

## **Determinants of Child Malnutrition in Empowered Action Group (EAG) States of India**

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### **Abstract**

Malnutrition among children is one of the biggest public health problems recognized by UN for achieving Millennium Development Goals (MDG). India having one of the largest child development programs in the world contributes to one-third of world's malnourished children. The main objective of this paper is to examine the determinants of child nutritional status in Empowered Action Group (EAG) states of India that are Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttarakhand and Uttar Pradesh. Data for this study have been taken from National Family Health Survey (NFHS-3) conducted during 2005-06. The unit level information on 20668 children aged 0-59 months has been included in the analysis.

Common indices for nutritional deficiencies i.e., Stunting, Underweight and Wasting are used in this study. Following the methodology of NFHS-3, malnutrition has been labeled in various categories. These indices have been expressed in z-scores from the median for the WHO international reference population. To identify the covariates of malnutrition, multivariate logistic regression model has been used.

A significant association is observed between child's nutritional status and mother's education, wealth index, mother's nutritional status, size of child at birth, birth order, child's age and type of caste/tribe. Our analysis reveals that for **Stunted children**, child's age (OR 5.32) is the most dominant factor affecting chronic malnutrition that is followed by mother's educational status (OR 2.43), wealth index, mother's nutritional status, size of child at birth, type of caste/tribe and birth order (OR 1.24). For **Underweight children**, we find wealth index (OR 2.23) as the dominant factor followed by mother's nutritional status, mother's educational status (OR 2.08), child's age, size of child at birth, type of caste/tribe and birth order (OR 1.13). For children suffering from acute malnutrition (**Wasting**), mother's nutritional status (OR 2.50) was the most dominant factor followed by child's age, mother's education (OR 1.45), wealth index, type of caste/tribe and size of child at birth (OR 1.54).

**Keywords:** Empowered action group; Malnutrition; Stunting; Underweight; Wasting; Logistic regression

## 1. Introduction

Malnutrition continues to be a serious problem in most developing countries as it is directly or indirectly associated with most child deaths. According to UNICEF [1], “about half of all child deaths are associated with malnutrition”. Malnutrition among children is one of the biggest public health problems in India. Malnutrition during childhood leads to poor growth and increased risk of mortality and morbidity in later stages of life. People become malnourished if their diet does not provide adequate calories and protein for proper health and development or they are unable to fully utilize the food they eat due to illness; this is commonly known as *under nutrition*. Malnutrition may also occur due to consumption of too many calories, known as *over nutrition*. In 2012 the Under-Five Mortality (U5MR) in India was 52 per 1000 live births [2]. India has one of the largest child welfare program in the world but progress on reducing malnutrition is limited [3]. More than one third of world’s malnourished children are Indians [4]. Under-nutrition is one of the most important contributory factors to be addressed for achieving one of the 8 Millennium Development Goals (MDG), established by United Nations summit held in 2009, i.e. reducing the child mortality by two thirds [5].

As described above malnutrition in children is a major deterrent for the proper physical growth. The indices of physical growth to describe the nutritional status used are:-Height-for-age (stunting) - a measure of chronic malnutrition and reflects inadequate nutrition received over a long period of time and is also affected by recurrent and chronic illness, Weight-for-height (wasting)-a measure of acute malnutrition and reflects inadequate nutrition received in the period immediately before the survey and Weight-for-age (underweight)- a composite index of height-for-age and weight-for-height taking into account both acute and chronic malnutrition. In India about half of the children (48%) are stunted and 43% are underweight, wasting also being a serious problem is affecting 20% of children under five years of age [6].

There are 30 states and 6 union territories in India having world’s 2nd largest population. With high fertility rates and low socio-demographic indicators, eight states among them have been identified as Empowered Action Group (EAG) states. These states are Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttarakhand and Uttar Pradesh constituting about 46 % of India’s population (according to 2011 India Census). The Annual Health Survey 2012-13 reported that in these states under-five mortality ranges from 48-90 per 1000 live births [7].

It was found that in India, mother’s education and socio-economic status of the household have an impact on child’s nutritional status. Children of illiterate mothers and belonging to poor households have higher risk of malnutrition as compared to children of educated mothers and belonging to households having higher socio-economic status [10-15].

This paper reports on a study to examine the nutritional status of children from EAG states and to identify the possible determinants of child malnutrition.

## 2. Data and Methods

Data for this study has been obtained from National Family Health Survey (NFHS- 3) [6] conducted during 2005-06. The unit level information on 20,668 children aged 0-59 months has been included in the analysis. For the assessment of nutritional status, NFHS-3 has included an anthropometric component, in which weights and measurements of all children

under five years of age were recorded. It is widely used method for assessing the nutritional status [15-16]. Until 2006, the U.S. National Center for Health Statistics (NCHS) standard was commonly used reference population which was used in NFHS-1 and NFHS-2. However, NFHS-3 estimates are based on a new international reference population released by WHO in April 2006 (WHO Multicenter Growth Reference Study Group, 2006) [8] and accepted by the Government of India. The indices of physical growth that are used to describe the nutritional status are **stunting, wasting and underweight**.

These indicators are expressed in standard deviation units (z-scores) from the median of the international reference population. Z-scores below -2 SD from the median of the reference population are considered to be short for their age (stunted), thin for their age (underweight) or thin for their height (wasted). Those below -3 SD from the reference-median are considered to be severely stunted, underweight or wasted. They are used as dependent variables in the analysis. All the three dependent variables are dichotomised. Those that are malnourished are coded as 1 and nourished children are coded as 0. Attributes of children such as age, birth order, size at birth, type of caste/tribe, mothers' characteristics (educational and nutritional status) and family's wealth status are taken as independent variables. For carrying out statistical analysis all the variables used are re-coded into categorical form so that appropriate tests can be applied.

Statistical analysis was performed using SPSS windows version 16.0 software. It has been carried out at two levels. First, univariate analysis was performed to find out the factors that are individually affecting nutritional status of children without the effect of confounding. Univariate analysis was performed on each possible predictor and outcome in the form of either binary logistic regression or cross-tabulation analysis, wherever applicable, to find out the association between them. While performing univariate logistic regression analysis, constant was not included in the model to examine the isolated impact of respective determinants on the outcome variable. Variables found significant at univariate analysis were used for multivariate binary logistic regression analysis. The multivariate logistic regression with binary outcome as defined below has been applied to identify the effect of possible determinants on each of the three outcomes: stunting, underweight and wasting being the three standard indicators of nutritional status of children:

$$Prob(event) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)'}}$$

Where,  $\beta_0, \beta_1, \beta_2, \dots, \beta_k$  are regression coefficients for respective predictors  $X_0 (= Const.)$ ,  $X_1, X_2, \dots, X_k$ . Seven predictors ( $k=7$ ), namely **child's age in months, mother's educational status, size of child at birth, wealth index, type of caste or tribe, birth order** and **mother's nutritional status** are used for predicting **stunting** and **underweight** whereas, six predictors ( $k=6$ ) are used for **wasting** that excludes **birth order**.

Since birth weight may not be known for many babies, the mother's estimate of the baby's size at birth was obtained for all births. NFHS-3 has classified size of child at birth as follows: Very Large, Larger than Average, Average, Smaller than Average and Very Small.

We have collapsed it into three categories which are **Large** (containing Very large and Larger than Average), **Average** and **Small** (containing Smaller than Average and Very Small)

### 3. Results

Characteristics of mothers included in the study are given in Table 1. It was observed that Uttar Pradesh had the highest number of unemployed mothers whereas, the lowest were in Chhattisgarh. Mean parity (average number of children ever born) of mothers in these states ranged from 2.76 to 3.82 and the mean age at marriage was between 16.01 and 18.17 years. Further, Rajasthan had the highest number of illiterate mothers whereas, Uttarakhand had the lowest. It was found that in India 48% children were stunted, 42.5% were underweight and 19.8% were wasted [6]. However, in EAG states the prevalence of stunting, underweight and wasting was 51.9, 48.2 and 23.0% respectively [Fig. 1]. Annexure 1 contains brief description of predictors included in the analysis. It has been observed that approximately 60% of children in EAG states were in the age group of 25-59 months whereas, one fifth of children included in the analysis were in the age group of 13-24 months. It was evident that more than half of the mothers in these states were illiterate and more than one-third had poor nutritional status. Nearly 60% of children had average size at birth and about 20% were small at birth. About 15% of children belonged to richest households. Nearly half of the children belonged to other backward classes while lowest were scheduled tribes.

#### 3.1 Univariate Analysis

The variables that were found significant for stunting, underweight and wasting were: child's age in months, mother's education, wealth-index, type of caste/tribe, birth order, mother's nutritional status and size of child at birth. These were further subjected to multivariate analysis.

#### 3.2 Multivariate Analysis

**Risk factors for stunting:** The analysis identified child's age in months, mother's educational status, size of child at birth, wealth index, type of caste/tribe, birth order and mother's nutritional status as the determinants of stunting in children. As shown in Table 2, findings from the study revealed that the odds of being stunted increased after first six months of life and children in the age group of 13-24 months were 5 times more likely to be stunted than children in the age group of 0-6 months. Children in the age group of 7-12 months were twice more likely to be stunted as compared to children aged 0-6 months. Children with small size at birth were 1.3 times more likely to be stunted than children having large size at birth. Children with higher birth order were more prone to stunting than those having lower birth order. Children with birth order 4 and above had 1.2 times more chances of being shorter for their age.

The odds ratios decreased with the increase in mother's education. Children whose mothers were illiterate were twice more likely to be stunted as compared to children having mothers education of 12 years or more. Similar is the case with mother's nutritional status. Mothers having body mass index below normal were 1.3 times more likely to have children suffering from chronic malnutrition as compared to those having body mass index above normal. Children belonging to poorest families had twice risk of being stunted than those belonging to richest families. Scheduled and other backward class families were more likely to have stunted children than other castes.

**Risk factors for underweight:** The following factors emerged as determinants of **underweight** in children: child's age in months, mother's educational status, size of child at

birth, wealth index, type of caste/tribe, birth order and mother's nutritional status. From Table 2, it was evident that the factor coming out as the strongest determinant was households' wealth index. There was an inverse relationship between wealth quintile and child's nutritional status. The households with poorest wealth status were twice more likely to have underweight children as compared to richest households. Next to this was mother's nutritional and educational status. Children with poor mother's nutrition had two-fold risk of being underweight than those whose mothers were well nourished. Children whose mothers were illiterate also had twice risk of having malnourished children as compared to those whose mothers had education of 12 years or more.

Findings also showed that the risk of being underweight increased with increase in child's age. The odds ratio for underweight was found after first six months of life and it was nearly two times for children in the age group of 25-59 months as compared to children in age group of 0-6 months. Children having small size at birth were 1.6 times more likely to be thin for their age than children having larger size at birth. Taking caste into consideration, as compared to children belonging to other castes, children belonging to scheduled tribes were 1.5 times and those belonging to scheduled castes and other backward classes were 1.3 and 1.2 times respectively more likely to be underweight. Children having birth order 4 and above were more prone to be underweight as compared to children having birth order 1.

**Risk factors for wasting:** Child's age in months, mother's education, size of child at birth, wealth index, type of caste/tribe and mother's nutritional status were identified as the determinants of **wasting** in children. As shown in Table 2, mother's nutritional status was emerging out as the strongest determinant of acute malnutrition. The likelihood of being wasted was higher for children whose mothers had body mass index below normal than children whose mothers had body mass index above normal. Mothers with poor nutritional status were nearly thrice more likely to have children who were wasted than healthy mothers. Further, it was observed that there was an inverse relationship between child's age and wasting; with an increase in child's age the odds ratio for wasting decreased. As compared to children in the age group of 25-59 months, those in the age-group of 0-6 months were twice more likely to be wasted. It is observed that mother's educational status and household's wealth index were having inverse relationship with wasting. Mothers having education of less than 5 years were 1.5 times more likely to have a wasted child than those educated for 12 years or more.

Children belonging to poorest family had 1.3 times more risk of having acute malnutrition than children belonging to richest household. In comparison to children belonging to other caste, scheduled tribe children had two-fold risk of being wasted. Babies having smaller size at birth were 1.5 times more likely to be wasted than children having larger size at birth.

#### 4. Discussion

Child's age in months emerged as one of the strongest determinants of nutritional status of children. Findings in this paper indicated that cases of stunting and underweight were least during the first six months of life, and it increased with the increase in age. Similar results have been found in other studies [18, 19, 21]. Rajaretnam and Jyoti [22] have shown that stunting increase with the increase in age and also children of higher birth orders are at a greater risk of being severely under nourished. Late initiation of supplementary food to children might be one of the reasons for this. Household's economic status also affects child

malnutrition [10, 11]. There was an inverse relationship between the two indicating that poor families are unable to fulfill basic needs of children resulting into poor growth and development of children.

Child's nutritional status is likely to be affected by maternal characteristics, like mother's educational and nutritional status. These results were consistent with other studies [9, 20, 21]. Educated mothers are well aware of the nutritional requirements of infants and are thereby capable of taking proper care as compared to illiterate mothers, who are more likely to give birth to malnourished children. The paper also established a strong relationship between child's nutrition and maternal nutrition as shown by Arnold [20]. Healthy mothers were more likely to produce healthy and well-nourished children as compared to unhealthy and weak mothers.

Size at birth also plays a significant role in malnourishment. Children who were born healthy and had large size at birth had least risk of being malnourished as compared to children who were born weak. Children having higher birth order were also subjected to the risk of being malnourished [20]. Other than demographic characteristics, social characteristics were also one of the significant determinants of child malnutrition. Mothers belonging to scheduled castes or tribes were more likely of having undernourished children than those not belonging to any of these sub-classes.

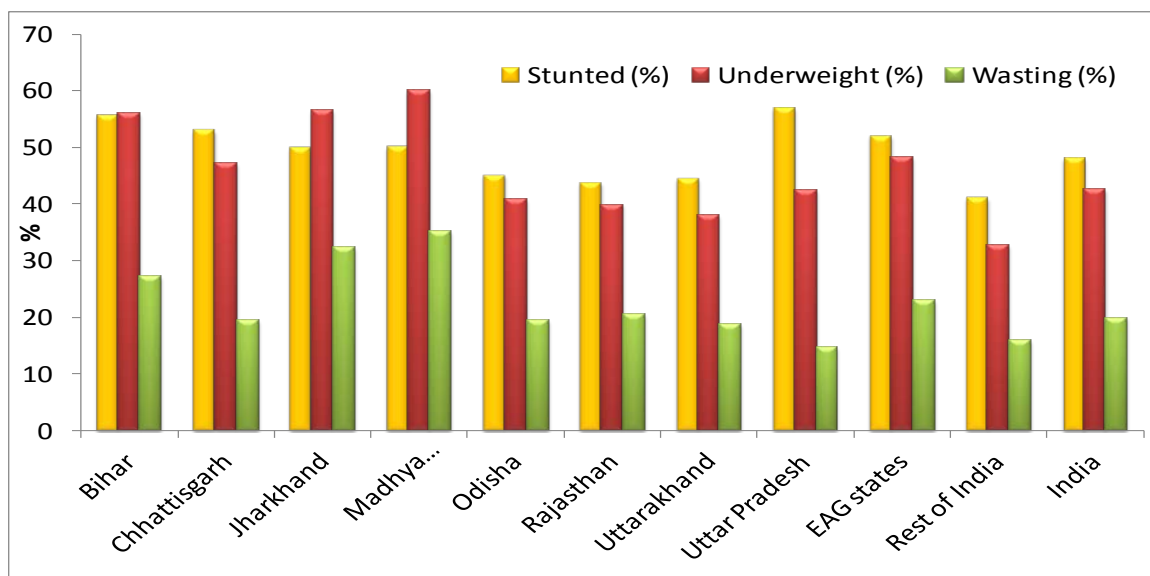
**Table 1: Mother's characteristics and prevalence of malnutrition**

States	Characteristics of mothers				Prevalence of malnutrition			
	Unem- ployed (%)	Mean parity	Mean age at marriage	Illiterate (%)	No. of Children	Stunted (%)	Underweight (%)	Wasted (%)
<b>Bihar</b>	76.7	3.72	16.01	70.2	2320	55.6	55.9	27.1
<b>Chhattisgarh</b>	52.7	3.15	16.68	54.0	1592	52.9	47.1	19.5
<b>Jharkhand</b>	72.1	3.42	16.17	66.9	1657	49.8	56.5	32.3
<b>Madhya Pradesh</b>	61.9	3.43	16.54	57.2	3016	50.0	60.0	35.0
<b>Odisha</b>	75.3	2.76	17.70	47.9	1781	45.0	40.7	19.5
<b>Rajasthan</b>	57.1	3.47	16.21	70.4	2023	43.7	39.9	20.4
<b>Uttarakhand</b>	63.1	2.91	18.17	41.8	1228	44.4	38.0	18.8
<b>Uttar Pradesh</b>	76.8	3.82	16.62	66.1	7051	56.8	42.4	14.8
<b>EAG states</b>	69.5	3.49	16.65	61.8	20668	51.9	48.2	23.0
<b>India</b>	68.9	3.03	17.76	44.0	51555	48.0	42.5	19.8

**Table 2: Multivariate analysis**(Note: The table is based on 20,668 children,  $p < 0.05$ )

Variables	Stunting			Underweight			Wasting		
	$\beta$	Exp( $\beta$ )	95% C.I. for Exp( $\beta$ )	$\beta$	Exp( $\beta$ )	95% C.I. for Exp( $\beta$ )	$\beta$	Exp( $\beta$ )	95% C.I. for Exp( $\beta$ )
<b>Age in months*</b>									
0-6							0.85	2.34	2.09-2.62
7-12	0.51	1.67	1.43-1.95	0.31	1.37	1.18-1.58	0.68	1.98	1.76-2.23
13-24	1.67	5.32	4.65-6.08	0.68	1.98	1.75-2.24	0.39	1.48	1.35-1.63
25-59	1.58	4.87	4.31-5.49	0.73	2.08	1.86-2.32			
<b>Mother's education(Ref. cat: 12 years or more)</b>									
No education	0.89	2.43	2.06-2.85	0.73	2.08	1.76-2.45	0.22	1.24	1.03-1.50
<5 years	0.64	1.89	1.55-2.32	0.69	1.99	1.62-2.43	0.37	1.45	1.15-1.83
5-7 years	0.64	1.89	1.59-2.24	0.51	1.67	1.40-1.98	0.20	1.22	0.99-1.49
8-9 years	0.64	1.89	1.59-2.24	0.53	1.70	1.43-2.02	0.11	1.12	0.92-1.37
10-11 years	0.41	1.50	1.24-1.81	0.34	1.40	1.15-1.71	0.17	1.19	0.95-1.49
<b>Size at birth(Ref. cat: Large)</b>									
Average	0.06	1.07	0.98-1.16	-0.01	0.99	0.91-1.08	0.02	1.02	0.92-1.13
Small	0.28	1.32	1.19-1.47	0.48	1.62	1.46-1.79	0.43	1.54	1.37-1.73
<b>Wealth index(Ref. cat: Richest)</b>									
Poorest	0.85	2.34	2.03-2.69	0.80	2.23	1.94-2.57	0.23	1.25	1.06-1.48
Poorer	0.73	2.07	1.80-2.38	0.60	1.82	1.58-2.09	0.10	1.11	0.94-1.30
Middle	0.66	1.94	1.69-2.22	0.43	1.54	1.34-1.77	0.04	1.04	0.88-1.23
Richer	0.50	1.65	1.45-1.89	0.40	1.48	1.30-1.70	0.04	1.04	0.89-1.23
<b>Caste/tribe(Ref. cat: Other caste)</b>									
Scheduled Caste	0.23	1.26	1.13-1.39	0.24	1.27	1.14-1.40	0.02	1.02	0.90-1.15
Scheduled Tribe	-0.02	0.98	0.86-1.11	0.38	1.47	1.30-1.66	0.50	1.66	1.44-1.90
OBC	0.12	1.13	1.03-1.23	0.18	1.20	1.09-1.31	0.01	1.01	0.91-1.12
<b>Birth order(Ref. cat: 1)</b>									
2	0.15	1.16	1.06-1.28	0.09	1.09	1.00-1.20			
3	0.11	1.12	1.01-1.24	0.13	1.13	1.02-1.25			
4 and above	0.22	1.24	1.13-1.36	0.22	1.24	1.13-1.36			
<b>Mother's nutritional status(BMI<math>\geq</math>25.0)</b>									
BMI $\leq$ 18.49	0.29	1.34	1.14-1.57	0.80	2.23	1.88-2.64	0.90	2.45	1.96-3.05
BMI= 18.5-24.9	0.17	1.18	1.01-1.38	0.40	1.49	1.26-1.76	0.46	1.59	1.28-1.97
<b>Constant</b>	-3.18	0.04		-2.79	0.06		-2.63	0.07	

\* For child's age in months, for stunting and underweight, reference category was taken as 0-6 months and for wasting, reference category was taken as 25-59 months.

**Fig 1: Prevalence of malnutrition among children under 5 years of age**

<b>Annexure-I: Description of Predictors in the Analysis</b>		
<b>Variable</b>	<b>Description</b>	<b>Frequency (%)</b>
0-6	Child's age is between 0-6 months	2279(12.0)
7-12	Child's age is between 7-12 months	1863(9.8)
13-24	Child's age is between 13-24 months	3712(19.6)
25-59	Child's age is between 25-59 months	11106(58.6)
<b>Mother's education</b>		
No education	Mother is illiterate	11896(57.6)
<5 years	Mother is having education of <5 years	1141(5.5)
5-7 years	Mother is having education between 5-7 years	2502(12.1)
8-9 years	Mother is having education between 8-9 years	2120(10.3)
10-11 years	Mother is having education between 10-11 years	1114(5.4)
12 +	Mother is having education of 12 years or more	1895(9.2)
<b>Size at birth</b>		
Large	Child has large size at birth	3739(18.2)
Average	Child has average size at birth	12393(60.4)
Small	Child has small size at birth	4385(21.4)
<b>Wealth index</b>		
Poorest	Household has poorest wealth index	6207(30.0)
Poorer	Household has poorer wealth index	4470(21.6)
Middle	Household has middle wealth index	3501(16.9)
Richer	Household has richer wealth index	3335(16.1)
Richest	Household has richest wealth index	3155(15.3)
<b>Caste/tribe</b>		
Scheduled Caste	Child belongs to scheduled caste	4270(20.7)
Scheduled Tribe	Child belongs to scheduled tribe	2395(11.6)
Other backward class	Child belongs to other backward classes	9177(44.5)
Other caste	Child does not belong to scheduled caste/tribe/OBC	4974(23.2)
<b>Birth order</b>		
First	Child has birth order 1	5542(26.8)
Second	Child has birth order 2	4912(23.8)
Third	Child has birth order 3	3498(16.9)
Fourth of more	Child has birth order four or more	6716(32.5)
<b>Mother's nutritional status</b>		
BMI≤18.49	Mother has body mass index ≤18.49	7651(38.5)
BMI= 18.5-24.9	Mother has body mass index between 18.5-24.9	11038(55.6)

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