

## Original Research Article

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# Scenario of under nutrition among under five years children in India and its states: findings from National Family Health Survey

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## ABSTRACT

**Background:** The status of undernutrition among under 5 years children living in India is a public health concern. Our study identified contributed factors of undernutrition and current scenario of undernutrition among children living across Indian states. Objective of the study was to know the current scenario of undernutrition among under 5 years children across Indian states and to examine the associated factors with this.

**Methods:** This study used data from 4th round of National Family Health Survey (NFHS-4) that was coordinated by International Institute for Population Sciences (IIPS) during 2015-16 under the ministry of health and family welfare, GoI. Multiple logistic regression model was done to study the association between outcome (under nutrition) and socio-economic and bio-medical predictors.

**Results:** This study identified four empowered action group (EAG) states as the problem states because of the greater number of undernourished children living in these states than other Indian states. The children whose mothers were fully exposed to mass media like newspapers/radio/television, have lower prevalence of undernutrition (50.6%). The results of multiple logistic regression revealed that the children belonging to poorest households were 2 times more likely [OR-CI, 2.35 (2.27-2.44)] to be undernourished than those belonging to richest.

**Conclusions:** Undernutrition can be reduced through awareness with the help of mass media, providing higher education to women and reducing socio-economic inequalities. It is necessary to re-think about nutritional policy with respect to children under 5 years and frame a full proof implementation plan to reduce undernutrition in India.

**Keywords:** Problem states, Stunted, Underweight, Wasted

## INTRODUCTION

In India, lack of nutrition and energy in kids is one of the most serious public health problems. The Food, health and care are influence by social, economic and political factors. The relative importance and combination of these factors differ from country to country.<sup>1</sup> Half of the world malnourished children covered by three countries named Bangladesh, India and Pakistan.<sup>2</sup> The malnutrition has directly or indirectly been responsible for 60 % of the 10.9 million deaths annually among under five children in

the world. Over 33% of these deaths are often associated with inappropriate feeding practices during first years of life. Globally, no more than 35 percent infants are exclusive breastfed during the first four months of life.<sup>3</sup> In the first six months of life, almost 96% of all infant deaths in developing countries are attributable to inappropriate feeding.<sup>4</sup> The empowered action group (EAG) states performance in regard to the utilization of maternal and child health (MCH) services has been laggard. These EAG states Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Orissa, Jharkhand,

Chhattisgarh and Uttarakhand. EAG states having much poorest population among the remaining states of India and also stand on the lower most rank of the human development index (HDI).<sup>5</sup> The prevalence of underweight children in India is the highest among lower or middle-income countries in the world, and nearly doubles that of Sub-Saharan Africa with direct consequences for mobility, mortality, productivity and economic growth.<sup>6</sup> Around 50% of the preschool children are stunted, 40 % of them are underweight and 20% of them are wasting. About 60 million children are underweight in India.<sup>7</sup> India was committed towards halving the prevalence of underweight children by 2015-as a key indicator for achieving the millennium development goal (MDG) of eradicating extreme poverty and hunger.<sup>8</sup>

Despite of the efforts by both national and international donors to enhance child malnutrition through ICDS, the level of malnutrition remains staggering. A wide social and economic disparities in health and nutritional outcomes is debated among many researchers and policy makers.<sup>9-11</sup> After many intervention programs related to malnutrition in India, condition is not enough good but yes, it's still improving as compared to previous. Changing dietary pattern is also responsible for non-communicable disease like obesity, hypertension, etc. Globally joint report on malnutrition prepared by WHO, UNICEF and World Bank reveal that 26 percent children under 5-year age were stunted (i.e., height-for-age below -2 SD) in 2011. A decreasing trend was found from a 35% in 1990 to 26 % in 2011.

At Global level high prevalence levels of stunting among children under-five years of age in Africa (36% in 2011) followed by Asia (27% in 2011) remain an alarming public health issue. More than 90% of the world's stunted children live in Africa and Asia.

In context of underweight globally, 16 % children under-five years of age were underweight (i.e., weight-for-age below -2SD) in 2011 - a 36% decrease from an estimated 159 million in 1990. Although, the prevalence of height-for-age(stunting) and weight-for-age (underweight) among children under-five years of age worldwide have decreased since 1990. The overall progress is insufficient and millions of children remain at risk. Wasting was also most important component of child malnutrition, an estimated 52 million children under-five years of age, or 8% were wasted in 2011 - a 11% decrease from an estimated 58 million in 1990 globally. Around 70% of the world's wasted children live in Asia, most in South-Central Asia. The children are at substantial increased risk of severe acute malnutrition and death. A proper nutrition affects significantly to declines in under-five mortality rates. To improve nutritional status is essential for achieving the MDGs.

As per the recent study on child malnutrition in India reveals that overall prevalence of malnutrition was still

high since 1992 -2016. Prevalence of underweight and stunting were found in decreasing trend while wasting was in increasing trend from 17% to 23%.<sup>12</sup>

To study the current scenario of undernutrition among children in the age group 0-59 months (under 5 years), the objectives were to study the spatial distribution of undernourished children through 3 indicators- stunting, underweight and wasting across Indian states, to study the associated factors between undernourished children and socio-economic and bio-medical predictors and to estimate the percentage contribution of selected associated predictors of undernourished children belonging to poor and non-poor households through multivariate decomposition approach.

## METHODS

This study utilizes data from National Family Health Survey of India, round 4 (NFHS-4) which was conducted in 2015-16. The NFHS is an Indian version of demographic and health survey (DHS). NFHS is a large scale periodic national survey conducted by the Government of India to obtain nationwide data on health and family welfare. Twenty-nine Indian states and 7 union territories were covered for data collection in NFHS-4. Separate questionnaires were used for men, women and households.

Biomarker details for different disease conditions were also recorded. The data collected for the variables was self-reported. The NFHS-4 sample used a stratified two stage sampling with cross-sectional study design. The details of the study, methods, sampling frame and questionnaire have been mentioned in the published report of NFHS-4 (13). 699,686 women between the age of 15-49 years and 112,122 men between the ages of 15-54 years and 259,627 children were included in the survey and the overall response rate was 98%. Our study included only children under 0-59 months from data of NFHS. In this paper, we focused on child under nutrition among under five children. NFHS-4 provides data on nutritional status in terms of z-scores. The values of z-scores are used to estimate stunting, wasting and underweighting among children (0-5 years). These three nutritional status indicators are expressed in terms of standard deviation unit (Z-score) from the median of the reference population. The index of the malnutrition provides different information about development and body composition that are used to study the nutritional status of children. The indices based on z-score are categorized into 3 types namely height-for-Age z-score (HAZ), weight-for-height z-score (WHZ) and weight-for-age z-score (WAZ). As per the guidelines suggested by WHO, Stunting, Wasting and Underweight were used to measure under nutrition status of children under 5 years.

### Outcome variable

The indicators of undernutrition i.e. stunting (hw70), underweight (hw71) and wasting (hw72) were available in terms of z-score in the kids file of NFHS-4 data downloaded from the website of DHS. The main outcome variable of the study was 'under nutrition'. This variable has been created after clubbing dichotomous code (0 and 1) of the variables stunting, underweight and wasting, which were already dichotomized. Also, we have created the variable media by clubbing responses of the pre-existing variables in data i.e., frequency of reading newspaper or magazine (v157), frequency of listening to radio(v158) and frequency of watching television (v159).

### Predictors

The predictors used in this study are age-group, sex, maternal education level, number of anti-natal care visits during pregnancy, wealth index, anemia level, media and diarrhea.

### Data analysis

We have removed list wise missing, flagged and no information cases before performing analyses. State wise prevalence (%) has been estimated for stunting, wasting and underweight children under 5 years. Multiple logistic regression models were done to study the association between outcome (undernutrition) and predictors.

A state wise spatial map based on prevalence (%) of indicators of undernutrition was created in STATA software through the packages 'shp2dta' (package used to convert 'shp file' into 'dta format' and 'spmap' (specially designed to visualize spatial data). To test the multicollinearity between independent predictors, we have used two commonly used measures i.e., tolerance (an indicator of how much collinearity a regression analysis can tolerate) and variance inflation factor (VIF) (an indicator of how much of the inflation of the standard error could be caused by collinearity). As a rule of thumb, a VIF of 10 or greater (equivalently, tolerance of 0.1 or less) is a cause for concern. In our study, we found VIF of all the predictors to be less than 10. That's why we have included all the variables in the regression model.

The mathematical formula of the multiple logistic regression models is as given below-

$$\log \left( \frac{P_k}{1-P_k} \right) = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \dots + \beta_8 * X_8$$

where,  $P_k$  = Probability of undernutrition among under 5 children ( $k=1, 2, 3, \dots, 8$ )

$X_1, X_2, X_3, \dots, X_{10}$  are predictors (age, sex, maternal education, wealth index, media, anemia, ANC visit, diarrhoea).

$\beta_1, \beta_2, \beta_3, \dots, \beta_8$  are coefficients,  $\beta_0$  is intercept.

The package 'mvdcmp' was used to estimate the contributing factors affecting undernutrition use among 5 years children. The package 'mvdcmp' was primarily made for use in non-linear decomposition and was based on recent contributions, which include convenient method to handle path dependency, calculating asymptotic standard errors, and overcoming the identification of problem associated with the choice of a reference category when dummy variable are included among the predictors.<sup>14</sup> The technique of decomposition was used to know the contributing factors affecting (directly or indirectly) or may affect the under nutrition among children (under 5 years).

Mathematical formulation of the overall decomposition has given below-

$$Z = G(Y\sigma)$$

Where  $Z = n \times 1$  dependent variable vector undernutrition (dependent variable),  $Y = n \times k$  matrix of independent variables and  $\sigma$  is  $k \times 1$  vector of coefficients.  $G(\cdot)$  is any once-differential function mapping a linear combination of  $Y(Y\sigma)$  to  $Z$

The mean difference in  $Z$  between two groups H (poor) and I (non-poor) can be decomposed as –

$$Z_H - Z_I = G(Y_H \sigma_H) - G(Y_I \sigma_I)$$

$$Z_H - Z_I = \{G(Y_H \sigma_H) - G(Y_I \sigma_H)\} + \{G(Y_I \sigma_H) - G(Y_I \sigma_I)\}$$

$$E \qquad \qquad \qquad C$$

Here component 'E' refers to the part of the differential attributable to difference in endowments or characteristics while, 'C' refers to the part of the differential attributable to differences in coefficients. Here, I had selected H as the comparison group and I as the reference group.

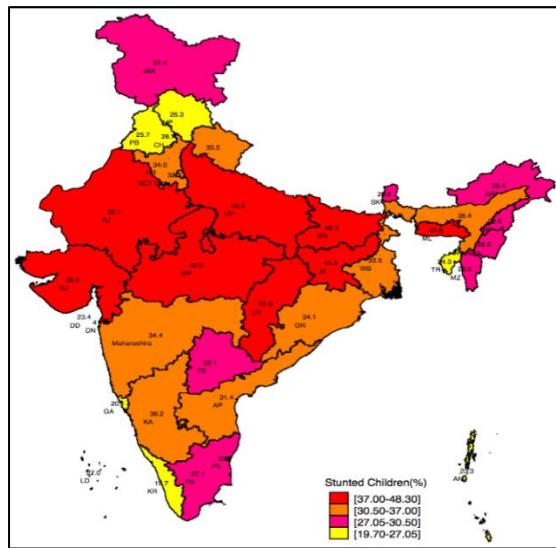
All statistical analyses were performed using STATA (version 13.0)

## RESULTS

### Scenario of stunted children in India

We have found that about 38 per cent of under 5 years children were stunted in India. Around 6 EAG ((Uttar Pradesh (46.3%), Bihar (48.3%), Rajasthan (39.1%), Madhya Pradesh (42.0%), Chhattisgarh (37.6%), Jharkhand (45.3%)) states show highest percentage of stunted children in the country. Among north-eastern states, Meghalaya (43.8%) shows the highest percentage of stunted children. This spatial map clearly shows that southern states are in a better condition with respect to the

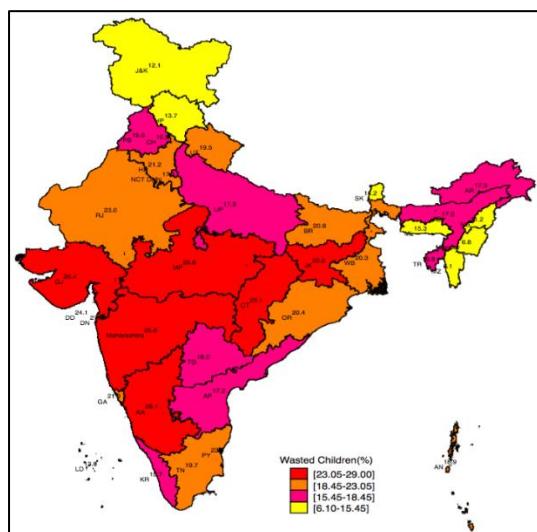
stunted children. Among UTs, Dadra & Nagar Haveli (41.7%) shows highest percentage of stunted children (Figure 1).



**Figure 1: The geographical variation of stunted children under 5 years across Indian states.**

#### *Status of wasted children in India*

Nearly 21 per cent of under 5 years children are wasted in India. Six states of India show a very high percentage of under 5 years wasted children than other state these are Jharkhand (29.0%), Madhya Pradesh (25.8%), Chhattisgarh (23.1%), Karnataka (26.1%) states show highest percentage of wasted children in the country. Among north-eastern states, Arunachal Pradesh (17.3%) shows the highest percentage of stunted children. This spatial map shows that among southern Karnataka show higher percentage of wasted condition (Figure 2).

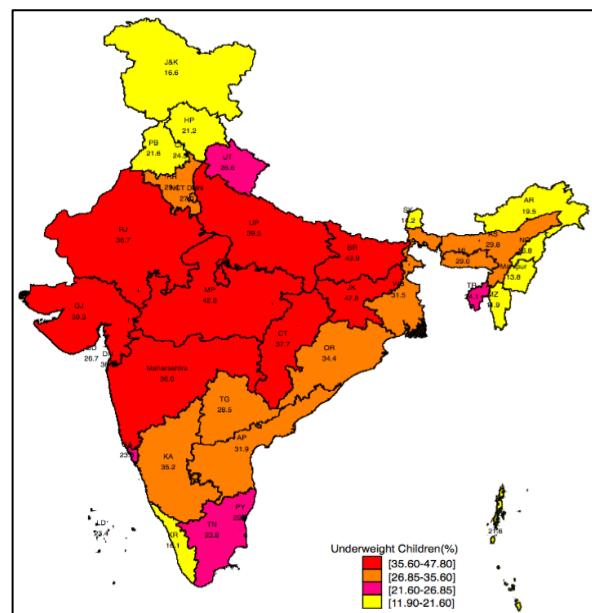


**Figure 2: The geographical variation of wasted children under 5 years across Indian states.**

#### *Scenario of underweight children in India*

Around 35 percent of under 5 years children are underweight in India. Six states of India show a very high percentage of under 5 years wasted children than other state these are Jharkhand (47.8%), Madhya Pradesh (42.8%), Maharashtra (36.0%), Chhattisgarh (37.7%) states show highest percentage of Underweight children in the country.

Among North-Eastern states, Arunachal Pradesh (17.3%) shows the highest percentage of stunted children around 2 union territories. The spatial map shows that among southern Karnataka (35.2%) shows higher percentage of underweight condition. Among UTs, Dadra & Nagar Haveli (38.9%) and Daman and Diu (26.7%) show highest percentage of underweight children (Figure 3).



**Figure 3: The geographical variation of underweight children under 5 years across Indian states.**

#### *Status of undernutrition under 5 years children in India*

Prevalence of undernutrition among under 5 children were higher in age group between 12-36 months (57.1 %) followed by 36+ months (55.4%) while lowest in age group 6-9 months (46.8%). Higher prevalence of undernutrition was found in male children (55.4%) as compared to female (54.1%). In context of maternal educational background, it was seen that higher the mother's education, lower the prevalence of undernutrition among their children. Similar pattern was observed in case of wealth index. The children whose mothers were fully exposed to media like newspapers/radio/television have lower prevalence of undernutrition (50.6%) than whose mothers were not exposed to any means of mass media (65.9%). It was found that the prevalence of undernutrition among children were less whose mothers completed more than 4

anti-natal care visits in the hospital. The higher prevalence of undernutrition was found among the children who were anemic (59.7%). Undernutrition were higher among the children who suffered from diarrhea (56.4 %) (Table 1).

**Table 1: Prevalence of under nutrition among children under 5 years by background characteristics, NFHS-4, 2015-16.**

Background characteristic	Under nutrition (n=225,002)	
Age-group in months	No (n=101,732)	Yes (n= 123, 270)
<5	49.5	50.5
6-9	53.2	46.8
9-12	49.9	50.1
12-36	42.9	57.1
36+	44.6	55.4
<b>Sex of child</b>		
Male	44.6	55.4
Female	45.9	54.1
<b>Maternal highest educational level</b>		
No education	34.1	65.9
Primary	40.3	59.7
Secondary	50.7	49.3
Higher	62.8	37.2
<b>Wealth index</b>		
Poorest	31.8	68.2
Poorer	40.8	59.2
Middle	48.1	51.9
Richer	55.0	45.0
Richest	62.2	37.8
<b>Media (newspaper or magazine/radio/television)</b>		
No exposure	34.1	65.9
Exposure	49.5	50.6
<b>No. of ANC visits during pregnancy</b>		
less than 4	42.6	57.4
4 or more	53.2	46.8
<b>Anaemia level</b>		
Not anaemic	50.3	49.7
Anaemic	40.4	59.7
<b>Had diarrhoea</b>		
No	45.4	54.6
Yes	43.7	56.4
<b>Total</b>	45.2	54.8

**Association of undernutrition with selected predictors and contributing factors**

The results of multiple logistic regression revealed that socioeconomic factors, exposure to media and biomedical predictors were significantly associated with undernutrition among under 5 years children. The children belonging to poorest household were 2 times more likely (OR-CI, 2.35 (2.27-2.44)) to be undernourished than those belonging to richest. Anemic

children were 1.4 times more likely (OR-CI, 1.41 (1.38-1.43)) to be undernourished than non-anemic. We estimated that male children were more likely (OR-CI, 1.07 (1.05-1.09)) to be undernourished than female. The regression results showed that diarrhea was significantly associated with undernutrition. The children suffering from diarrhea were more likely to be undernourished (OR-CI, 1.07 (1.04-1.10)) than non-diarrheal.

The children whose mothers have completed more than four ANC visits in the hospital, were less likely to be undernourished (OR-CI 0.89 (0.87-0.91)). Similarly, the children whose mothers were fully exposed to media exposure, were less likely (OR-CI 0.91 (0.89-0.93)) to be undernourished than those having no media exposure.

**Table 2: Results of multiple logistic regression showing association of undernutrition with selected predictors.**

Undernutrition (outcome var.)	Odds ratio	SE	(95% Conf. interval)	
<b>Age group in months</b>			LL UL	
<5 ®	1			
6-9	0.698***	0.016	0.667	0.73
9-12	0.793***	0.020	0.754	0.833
12-36	1.054**	0.018	1.018	1.091
36+	0.999	0.017	0.967	1.034
<b>Sex</b>				
Female®	1			
Male	1.075***	0.009	1.057	1.094
<b>Maternal educational level</b>				
No education®	1			
Primary	0.897***	0.013	0.872	0.923
Secondary	0.732***	0.009	0.715	0.749
Higher	0.586***	0.011	0.564	0.609
<b>Wealth index</b>				
Richest®	1			
Richer	1.219***	0.020	1.181	1.259
Medium	1.490***	0.024	1.443	1.538
Poorer	1.828***	0.030	1.769	1.888
Poorest	2.358***	0.043	2.274	2.444
<b>Media</b>				
No exposure®	1			
Exposure	0.912***	0.011	0.891	0.935
<b>No. of ANC visits during pregnancy</b>				
Less than 4®	1			
4 or more	0.895***	0.009	0.876	0.913
<b>Anaemia</b>				
No anaemic®	1			
Anaemic	1.410***	0.013	1.384	1.436
<b>Diarrhoea</b>				
No®	1			
Yes	1.071***	0.016	1.039	1.104

®-Reference Category, p\*\*<0.01, p\*\*\*<0.001, LL-lower limit, UL-upper limit.

The results of multivariate decomposition show that both endowment and coefficient are significant among high outcome group (poor). Differences in effects account for 67% of the observed poor-non-poor differential in the prevalence of undernutrition among children, with differences in intercepts (baseline logits). As per the convention, positive Ek coefficient indicates the expected reduction in the poor-non-poor undernutrition among children (under 5 years) if poor were equal to non-poor on the distribution of Yk. A negative Ck coefficient

indicates the expected increase in poor-non-poor gap if poor had the same return of the risk or behavioural responses, as non-poor. On equalizing the level of education among mothers, undernutrition can be reduced by 13% among children who completed less than 10 years of schooling. Percentage contribution of exposure to media i.e., television (tv) was around 11.3%. This suggests us that increasing awareness through television may be effective for reducing undernutrition among under 5 years children.

**Table 3: Results of multivariate decomposition showing contributing factors affecting undernutrition among children under 5 years belonging to poor and non-poor households (NFHS-4, 2015-16).**

Decomposition results		Number of obs.=225002					
High outcome group: poor=1 Low outcome group: non-poor=0							
Undernutrition	Coef.	Std. err.	z	P>z	95% CI	Pct.	
E	0.061	0.001	52.43	0.000	0.059	0.064	32.97
C	0.125	0.003	48.91	0.000	0.120	0.130	67.04
R	0.186	0.002	83.31	0.000	0.182	0.191	100
<b>Due to difference in characteristics (E)</b>							
Under nutrition	Coef.	Std. err.	z	P>z	95% Conf. Interval	Pct.	
<b>Maternal education</b>							
No Education®	0		.				
Educated	0.0244	0.0009	27.55	0.0000	0.023	0.026	13.08
<b>Media</b>							
Not Exposed®	0						
Exposed	0.021	0.001	21.47	0.000	0.019	0.023	11.29
<b>ANC visit</b>							
No visit®	0						
>4 visit	0.011	0.001	14.74	0.000	0.010	0.013	5.94
<b>Anaemia</b>							
Not anaemic®	0						
Anaemic	0.005	0.000	36.39	0.000	0.005	0.005	2.62
<b>Diarrhoea</b>							
No diarrhoea®	0						
Had diarrhoea	0.0000775	0.0000245	3.16	0.002	0.0000295	0.000125	0.04
<b>Due to difference in coefficients (C)</b>							
Under nutrition	Coef.	Std. Err.	z	P>z	95% Conf. Interval	Pct.	
<b>Maternal education</b>							
No Education®	0						
Educated	0.028	0.007	4.02	0.000	0.015	0.042	15.25
<b>Media</b>							
Not exposed®	0						
Exposed	-0.020	0.012	-1.69	0.091	-0.043	0.003	-10.59
<b>ANC visit</b>							
No visit®	0						
>4 visit	-0.005	0.002	-2.35	0.019	-0.009	-0.001	-2.77
<b>Anaemia</b>							
Not Anaemic®	0						
Anaemic	0.011	0.002	5.23	0.000	0.007	0.016	6.13
<b>Diarrhoea</b>							
No diarrhoea®	0						
Had diarrhoea	0.001	0.001	0.82	0.411	-0.001	0.002	0.31
Cons	0.109	0.013	8.63	0.000	0.085	0.134	58.70

\*Pct.- % contribution.

## DISCUSSION

Our Study suggested that the prevalence of undernutrition among children under 5 years of age remained high among EAG states. In India prevalence of stunting, wasting and underweight in under 5 year of children was 38%, 21% and 35% respectively. Our Spatial map related to stunting shows that among EAG states Bihar (48.6%) was highest followed by UP (46.3%) and M.P (42.0%) respectively while among north east region and UT Meghalaya (43.8%) and Dadra Nagar Haveli (41.7%) was reported highest prevalence. In context of wasting our map depicted that among EAG states Jharkhand (29.0%), Madhya Pradesh (25.8%) and Chhattisgarh (23.1%) was reported highest prevalence respectively, among north east region Arunanchal Pradesh were reported highest prevalence (17.3%) while Karnataka show higher percentage of wasted condition in southern region (26.1). Highest prevalence of underweight children under 5year was reported in Jharkhand (47.8%), Madhya Pradesh (42.8%), Maharashtra (36.0%) and Chhattisgarh (37.7%) respectively. Among North eastern states Arunanchal Pradesh were highest prevalence, Karnataka was highest in southern (35.2%) while Dadra and Nagar Haveli (38.9%) and Daman and Diu (26.7%) show highest percentage of underweight among UTs. Prevalence of undernutrition among under 5 children were higher in age group between 12-36 months (57.1%) followed by 36+ months (55.4%) while lowest in age group 6-9 months (46.8%). Male children (55.4%) were found more undernourished than female. Maternal education lowers the prevalence of under nutrition similarly in case of wealth index and media exposure. The children suffered from anemia (59.7%) and diarrhea (56.4%) were higher chance of being undernourished. Children, who did not suffer from any disease like diarrhea, were significantly less likely to be underweight. The results of the current study were consistent with previous studies that malnourished children would be more prone to sickness or sick children would tend to be underweight thus confirming the two way relationship between undernutrition and health.<sup>15,16</sup> Our study clearly indicated that children under 5 of uneducated mothers were the foremost liable to undernutrition. This finding was consistent with the previous study done in India. The findings conjointly disclosed significantly lower risks of undernutrition in children under 5years from a far better educated mother with similar unit facilities.<sup>17</sup>

The study clearly showed that socioeconomic factors, exposure to media and biomedical predictors were significantly associated with undernutrition among under 5 years children.

### Limitations

The study used secondary knowledge that was collected cross-sectionally. In cross-sectional studies, it's troublesome to require under consideration seasonal variations of the occurrences of the many aspects that

area unit specially coated in longitudinal studies within the absence of time-series and clinical knowledge, cross-sectional surveys lend a hand for assessing the determinants and patterns of childhood undernutrition within the period of time preceding the survey. Such findings could also be of relevancy for health intervention programs within the region.

### Novelty in the study

This study is unique in the sense that very few studies have tried to estimate multi-variate decompositions to estimate the percentage contribution of associated factors of under-nutrition in India on the basis of fourth round of NFHS. Another strength of the study is that it's an attempt to understand the spatial variation of undernourished children across Indian states and identify problem states. Also, we tried to establish an association between social and biomedical predictors of under nutrition among children.

## CONCLUSION

It is concluded from the study that evidence-based targeted interventions which are sensitive to the need of mothers and children belonging to different sections of society in India, may help to reduce undernutrition. Our study found that most of the undernourished children live in four EAG states (Bihar, Uttar Pradesh, Jharkhand & Madhya Pradesh). Since, these states are backward with respect to nutritional status in terms of stunting, wasting and underweight. These states should be a major concern for health planners and decision makers. This study also suggests that under nutrition among children may be reduced through awareness with mass media (radio/television/newspaper) and counselling during antenatal care visits at the health care centres.

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