background characteristics	Stunting			Wasting			Underweight		
Child characteristics	2006	2016	% change 2006-16	2006	2016	% change 2006-16	2006	2016	% change 2006-16
Sex of child									
Male	52.2	44.4	14.9	23.3	22.2	4.7	47.6	40.6	14.7
Female	52.9	43.6	17.6	21.8	20.2	7.3	49.1	40.4	17.7
Age of child									
Less than 12 months	26.0	23.9	8.1	33.8	30.4	10.1	37.9	31.7	16.4
12-24 months	57.5	48.0	16.5	27.5	23.4	14.9	50.7	41.1	18.9
24-36 months	62.2	49.9	19.8	18.7	19.1	-2.1	51.4	42.8	16.7
36-48 months	60.2	50.4	16.3	16.8	17.2	-2.4	51.2	43.1	15.8
48-59 months	56.0	46.6	16.8	16.6	16.7	-0.6	50.1	43.3	13.6
Breast feeding status									
less than 6 months	28.9	27.6	4.5	29.5	26.8	9.2	36.0	31.2	13.3
6-11 months	38.1	28.8	24.4	27.4	26.4	3.6	42.0	33.4	20.5
12-23 months	57.6	47.0	18.4	22.5	23.3	-3.6	50.4	41.4	17.9
24 months and above	62.6	49.9	20.3	18.2	19.8	-8.8	54.1	45.2	16.5
Birth size									
Large	51.0	41.2	19.2	20.5	19.8	3.4	46.6	37.0	20.6
Average	51.8	43.0	17.0	20.6	20.8	-1.0	45.7	39.3	14.0
Small	55.8	51.8	7.2	30.1	25.1	16.6	57.1	50.2	12.1
Place of delivery									
Home delivery	56.0	50.3	10.2	23.3	21.6	7.3	51.8	46.4	10.4
Institutional delivery	41.1	41.5	-1.0	20.2	21.1	-4.5	36.8	38.2	-3.8

Continued.

Background characteristics	Stunting			Wasting			Underweight		
Immunization									
No	49.2	46.9	4.7	28.3	21.4	24.4	49.7	42.8	13.9
Full	49.9	45.8	8.2	18.4	20.0	-8.7	44.4	41.1	7.4
Partial	54.1	41.5	23.3	23.7	22.6	4.6	49.9	39.4	21.0
Birth order									
One	45.9	39.3	14.4	20.8	20.9	-0.5	41.8	36.6	12.4
Two to three	51.5	43.6	15.3	22.7	21.1	7.0	46.8	40.1	14.3
Four and above	58.2	52.5	9.8	23.7	22.2	6.3	54.6	47.7	12.6
Birth Interval									
Less than two years	57.9	50.6	12.6	20.8	21.1	-1.4	51.3	46.0	10.3
More than two years	53.1	44.3	16.6	24.2	21.6	10.7	50.0	40.7	18.6
Status of child									
Wanted	51.5	43.5	15.5	23.3	21.5	7.7	48.4	40.4	16.5
Unwanted	55.2	47.3	14.3	20.8	19.8	4.8	48.2	41.2	14.5
Mother characteristics									
Mother's age at time of birth									
15-24	52.1	43.8	15.9	22.5	21.0	6.7	47.1	40.5	14.0
25-34	51.3	42.9	16.4	22.5	21.4	4.9	47.7	39.6	17.0
35-49	56.6	47.3	16.4	23.2	21.7	6.5	53.9	43.0	20.2
Mother's education									
Illiterate	58.7	52.7	10.2	24.1	22.6	6.2	54.5	48.2	11.6
Literate but below primary	50.3	47.7	5.2	26.4	20.9	20.8	49.5	43.8	11.5
Primary but below middle	47.6	45.4	4.6	19.9	21.0	-5.5	41.2	41.5	-0.7
Middle but below high school	43.1	38.0	11.8	20.2	20.7	-2.5	38.6	35.5	8.0
High school and above	23.8	27.2	-14.3	13.3	18.7	-40.6	20.5	25.3	-23.4
BMI of Mother									
Underweight	56.4	50.3	10.8	27.9	26.1	6.5	56.5	50.9	9.9
Average	50.8	43.2	15.0	19.7	20.4	-3.6	44.2	38.5	12.9
Overweight	38.2	32.2	15.7	8.8	13.8	-56.8	25.9	25.2	2.7
Obese	34.8	28.8	17.2	6.8	9.8	-44.1	15.7	21.5	-36.9
Household characteristics									
Religion									
Hindu	51.8	43.8	15.4	22.7	21.5	5.3	48.2	40.5	16.0
Muslim	56.4	45.6	19.1	21.3	19.5	8.5	48.6	40.2	17.3
Others	52.4	39.0	25.6	30.7	27.2	11.4	55.2	43.0	22.1
Social group									
SC	58.7	50.1	14.7	23.1	21.4	7.4	53.6	44.9	16.2
ST	54.9	47.4	13.7	33.9	28.9	14.7	60.1	49.5	17.6
OBC	53.0	43.8	17.4	21.6	20.5	5.1	48.1	40.1	16.6
Others	43.9	34.2	22.1	18.7	18.2	2.7	37.3	30.0	19.6
Wealth quintile									
Poorest	60.4	53.1	12.1	27.0	23.9	11.5	59.3	49.6	16.4
Poorer	55.8	46.3	17.0	23.3	20.9	10.3	51.4	42.2	17.9
Middle	52.9	39.1	26.1	20.6	19.4	5.8	44.6	34.6	22.4
Richer	43.7	32.6	25.4	18.6	18.8	-1.1	38.3	30.4	20.6
Richest	26.9	24.8	7.8	14.4	18.0	-25.0	22.3	23.1	-3.6
Community characteristics									
Type of residence									
Urban	44.2	36.3	17.9	20.0	20.3	-1.5	38.9	34.0	12.6
Rural	54.3	45.8	15.7	23.1	21.5	6.9	50.4	42.0	16.7

Continued.

Background characteristics	Stunting			Wasting			Underweight		
EAG states									
UP	56.5	46.3	18.1	14.9	18.0	-20.8	42.3	39.5	6.6
Uttarakhand	44.7	33.9	24.2	18.8	19.5	-3.7	38.1	26.8	29.7
Bihar	55.5	48.4	12.8	27.3	20.9	23.4	56.1	44.0	21.6
Jharkhand	49.8	45.5	8.6	32.6	28.9	11.3	57.1	47.8	16.3
Odisha	45.0	34.1	24.2	19.6	20.4	-4.1	40.9	34.3	16.1
Chhattisgarh	53.8	37.6	30.1	20.1	23.1	-14.9	47.7	37.7	21.0
MP	49.8	42.0	15.7	35.3	25.8	26.9	59.9	42.8	28.5
Rajasthan	44.1	39.1	11.3	20.5	23.0	-12.2	40.4	36.6	9.4
EAG states	52.2	44.0	15.7	22.6	21.3	5.8	48.3	40.5	16.1
India	48.0	38.0	20.8	20.0	21.0	-5.0	43.0	36.0	16.3

Sources: Based on author's computation from NFHS-3 (2005-2006) and NFHS-4 (2016).

Calculated as relative change = $[(2006\% - 2016\%) / 2006\% * 100]$

Table 2: Predicted probabilities (95% confidence interval) of stunting among children below 5 years of age who were undernutrition by selected socioeconomic characteristics in EAG states, India 2006-2016.

Background characteristics	Stunting				
Child characteristics	2006		2016		Percentage change in predicted probabilities 2006-2016
	PP	(95% C. I)	PP	(95% C. I)	
Sex of child					
Male	0.522	0.510-0.533	0.434	0.429-0.439	16.819
Female	0.525	0.513-0.538	0.416	0.411-0.422	20.733
Age of child					
Less than 12 months	0.293	0.265-0.321	0.263	0.253-0.274	10.233
12-24 months	0.577	0.553-0.600	0.503	0.492-0.514	12.781
24-36 months	0.607	0.587-0.628	0.481	0.471-0.491	20.802
36-48 months	0.585	0.566-0.605	0.479	0.469-0.489	18.212
48-59 months	0.544	0.524-0.564	0.431	0.420-0.442	20.759
Breast feeding status					
less than 6 months	0.460	0.427-0.492	0.380	0.369-0.392	17.278
6-11 months	0.518	0.490-0.545	0.427	0.415-0.440	17.461
12-23 months	0.515	0.498-0.532	0.413	0.404-0.423	19.758
24 months and above	0.555	0.538-0.571	0.456	0.448-0.464	17.773
Birth size					
Large	0.509	0.490-0.529	0.415	0.405-0.425	18.480
Average	0.514	0.503-0.524	0.418	0.413-0.422	18.672
Small	0.566	0.547-0.585	0.487	0.476-0.497	13.994
Place of delivery					
Home delivery	0.527	0.517-0.537	0.427	0.420-0.434	19.069
Institutional delivery	0.509	0.488-0.530	0.426	0.421-0.430	16.380
Immunization					
No	0.513	0.483-0.544	0.413	0.399-0.426	19.592
Full	0.506	0.489-0.523	0.427	0.421-0.433	15.585
Partial	0.533	0.522-0.545	0.428	0.422-0.433	19.844
Birth order					
Two to three	0.517	0.505-0.530	0.418	0.414-0.423	19.125
Four and above	0.531	0.517-0.546	0.444	0.436-0.451	16.526
Birth Interval					
Less than two years	0.554	0.538-0.569	0.456	0.449-0.463	17.618
More than two years	0.509	0.499-0.520	0.414	0.409-0.418	18.763
Status of child					

Continued.

Background characteristics	Stunting				
Wanted	0.522	0.511-0.532	0.426	0.422-0.430	18.349
Unwanted	0.527	0.512-0.543	0.428	0.417-0.438	18.879
Mother's characteristics					
Mother's age at time of birth					
15-24	0.528	0.514-0.542	0.430	0.423-0.436	18.620
25-34	0.519	0.504-0.533	0.426	0.420-0.432	17.846
35-49	0.522	0.501-0.544	0.420	0.411-0.429	19.548
Mother's education					
Illiterate	0.545	0.534-0.557	0.456	0.450-0.463	16.316
Literate but below primary	0.500	0.465-0.535	0.438	0.423-0.453	12.426
Primary but below middle	0.502	0.470-0.534	0.432	0.420-0.444	13.970
Middle but below high school	0.506	0.483-0.528	0.402	0.394-0.409	20.610
High school and above	0.383	0.339-0.427	0.341	0.328-0.354	10.972
BMI of Mother					
Underweight	0.547	0.534-0.561	0.460	0.452-0.467	16.022
Average	0.512	0.500-0.523	0.419	0.414-0.424	18.055
Overweight	0.447	0.404-0.490	0.377	0.364-0.390	15.612
Obese	0.552	0.462-0.641	0.374	0.347-0.400	32.312
Household characteristics					
Religion					
Hindu	0.518	0.508-0.527	0.423	0.419-0.427	18.221
Muslim	0.548	0.525-0.571	0.449	0.438-0.459	18.148
Others	0.554	0.494-0.613	0.389	0.362-0.416	29.747
Social group					
SC	0.556	0.537-0.575	0.453	0.445-0.461	18.496
ST	0.526	0.499-0.552	0.444	0.433-0.455	15.510
OBC	0.521	0.508-0.533	0.422	0.416-0.427	18.997
Others	0.495	0.474-0.515	0.383	0.373-0.393	22.559
Wealth quintile					
Poorest	0.578	0.561-0.596	0.473	0.465-0.480	18.291
Poorer	0.533	0.515-0.552	0.442	0.434-0.449	17.227
Middle	0.523	0.503-0.544	0.399	0.390-0.409	23.735
Richer	0.482	0.459-0.506	0.359	0.347-0.370	25.644
Richest	0.400	0.366-0.435	0.315	0.300-0.330	21.216
Community characteristics					
Type of residence					
Urban	0.541	0.522-0.560	0.442	0.432-0.452	18.350
Rural	0.517	0.506-0.527	0.423	0.418-0.427	18.189
EAG states					
UP	0.556	0.518-0.594	0.438	0.428-0.447	21.277
Uttarakhand	0.449	0.422-0.475	0.394	0.379-0.409	12.148
Bihar	0.564	0.548-0.579	0.424	0.411-0.437	24.852
Jharkhand	0.554	0.530-0.579	0.410	0.401-0.420	25.965
Odisha	0.460	0.429-0.492	0.352	0.339-0.366	23.410
Chhattisgarh	0.471	0.439-0.504	0.407	0.396-0.418	13.644
MP	0.537	0.507-0.567	0.463	0.455-0.470	13.837
Rajasthan	0.501	0.478-0.523	0.417	0.396-0.437	16.814

The prevalence of stunting, wasting and underweight were declined among sex of child and children whose birth size small. Prevalence of stunting (50% versus 42%)

and underweight (46% versus 38%) were more in home delivery as compared to institutional delivery. Examining the prevalence of undernutrition by mother's level of

education also provides similar patterns of decline. For instance, the prevalence of stunting has declined from 59 percent in 2006 to 53 percent in 2016 and underweight has 55 percent in 2006 to 42 percent in 2016 among the uneducated mothers. In contrast, the prevalence of stunting and underweight among the most educated mothers (>secondary) has increased in 2006 to 2016. Undernourished mother has played a significant role to increased stunting and underweight. In other words, the prevalence of both, stunting and underweight, during this period have declined across wealth and educational categories. For instance, among the richest wealth quintile, the prevalence of stunting has dropped from 27 percent in 2006 to 25 percent in 2016. Among the poorest wealth quintile, the prevalence of stunting and underweight has declined by 12 percent and 16 percent respectively during a last decade. The trends remain more or less similar across other wealth quintiles. Percentage of stunting and underweight are more among children who belong to rural areas than who belong to urban areas and has almost similar patterns of declined.

Multivariate analysis

In this study Table 2, 3 and 4 depict the magnitude of change in childhood undernutrition by selected socioeconomic characteristics over a decade. Table 2, result indicate that the predicted probabilities of stunted among male and female children were almost same however the decline in the prevalence of stunted was 4 percent higher among female compared to male children during 2006-16. At the same period, the prevalence of stunted was about twice higher (21%) among children whose age 4 to 5 years than the children whose age less than 1 year (10%). Likewise, the decline in the prevalence of stunted children was almost double (21%) among mothers who had completed middle or below middle as

compared to mothers who had completed high school or above (11%) and obesity mother (16%) as compared to low BMI of mother (32%). There were no much difference found in breastfeeding status, birth size, and place of delivery, immunization, birth order, birth interval, status of child, mother's age at time of birth. Caste and religion also varied the changes. Over the same period, children who belong to the poorest quintile, the probability of stunted declined from 0.578 to 0.473, a decline of 18 percent points whereas, children who belong richer quintile, the probability of stunted declined by 25 percent. The higher percentage of declining in prevalence of stunting in Jharkhand as compared to other states. The predicted probabilities of stunted was higher among children from Madhya Pradesh (0.463). The declined of predicted probability was lower in Madhya Pradesh (14%) than Jharkhand (26%) during 2006-16.

According to Table 3, the predicted probabilities of wasted among children below 5 years of age were increased during a decade. It varied by age of child, breastfeeding status, birth size, birth order and birth interval while sex of child, place of delivery, immunization and status of child had no much difference of predicted probabilities of wasted. Considering mother's education, the predicted probability of wasted higher among children of mothers with no education, from 0.228 in 2006 to 0.437 in 2016, which was increased by 92 percent. Children who belong to the poorest quintile had a higher probability of wasted as compared to the richest quintile. The predicted probability of wasted was increased more among poorest children (88%) than the richest children (57%). In the case of variation in the probability of wasted children, the predicted probability of wasted increased by 92 percent in urban areas and 78 percent in rural areas over the last decade.

Table 3: Predicted probabilities (95% confidence interval) of wasting among children below 5 years of age who were undernutrition by selected socioeconomic characteristics in EAG states, India 2006–2016.

Background characteristics	Wasting				
Child characteristics	2006		2016		Percentage change in predicted probabilities 2006-2016
	PP	(95% C. I)	PP	(95% C. I)	
Sex of child					
Male	0.235	0.225-0.246	0.417	0.412-0.422	-76.926
Female	0.218	0.207-0.228	0.404	0.398-0.409	-85.656
Age of child					
Less than 12 months	0.341	0.308-0.375	0.345	0.333-0.357	-1.104
12-24 months	0.260	0.238-0.282	0.433	0.422-0.444	-66.478
24-36 months	0.194	0.177-0.211	0.442	0.433-0.452	-128.269
36-48 months	0.176	0.160-0.191	0.429	0.418-0.439	-143.789
48-59 months	0.171	0.156-0.186	0.419	0.408-0.430	-144.818
Breast feeding status					
less than 6 months	0.231	0.205-0.258	0.367	0.356-0.379	-58.951
6-11 months	0.201	0.180-0.223	0.407	0.395-0.419	-102.066

Continued.

Background characteristics	Wasting				
12-23 months	0.232	0.216-0.248	0.402	0.392-0.412	-73.046
24 months and above	0.233	0.216-0.250	0.440	0.432-0.449	-88.808
Birth size					
Large	0.206	0.190-0.223	0.383	0.374-0.393	-85.736
Average	0.216	0.207-0.225	0.402	0.397-0.406	-86.051
Small	0.276	0.259-0.293	0.495	0.484-0.506	-79.124
Place of delivery					
Home delivery	0.226	0.217-0.234	0.416	0.409-0.423	-84.390
Institutional delivery	0.231	0.213-0.250	0.409	0.404-0.413	-76.702
Immunization					
No	0.246	0.220-0.271	0.402	0.389-0.416	-63.838
Full	0.217	0.202-0.232	0.417	0.411-0.423	-91.907
Partial	0.228	0.219-0.238	0.406	0.401-0.412	-78.023
Birth order					
Two to three	0.227	0.216-0.238	0.404	0.399-0.409	-77.866
Four and above	0.227	0.214-0.239	0.427	0.419-0.435	-88.357
Birth Interval					
Less than two years	0.210	0.197-0.223	0.441	0.434-0.448	-109.933
More than two years	0.234	0.225-0.243	0.398	0.394-0.403	-69.989
Status of child					
Wanted	0.225	0.217-0.234	0.412	0.408-0.416	-82.760
Unwanted	0.230	0.216-0.244	0.404	0.393-0.415	-75.527
Mother characteristics					
Mother's age at time of birth					
15-24	0.226	0.213-0.238	0.412	0.405-0.419	-82.628
25-34	0.227	0.215-0.239	0.410	0.404-0.416	-80.530
35-49	0.229	0.210-0.248	0.411	0.401-0.420	-79.313
Mother's education					
Illiterate	0.228	0.218-0.238	0.437	0.431-0.444	-92.036
Literate but below primary	0.245	0.215-0.276	0.420	0.405-0.435	-71.047
Primary but below middle	0.226	0.198-0.254	0.413	0.401-0.425	-82.846
Middle but below high school	0.228	0.208-0.248	0.386	0.379-0.394	-69.545
High school and above	0.191	0.154-0.227	0.345	0.331-0.358	-80.756
BMI of mother					
Underweight	0.269	0.257-0.281	0.494	0.486-0.501	-83.647
Average	0.203	0.193-0.212	0.390	0.386-0.395	-92.548
Overweight	0.143	0.110-0.177	0.307	0.294-0.320	-114.150
Obese	0.104	0.038-0.170	0.296	0.270-0.322	-183.658
Household characteristics					
Religion					
Hindu	0.224	0.216-0.232	0.408	0.404-0.412	-81.858
Muslim	0.233	0.212-0.254	0.428	0.417-0.439	-83.788
Others	0.271	0.219-0.323	0.413	0.385-0.440	-52.242
Social group					
SC	0.227	0.210-0.243	0.432	0.424-0.441	-90.655
ST	0.273	0.249-0.296	0.444	0.433-0.455	-62.763
OBC	0.214	0.203-0.225	0.405	0.400-0.411	-89.463
Others	0.223	0.205-0.241	0.362	0.352-0.373	-62.439
Wealth quintile					
Poorest	0.243	0.228-0.258	0.459	0.451-0.466	-88.489
Poorer	0.223	0.207-0.238	0.418	0.411-0.426	-87.970

Continued.

Background characteristics	Wasting				
Middle	0.222	0.205-0.240	0.377	0.367-0.386	-69.343
Richer	0.219	0.198-0.239	0.351	0.339-0.363	-60.315
Richest	0.198	0.169-0.228	0.311	0.296-0.326	-56.891
Community characteristics					
Type of residence					
Urban	0.227	0.210-0.244	0.437	0.427-0.447	-92.211
Rural	0.227	0.218-0.236	0.405	0.401-0.409	-78.768
EAG states					
UP	0.211	0.178-0.244	0.419	0.410-0.428	-98.808
Uttarakhand	0.206	0.183-0.228	0.403	0.388-0.418	-96.149
Bihar	0.161	0.148-0.173	0.444	0.430-0.457	-176.568
Jharkhand	0.280	0.257-0.303	0.437	0.427-0.447	-56.014
Odisha	0.276	0.247-0.305	0.363	0.348-0.377	-31.465
Chhattisgarh	0.181	0.157-0.206	0.397	0.385-0.408	-118.615
MP	0.200	0.176-0.225	0.408	0.401-0.415	-103.524
Rajasthan	0.355	0.332-0.377	0.351	0.331-0.371	0.987

Table 4: Predicted probabilities (95% confidence interval) of underweight among children below 5 years of age who were undernutrition by selected socioeconomic characteristics in EAG states, India 2006-2016.

Background characteristics	Underweight				
Child characteristics	2006		2016		Percentage change in predicted probabilities
	PP	(95% C. I)	PP	(95% C. I)	2006-2016
Sex of child					
Male	0.478	0.466-0.490	0.417	0.412-0.422	12.888
Female	0.485	0.473-0.497	0.404	0.398-0.409	16.735
Age of child					
Less than 12 months	0.398	0.368-0.428	0.345	0.333-0.357	13.224
12-24 months	0.501	0.477-0.524	0.433	0.422-0.444	13.480
24-36 months	0.512	0.491-0.533	0.442	0.433-0.452	13.598
36-48 months	0.501	0.481-0.521	0.429	0.418-0.439	14.444
48-59 months	0.492	0.473-0.512	0.419	0.408-0.430	14.895
Breast feeding status					
less than 6 months	0.447	0.415-0.479	0.367	0.356-0.379	17.869
6-11 months	0.458	0.431-0.486	0.407	0.395-0.419	11.202
12-23 months	0.474	0.457-0.491	0.402	0.392-0.412	15.216
24 months and above	0.510	0.493-0.528	0.440	0.432-0.449	13.715
Birth size					
Large	0.468	0.448-0.489	0.383	0.374-0.393	18.135
Average	0.459	0.448-0.470	0.402	0.397-0.406	12.472
Small	0.562	0.543-0.581	0.495	0.484-0.506	11.921
Place of delivery					
Home delivery	0.486	0.476-0.496	0.416	0.409-0.423	14.374
Institutional delivery	0.463	0.442-0.485	0.409	0.404-0.413	11.854
Immunization					
No	0.471	0.440-0.501	0.402	0.389-0.416	14.506
Full	0.475	0.458-0.492	0.417	0.411-0.423	12.230
Partial	0.486	0.475-0.497	0.406	0.401-0.412	16.382
Birth order					
Two to three	0.473	0.460-0.486	0.404	0.399-0.409	14.633
Four and above	0.492	0.477-0.507	0.427	0.419-0.435	13.281
Birth interval					
Less than two years	0.498	0.482-0.513	0.441	0.434-0.448	11.374

Continued.

Background characteristics					
Underweight					
More than two years	0.474	0.464-0.484	0.398	0.394-0.403	15.939
Status of child					
Wanted	0.481	0.470-0.491	0.412	0.408-0.416	14.366
Unwanted	0.482	0.467-0.498	0.404	0.393-0.415	16.236
Mother characteristics					
Mother's age at time of birth					
15-24	0.479	0.465-0.494	0.412	0.405-0.419	14.079
25-34	0.482	0.468-0.496	0.410	0.404-0.416	14.922
35-49	0.485	0.463-0.507	0.411	0.401-0.420	15.318
Mother's education					
Illiterate	0.505	0.493-0.517	0.437	0.431-0.444	13.414
Literate but below primary	0.479	0.443-0.514	0.420	0.405-0.435	12.318
Primary but below middle	0.440	0.407-0.473	0.413	0.401-0.425	6.118
Middle but below high school	0.455	0.432-0.478	0.386	0.379-0.394	15.147
High school and above	0.332	0.287-0.377	0.345	0.331-0.358	-3.871
BMI of Mother					
Underweight	0.537	0.523-0.550	0.494	0.486-0.501	7.972
Average	0.449	0.438-0.461	0.390	0.386-0.395	13.137
Overweight	0.386	0.341-0.430	0.307	0.294-0.320	20.395
Obese	0.402	0.301-0.503	0.296	0.270-0.322	26.421
Household characteristics					
Religion					
Hindu	0.477	0.467-0.487	0.408	0.404-0.412	14.473
Muslim	0.495	0.471-0.518	0.428	0.417-0.439	13.531
Others	0.545	0.483-0.606	0.413	0.385-0.440	24.237
Social group					
SC	0.507	0.487-0.526	0.432	0.424-0.441	14.630
ST	0.517	0.489-0.544	0.444	0.433-0.455	14.029
OBC	0.476	0.463-0.488	0.405	0.400-0.411	14.784
Others	0.446	0.425-0.467	0.362	0.352-0.373	18.672
Wealth quintile					
Poorest	0.540	0.522-0.558	0.459	0.451-0.466	15.024
Poorer	0.492	0.473-0.511	0.418	0.411-0.426	14.938
Middle	0.462	0.441-0.482	0.377	0.367-0.386	18.387
Richer	0.443	0.419-0.467	0.351	0.339-0.363	20.809
Richest	0.365	0.330-0.401	0.311	0.296-0.326	14.860
Community characteristics					
Type of residence					
Urban	0.487	0.468-0.507	0.437	0.427-0.447	10.340
Rural	0.479	0.468-0.490	0.405	0.401-0.409	15.463
EAG states					
UP	0.498	0.459-0.537	0.419	0.410-0.428	15.914
Uttarakhand	0.415	0.389-0.442	0.403	0.388-0.418	2.928
Bihar	0.437	0.421-0.452	0.444	0.430-0.457	-1.695
Jharkhand	0.555	0.530-0.580	0.437	0.427-0.447	21.233
Odisha	0.508	0.476-0.540	0.363	0.348-0.377	28.637
Chhattisgarh	0.408	0.376-0.440	0.397	0.385-0.408	2.822
MP	0.461	0.430-0.492	0.408	0.401-0.415	11.513
Rajasthan	0.595	0.573-0.618	0.351	0.331-0.371	40.997

Table 5: Decomposition analysis for underweight in children below age five.

N of observation G=0	6581		
N of observation G=0	20329		
Pr (Y!=0G=0) (NFHS-3)	0.45685		
Pr (Y!=0G=1) (NFHS-4)	0.41291		
Difference	0.04394		
Total explained	0.05101		
Characteristics	Coefficients	Percentage contribution	P>z
Not working	0.00595	11.7	0.000
Urban residence	0.00086	1.7	0.410
Full immunization	-0.00357	-7.0	0.015
Birth order less than three	0.00364	7.1	0.000
Unwanted child	0.00052	1.0	0.696
Age at first birth more than 20	0.00674	13.2	0.000
Under nourished mother	0.01073	21.0	0.000
Religion Hindu	0.00041	0.8	0.002
SC/ST	-0.00217	-4.3	0.000
Rich	-0.00784	-15.4	0.000
Open defecation	0.00129	2.5	0.054
Currently breastfeeding	0.00012	0.2	0.423
Institutional delivery	0.02130	41.8	0.000
Educated mother	0.01301	25.5	0.000

Table 6: Decomposition analysis for stunting in children below age five.

N of observation G=0	16581		
N of observation G=0	20329		
Pr (Y!=0G=0) (NFHS-3)	0.49762		
Pr (Y!=0G=1) (NFHS-4)	0.43322		
Difference	0.06439		
Total explained	0.05821		
Characteristics	Coefficients	Percentage contribution	P>z
Not working	0.00186	3.2	0.193
Urban residence	0.00009	0.2	0.936
Full immunization	-0.00537	-9.2	0.000
Birth order less than three	0.00175	3.0	0.081
Unwanted child	0.00589	10.1	0.000
Age at first birth more than 20	0.01177	20.2	0.000
Under nourished mother	0.00435	7.5	0.000
Religion Hindu	0.00056	1.0	0.000
SC/ST	-0.00099	-1.7	0.004
Rich	-0.00931	-16.0	0.000
Open defecation	0.00035	0.6	0.581
Currently breastfeeding	-0.00020	-0.3	0.169
Institutional delivery	0.03277	56.3	0.000
Educated mother	0.01466	25.2	0.000

As stated in Table 4, children whose aged above less than one year were less predicted probabilities of underweight as compared to whose age above one year and the percentage change in predicted probabilities were higher among children whose age 4 to 5 years (15%) compared to children whose age less than one year (13%). The probability of underweight was higher among the small birth size of children (0.49) as compared to the large size

of children (0.38) which was declined by 18 percent and 12 percent respectively. These were also varied by place of delivery, immunization, birth order, birth interval, status of the child, mother's age at time of birth. Considering mother's education, the probability of underweight among children of mothers with no education, from 0.505 in 2006 to 0.437 in 2016, whereas the declined among children with more educated mothers

was 15 percent. Children who belong to the poorest quintile had a higher risk of underweight as compared to the richest quintile. The percentage of underweight declined more among richer children (21%) than the poorest children (15%). In the case of variation in the proportion of underweight children, the predicted probability of underweight declined by 15 percent in rural areas and 10 percent in urban areas over the last decade.

Socio-economic inequality in childhood undernutrition

Tables 5 and 6 present results from the decomposition analysis which shows how the various socioeconomic characteristics of respondents contribute to inequality in child undernutrition. According to Table 5, institutional delivery contributed 41.8 percent and educated mothers contributed 25.5 percent in reducing the prevalence of underweight. Proportion of undernourished mothers contributed 21.0 percent in reducing the prevalence of underweight children it means percentage of undernourished mothers has decreased from 2006 to 2016. Similarly, proportion of not working mothers contributed 11.7 percent in total reduction of underweight children, it possible only if proportion of not working mothers decreased from 2006 to 2016. Proportion of rich has tried to increase the prevalence of underweight children from 2006 to 2016, this is also due to reduction in proportion of rich from 2006 to 2016. Although in Table 6, institutional delivery and educated mother contributed about 56 percent and 25 percent in reducing the prevalence of stunting respectively. Mothers whose age at first birth more than 20 years were contributed 20.2 percent whereas unwanted child contributed 10.0 percent. Proportion of under-nourished mothers contributed 7.5 percent in reducing the prevalence of stunting children. Proportion of rich has tried to increase the prevalence of under-weight children from 2006 to 2016, this is also due to reduction in proportion of rich from 2006 to 2016.

DISCUSSION

There are various programmes in India that are centered around absolute undernutrition among children under five years, but as per the findings of the study, socioeconomic inequality in undernutrition is still present in India. The study investigated the prevalence of undernutrition at the national level and then measured the socioeconomic inequality in undernutrition among under five children. According to the present study, the prevalence of stunting (38%) and underweight (36%) have declined by 21 percent and 16 percent during the decade respectively while, wasting increased by 5 percent. Sex-specific differences in child undernutrition revealed that there is a significant decline among both males and females during a last decade. Sex of child, child's age, birth size, place of delivery, immunization, birth order, birth interval, status of child, mother's education level, BMI of mother, wealth quintile and place of residence were significantly associated with stunting and underweight. Most of the stunting and underweight children were found among

women whose were young at the time of delivery. The Akombi study also suggests the increasing trend in child undernutrition in northern Nigeria, compounded by the overall status of women in the region, where pregnancies at a young age (15-19 years) were very high and women's education levels are very low.²²

The decomposition analysis shows how undernutrition is distributed among various socioeconomic groups. Mother's poor nutritional status is playing significant role in the child's short-term as well as long-term growth failures. According to Smith and Haddad, women's nutritional status does indeed affect children's nutritional status in early childhood through being less successful at breastfeeding, and caring practice that is vitally important for a child's health and proper growth.²³ The children of uneducated woman have significantly higher risk of undernutrition than the children of woman who are educated. These results suggest that educated and knowledgeable mothers might have better health seeking behaviour coupled with household hygiene practices and they are likely to take appropriate actions to improve the health status of their children, which is also an important component of child nutrition. Similarly, prevalence of underweight and stunting are more improved among children whose mother are working. Besides these covariates, place of residence, birth order, child status, religion, and sanitation facility also play a vital role in child undernutrition.

Increased access to health services and the development of healthcare facilities, as well as the promotion of public health indicators after the implementation of a health care programme across the country on the one hand, and the establishment of the Multidisciplinary Program for Improvement of Nutritional Status of Children in India on the other hand, may be the main reasons that the prevalence of undernutrition has decreased in recent years in India. The average reports of undernutrition indices at the national level can be misleading and may hide useful and vital subnational information that can be used for better and more appropriate policymaking.^{24,25}

Therefore, obtaining a clear picture of undernutrition in children across socioeconomic groups, especially the stunting index, which has a well-proven relationship with the socioeconomic status of children seems essential for policymakers.^{7,26,27}

CONCLUSION

The results of this study indicated that not only the degree of socioeconomic inequality in undernutrition but also its pattern should be of concern in setting health policies. For this there is need to adopt different strategies of health policy intervention. It is important to have policies towards improving female literacy in the EAG states because maternal education plays a vital role in child health and in EAG states, the literacy rate is very low among women.

The existence of a functional health insurance system and increasing universal coverage are recommended to mitigate child undernutrition, so that the vulnerable and deprived populations who are not able to access health care facilities, can easily access health care services for early detection and treatment of undernutrition without any financial constraint.

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