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FACTORS AFFECTING CHILD MALNUTRITION UNDER FIVE YEARS AGE IN BIHAR, INDIA

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Abstract: *The purpose of this study is to examine the socio-economic factors responsible for child malnutrition under the age of five in Bihar, a state of India currently the most malnourished and poor in terms of child health outcomes across the country. The analysis is based on nationally representative cross-section data compiled by the International Institute of Population Studies (IIPS), Mumbai, with regard to the National Family Health Survey (NFHS), 2015-16. The percentage of stunted, wasted and underweight has been treated as dependent variables, while main explanatory variables of child malnutrition are female education, children's place of residence, wealth index of household, family planning, sex of child, religion and mother's age cohort. In order to examine the association between explanatory variables and malnutrition, multilevel logistic regression models have been applied. Results indicate a high incidence of less stunted, wasted and underweight children in case of an educated mother beyond primary education compare to mothers with no education. Wealth index found to be a very significant indicator in the sense that children from the poorest families endured the burden of undernutrition more than those from the richest families. The modern method of using contraception is also an important indicator which influences the rate of underweight in children. These results suggest that improving maternal education, economic status and contraceptive use can have a positive effect on child nutritional status and mortality.*

Keywords: *malnutrition, wealth index, education, contraceptive use*

1. Introduction

Childhood malnutrition continues to be a public health issue and the most common nutritional disorder for any developing nation. Addressing the problem of malnutrition,

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the sustainable development goal 2 (SDG2) adopted by United Nations (2019) indicates that 'by 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons. In this context, monitoring child malnutrition at regional level is essential for planning and policy making in any developing country. In India, the high prevalence of child malnutrition remains one of the challenging and leading risk factors, accounting for one third of the world's wasted (height-for-age) children and unfavorably affecting child morbidity, health-care expenditure and economic progress (Measham and Chattergee (1999); Mishra, Lahiri and Luther, 1999). Child nutritional status reflects not only a country's past health status, but also its future health trails (Subramanyam et al., 2010). Studies on child nutrition have shown that poor quality of nutritional status can increase the risk of child illness, retardation in physical and mental development, resulting in reduced adult size, ability to work, loss of productivity and efficiency, increases in health care expenditures and can initiate the poverty trap (World Bank, 2006; Grantham et al., 2007; Tarozzi and Mahajan, 2007; Walker et al., 2007). Severe or chronic malnutrition also increase the educational attainment and outcome of the children (Ahmed et al., 2012). UNICEF reported that in India, 43 percent of children under-5 years are underweight and 48 percent are stunted due to chronic undernutrition. Worldwide, India executes poorly in child malnutrition status (ranked 114 out of 132 countries), just prior to Afghanistan and Pakistan (IFPRI, 2016) and home to about one-third of all malnourished children in the world in the early 2000s (Svedberg, 2008).

However, malnutrition is exceptionally concentrated in certain regions of India. Bihar, the most populated state in India (population of 104 million, of which 89 percent live in rural areas) is one of the poorest states in the country with around 34 percent of rural population living below the poverty line. Muslims are the dominant group among the minorities, accounting for 16.9 percent. According to Census (2011), the literacy rate of Bihar is 61.8 percent and only half of females (51.5%) are literate in the state. A recent health profile of Bihar indicates that the state is facing severe child malnutrition: 48.3 percent of children under 5 years of age were stunted, 20.8 percent wasted, and 43.9 percent children underweight (National Family Health Survey 4) in 2015. Stunting refers to the cumulative effects of the undernutrition which often results in delayed mental development, poor school performance and reduced intellectual capacity of a child (WHO, 2010). Wasting or thinness denotes to the severe process of weight loss which is associated to acute hunger and further severe disease. However, underweight is the composite index of stunting and wasting.

There are several reasons (place of residence, age and nutritional status; and maternal education) for stunting, wasting and underweight of children (Bangladesh Demographic and Health Survey, 2007). Previous studies have found the role of maternal education in enhancing child nutritional status. For example, highly educated mothers are also more likely to have children with better health outcome (Basu and Stephenson, 2005; Cleland, 2010; Miller and Rodgers, 2009). Studies claimed that maternal education is directly associated with child survival (Cleland, 2010) and child nutritional status (Frost, Forste and Hass, 2005). Other socio-economic covariates like religion, parent's educational status and standard of living also had a significant effect on the children

underweight (Bharti et. al., 2010). Also, location or place of residence is one of the socioeconomic covariates often used in the literature which determines child malnutrition across the region (Sastry, 1997). A growing body of literature recognizes the importance of economic status of households that influences the nutritional status of a child (Smith and Haddad, 2000; Haddad et 2003; Heltberg, 2009; Headey, 2013). A variety of indicators has been used to measure the economic status of the household, however, sorting of households according to income level is a more relevant proxy. Many studies claimed that malnutrition is associated with poverty and disease (Dasgupta et. al., 2005) and argued that due to poor access of food a large segment of children is suffering from severe health problems and morbidity. In order to improve child nutritional status, the Government of India has introduced major nutrition supplementation programs such as Integrated Child Development Services (ICDS) and Mid-day Meal (MDM) Programme at the disaggregated level. However, little is known about the empirical findings about the factors that drive child malnutrition, especially in poor states like Bihar. In this connection, policy makers and planners must prerequisite adequate knowledge of the factors that are responsible for poor child nutritional status (stunting, wasting and underweight) in order to formulate appropriate policies related to child health outcomes. Therefore, the main objectives of this paper are to understand nutritional status based on stunted, wasted and underweight of children less than age of five and to examine the factors which influence child malnutrition in respect of certain socio-economic variables, for instance, female education, place of residence, wealth status, family planning, sex of household, religion and mother's age cohort in Bihar.

2. Data and Methods

In this study, data has been assessed from the NFHS-4 conducted by the International Institute of Population Sciences (IIPS), Mumbai in 2015-16 and constrained to children under the age of five. NFHS is a collaborative project of IIPS and many organizations including foreign institutions. IIPS was assigned as the nodal agency by the Ministry of Health and Family Welfare, Government of India and is responsible for providing coordination and technical assistance for the NFHS-4 . The survey used a uniform questionnaire, two-stage sampling design with stratification by rural-urban background and field practice to make possible comparability of the data and to achieve enhanced data quality. For the anthropometric analysis, malnutrition of children is enumerated in terms of anthropometrical measures: weight-for-age (stunted), height-for-age (wasted) and weight-for-height (underweight) and Z-score ≤ 2 standard deviation; World Health Organisation/National Centre for Health Statistics reference standards were applied to compute the standardized Z-score for all three measures (WHO, 1978; Mazumdar, 2010).

In this survey, data of children's height, weight and underweight have been collected less than 5 years. Data related to determinants of child malnutrition are: place of residence (rural-urban), sex of child (male-female), female education, wealth index (based on an ownership-of-goods index) and family planning (use of contraceptive) are the important indicators that are assumed to effect nutritional status of a child. The logistic multiple regression analysis has been employed in the analysis for estimation of the odds of being malnourished in the children of Bihar. The dependent variable

denotes the number of children whose z-scores are below -2 are coded 1 and those with z-scores of -2 or higher are coded 0. The independent variables are entered in the regression equation and thus results obtained are compared with reference category. To account for survey design and sample weights, statistical analysis is carried out using SPSS (16.0 version) software for window and the significance levels of $p<0.01$, 0.05 and 0.10 were taken.

This survey collected the information of 25437 children from Bihar aged less than 5 years. Table 1 represents the possible confounding factors of child malnutrition. The definition of the variables is given below here:

Table 1: Definition of variables

Child malnutrition	Percentage of children aged less than 5 years considered as malnourished, three indicators-stunted, wasted and underweight were used.
Female education	This indicates to the educational level of the mother of the child and coded as: no education (attained no formal education), primary (received primary one through primary eight), secondary (secondary nine to secondary twelve) and higher (tertiary and university level).
Place of residence	This represents location of household, whether a household reside in rural area or urban area. It is conceptualized as equal to 1 if a household resides in rural area and 0 otherwise. coded as: Rural=1, others=0.
Wealth index	Wealth index of the household in quintiles constructed as an asset index reflecting the ownership of some basic assets by the household. It is classified into: poorest, poorer, middle, richer, and the richest quintiles.
Family Planning	This variable indicates the awareness and accessibility to healthcare to household and categorized as no contraceptive use (not using any method) modern (Include male and female sterilization, injectables, intrauterine devices (IUDs/ PPIUDs), contraceptive pills, implants, female and male condoms, diaphragm, foam/jelly, the standard days method, the lactational amenorrhoea method, and emergency contraception), traditional (Rhythm, Withdrawal and other traditional method), others (excluding modern and traditional method).
Sex of child	It represents the gender of the child and constructed as equal to 1 if child is male and 0 otherwise.
Religion	This indicates the cultural traits of the households and classified as Hindu, Muslim and others.
Mother age cohorts (years)	This captures the effect of age of the mother on nutritional status of the children. It is assumed that older mothers may be more experienced than their young counterparts although they may not quickly adapt new ways of improving the quality of life. Here, five-year age cohorts of women between 15-49 years (15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49) have been generated.

3. Findings

Descriptive statistics based on the association between each of the explanatory variables and dependent variables (eg., stunted, wasted and underweight) is presented in Table 2. It represents the descriptive statistics of sample including the information of female education, children's place of residence, wealth status of household, use of contraceptive, sex of child, religion and mother's age cohorts. It can be observed in Table 2 that higher rates of stunting (56.6%), wasting (58.3%) and underweight (56.3%) were observed in females who were illiterate, children residing in rural areas (around 90%), household had poorest wealth index (more than 55%), persons using traditional method of contraceptive (68%), male child (52%), Hindu community (83%) and the mothers whose age were between 25-29 years (37%).

Table 2: Child nutrition status background characteristics (in mean percentage)

Category	Stunting		Wasting		Underweight	
Female education	Mean	(%)	Mean	(%)	Mean	(%)
No education	14136	56.6	13231	58.3	13270	56.3
Primary	3093	12.4	2847	12.5	2918	12.4
Secondary	6745	27.0	5834	25.7	6431	27.3
Higher	982	3.9	778	3.4	973	4.1
Place of residence						
Urban	2519	10.1	2047	9.0	2444	10.4
Rural	22437	89.9	20643	91.0	21148	89.6
Wealth index						
Poorest	13984	56.0	13238	58.3	13103	55.5
Poorer	6023	24.1	5491	24.2	5739	24.3
Middle	2860	11.5	2412	10.6	2723	11.5
Richer	1627	6.5	1213	5.3	1563	6.6
Richest	462	1.9	336	1.5	464	2.0
Family Planning						
No contraceptive use	4206	16.7	4217	16.6	3989	16.9
Modern method	221	0.9	224	0.9	215	0.9
Traditional method	17106	67.7	17262	67.9	16002	67.8
Others	3717	14.7	3734	14.7	3386	14.4
Sex of child						
Male	12959	51.9	11755	51.8	12242	51.9
Female	11997	48.1	10935	48.2	11350	48.1
Religion						
Hindu	20707	83.0	18903	83.3	19578	83.0
Muslim	4223	16.9	3764	16.6	3988	16.9
Others	26	0.1	23	0.1	26	0.1
Mother's age cohorts						
15-19	822	3.3	832	3.3	729	3.1
20-24	7474	29.6	7554	29.7	6966	29.5
25-29	9413	37.3	9459	37.2	8837	37.5
30-34	4716	18.7	4752	18.7	4441	18.8
35-39	1978	7.8	1987	7.8	1850	7.8
40-44	629	2.5	634	2.5	580	2.5
44-49	218	0.9	219	0.9	189	0.8

Source: Author's calculation using the National Family Health Survey-4 (for the year 2015-16).

Odds ratio were calculated to estimate the association between malnutrition indicators of children and different independent variables.

Table 3: Determinants of stunting using multiple logistic regression results

Variable	Model 1		Model 2		Model 3		Model 4	
	B	Odd ratio	*B*	Odd ratio	*B*	Odd ratio	*B*	Odd ratio
Female education								
No education (Ref.)								
Primary	-0.518* (0.133)	0.595	-0.514* (0.135)	0.598	-0.515* (0.133)	0.597	-0.525* (0.136)	0.592
Secondary	-0.304* (0.110)	0.738	-0.290** (-124.00)	0.748	-0.299* (0.111)	0.741	-0.270** (0.129)	0.763
Higher	-1.167* (0.136)	0.311	-0.972* (0.203)	0.378	-1.163* (0.165)	0.313	-0.953* (0.207)	0.385
Place of residence								
Urban (Ref.)								
Rural			-0.033 (0.158)	0.967			-0.035 (0.160)	0.966
Wealth index								
Poorest (Ref.)								
Poor			-0.059 (0.117)	0.943			-0.080 (0.118)	0.923
Middle			0.197 (0.171)	1.217			0.125 (0.172)	1.166
Richer			-0.063 (0.203)	0.939			-0.131 (0.204)	0.877
Richest			-0.795* (0.257)	0.452			-0.879* (0.261)	0.415
Family Planning								
No contraceptive use (Ref.)								
Modern method					-1.186 (0.339)	0.306	-1.105* (0.343)	0.331
Traditional method					-0.406 (0.144)	0.667	-0.402* (0.146)	0.669
Others					-0.251 (0.182)	0.778	-0.233 (0.185)	0.792
Sex of child								
Male (Ref.)								
Female					-0.031 (0.109)	0.969	-0.047 (0.110)	0.954
Religion								
Hindu (Ref.)								
Muslim					0.048 (0.128)	1.050	.067 (.130)	
Others					-1.710* (0.614)	0.181	-1.666* (.617)	
Mother age cohorts (years)								
15-19 (Ref.)								
20-24							0.093 (0.241)	1.097
25-29							0.499 (0.245)	1.647

Variable	Model 1		Model 2		Model 3		Model 4	
	B	Odd ratio	*B*	Odd ratio	*B*	Odd ratio	*B*	Odd ratio
30-34							0.122 (0.254)	1.129
35-39							0.065 (0.284)	1.067
40-44							-0.167 (0.352)	.846
44-49							0.032* (0.558)	1.033
N	25437		25437		25437		25437	
Cox & Snell R Square	.002		.002		.003		.004	
Nagelkerke R Square	.011		.015		.016		.024	
-2 Log-likelihood	4720.8		4706.803		4700.13		4667.61	

Ref., reference category

Figures in the parentheses are SE of estimates

Table 3 reveals the parameter estimates of these four models for stunting. For each model, the coefficient of covariates in the logistic model is presented and the related standard error is shown in parentheses. Mother's education plays a dominant factor in determining child malnutrition. In model 1, it was found that mothers who completed primary education (OD=.595, SE=.133), secondary (OD=.738, SE=.110) and higher (OD=.311, SE=.136) education lowered the rates of stunting (Table 3). This finding is unfailing and supported by studies such as Roy (2000); Smith and Hadded (2000) and many others. Numerous studies claimed that mother's education is a contributing factor that is directly and strongly associated with child survival and nutritional status (Cleland, 2010; Basu and Stephenson, 2005; Cleland, 2010; Miller and Rodgers, 2009; Bbaale, 2014; Headey, 2013). It is well documented that education provides women with abundant opportunities to work outside the home and earn an income which empower them through greater authority and bargaining capability in the family (Nussbaum, 2004; Sen, 1999). In our model 2, with education, wealth index found to be very significant indicator which explained that household with richest quintile (OD=.452, SE=.257) highly associated to stunting in children. It means if the economic condition of a family is better it can upsurge the level of living of the household, allow them to take indispensable care of the children and further reduce the stunting of children. In this model, place of residence of children no longer affected the rate of stunting of children**.** In model 3, mother's education, use of traditional and other methods of contraceptive, sex of child and religion had a positive and significant effect on stunting of children under 5. In the final model, education of the mother, place of residence, wealth index, contraceptive use, religion and mother's age cohort played a significance effect on child nutritional status. Overall, the role of mother's education and its impact on child health make it critical to understand its impact on child nutritional status.

Table 4: Determinants of wasting using multiple logistic regression results

Variable	Model 1		Model 2		Model 3		Model 4	
	β	Odd ratio	*β*	Odd ratio	*β*	Odd ratio	*B*	Odd ratio
Female education								
No education (Ref.)								
Primary	-.299* (.066)	.742	-.121*** (.068)	.886	-.297* (.066)	.743	-.146** (.069)	.865
Secondary	-.754* (.046)	.470	-.246* (.054)	.782	-.768* (.046)	.464	-.306* (.056)	.737
Higher	-1.342* (.079)	.261	-.392* (.094)	.676	-1.372* (.080)	.254	-.475* (.096)	.622
Place of residence								
Urban (Ref.)								
Rural			.288* (.061)	1.333			.262* (.062)	1.300
Wealth index								
Poorest (Ref.)								
Poor			-.388* (.055)	.678			-.385* (.055)	.680
Middle			-.840* (.066)	.432			-.828* (.067)	.437
Richer			-1.316* (.079)	.268			-1.300* (.079)	.273
Richest			-1.414* (.121)	.243			-1.398* (.122)	.247
Family Planning								
No contraceptive use (Ref.)								
Modern method					-.136 (.194)	.873	.074* (.198)	1.077
Traditional method					.137* (.055)	1.147	.044* (.056)	1.045
Others					.244* (.073)	1.277	.155* (.076)	1.168
Sex of child								
Male (Ref.)								
Female					.168* (.050)	1.183	.077 (.051)	1.080
Religion								
Hindu (Ref.)								
Muslim					-.359* (.053)	.698	-.255* (.054)	.775
Others					-.765*** (.463)	.465	-1.050** (.464)	.350
Mother age cohorts (years)								
15-19 (Ref.)								
20-24							-.183 (.127)	.833
25-29							-.147 (.127)	.863
30-34							-.313** (.132)	.731
35-39							-.231***	.794

Variable	Model 1		Model 2		Model 3		Model 4	
	β	Odd ratio	*β*	Odd ratio	*β*	Odd ratio	*B*	Odd ratio
							(.146)	
40-44							-.318 (.185)	.727
44-49							-.695* (.248)	.499
N	25437		25437		25437		25437	
Cox & Snell R Square	.017		.035		.019		.037	
Nagelkerke R Square	.034		.070		.039		.074	
-2 Log-likelihood	16985.76		16511.26		16920.39		16461.52	

Ref., reference category

Figures in the parentheses are SE of estimates

Table 4 represents that mother's education has a robust and negative effect on wasting of children relative to mothers with no education (model 1). The odds ratios for primary education (OD=.742, SE=.066) are quite large and highly significant in comparison to secondary (OD=.470, SE=.046) and higher education (OD=.261, SE=.079) in all the four models. There is a strong connection between mother's education and child health and nutritional status. In model 2, with education, children who are living in rural areas have a significant effect on wasting with high odd ratio (OD=1.33, SE=.061). Households wealth status also determines wasting and has a significant effect on wasting relative to poorest wealth strata, however, odd ratios for all kind of wealth quintiles are low. It is obvious that the rural population has low purchasing power and hence it becomes very difficult for them to get access to hospital, health care facilities and improved sanitation. Rural population, mainly those who belong to poor social strata, do not get most of cost-free services from the Government of India and hence, they may improve child malnutrition. Recently, Government of India has introduced two major health programmes, for instance, Ayushman Bharat Pradhan Mantri Arogya Yojana (PM-JAY) in September 2018, in order to provide primary, secondary and tertiary level treatments to the poor and vulnerable and secondly, the National Rural Health Mission in April, 2005 with the goal of improving the availability of and access to universal health care for people residing in rural areas. In model 3, controlling place of residence, it has been observed that family planning and sex of child have a significant effect on wasting. The odds ratios for all levels of contraceptive use are quite large and highly significant. Female children (OD=1.18, SE=.050) are more wasted relative to male children with high odds ratio. In our society, it is hypothesized that female children are supposed to be nutritionally neglected due to their low status in society and hence are expected to be more wasted. In the final model, education, place of residence, wealth index, use of contraceptive, sex of child, and religion have a robust and significant effect on wasting. Wealth index is found to be a significant factor in influencing wasting in children which indicates households with richer and richest quintiles showing better-nourished children under 5. Use of modern contraceptive measures can reduce the wasting in the children. India adopted a family planning programme about seven decades back to control fertility and

reproductive health problems however, the use of any modern contraceptive in Bihar is only 23.3 percent which is below the half of all India figure of 47.8 percent. Also, the result shows that mothers who are lying under the higher age cohort have a significant effect on wasting.

Table 5: Determinants of underweight using multiple logistic regression results

Variable	Model 1		Model 2		Model 3		Model 4	
	B	Odd ratio	*β*	Odd ratio	*β*	Odd ratio	*β*	Odd ratio
Female education								
No education (Ref.)								
Primary	.362* (0.82)	1.44	.237* (.094)	1.27	.389* (.082)	1.48	.199** (.095)	1.22
Secondary	.352* (.093)	1.42	.231** (.102)	1.26	.375* (.093)	1.46	.217** (.102)	1.24
Higher	.315* (0.85)	1.37	.219* (.090)	1.25	.332* (.085)	1.39	.245* (.090)	1.28
Place of residence								
Urban (Ref.)								
Rural			-.031 (.062)	0.97			-.030 (.062)	.970
Wealth index								
Poorest (Ref.)								
Poor			.360* (.128)	1.43			.444* (.129)	1.56
Middle			.350* (.127)	1.42			.427* (1.28)	1.53
Richer			.412* (.129)	1.51			.481* (.129)	1.62
Richest			.205 (.129)	1.22			.243*** (.130)	1.28
Family Planning								
No contraceptive use (Ref.)								
Modern method					.275 (.067)	1.32	.209* (.068)	1.23
Traditional method					-.039 (.187)	0.96	-.047 (.188)	0.95
Others					-.091 (.051)	0.91	-.123** (.050)	0.88
Sex of child								
Male (Ref.)								
Female					-.051*** (.035)	0.95	-.050 (.036)	.951
Religion								
Hindu (Ref.)								
Muslim					-.121 (.544)	0.89	-.110 (.545)	.896
Others					-.190 (.545)	0.83	-.174 (.546)	.840
Mother age cohorts (years)								
15-19 (Ref.)								
20-24							-.825* (.232)	.438

Variable	Model 1		Model 2		Model 3		Model 4	
	B	Odd ratio	*β*	Odd ratio	*β*	Odd ratio	*β*	Odd ratio
25-29							-.337 (.218)	.714
30-34							-.212 (.218)	.809
35-39							-.108 (.220)	.898
40-44							-.165 (.225)	.848
44-49							-.419*** (.240)	.658
N	25437		25437		25437		25437	
Cox & Snell R Square	.001		.001		.003		.007	
Nagelkerke R Square	.001		.002		.006		.011	
-2 Log-likelihood	21049.32		21034.15		20991.29		20909.60	

Ref., reference category

Figures in the parentheses are SE of estimates

As shown in table 5, education was the single variable in all models which influenced the child malnutrition with high odds ratios. In model 1, the rates of underweight were lower among children whose mothers have primary (OD=1.44, SE=.82), secondary (OD=1.42, SE=.092) and higher level of education (OD=1.37, SE=.85) in comparison to mothers with no education. In model 2, apart from education, the rates of underweight were lower in children who are belonging to higher quintile of wealth (OD=1.51, SE=.129). This means, children from the poorest household were more likely to malnourished than children from the richer and richest wealth quintile. However, place of residence of children no longer affected the rate of underweight of children. Model 3 adds the sex ratio of children which shows that female children (OD=0.95, SE=.035) were more underweight relative to male children. In our society, differential vulnerability of girls is existed and giving 'son preference' is the main cause for underweight of female child. In this model, religion of household no longer affected the rate of underweight of children. In the final model, the rates of underweight in children were lower for those whose mothers were highly educated (OD=1.28, SE=.090), for families using modern methods (OD=1.23, SE=.068) of contraceptive and households with richer wealth quintile (OD=1.62, SE=.129). Also, mother's age cohort is an imperative indicator which determined children's underweight. The model reported that if the age cohort of mother is between 20-25 years, the effect of child malnutrition is negative and significant. Findings shows that early marriage is one of the reasons for high prevalence of malnutrition in Bihar as mean age of marriage of women is 18 years and by this definition, 50 percent of Indian women are married off as children in northern states like Bihar, Jharkhand and Rajasthan. A recent study by Wemakor et. al. (2018) strongly advocates that children of teenage mothers, compared to those of adult mothers were 8 times more likely to be stunted, 3 times more likely to be wasted and 13 times more likely to underweight. It is observed that if other variables were controlled for, it is education of women which is highly associated with low rates of underweight of children.

4. Conclusions

Child malnutrition refers to any kind of disorder of nutritional status resulting from a lack or surplus (over or underweight) of protein-energy and other nutrient intake or disproportion of essential nutrients. According to IFPRI, one out of every three children under five in developing countries is malnourished. High prevalence of malnutrition not only causes severe cognitive and physical loss of children but also it is a violation of a child's human right (Das & Sahoo, 2011). In this context, the present study examined the effects of various socio-economic and maternal factors on child malnutrition among children under the age of five in Bihar, India, using the data from NFHS-4. This study also accounts for maternal level information such as the educational level and age cohort of the mother that appears to cause malnutrition in children. Among socio-economic determinants, mothers beyond primary education emerged as a significant factor that influenced stunting, wasting and underweight of children belonging to the age of five. This showed children of educated mothers have lower prevalence of malnutrition after controlling for other six socio-economic variables in model 1 (Tables 3, 4 and 5). This result was supported by other empirical studies that have found that if mothers were exposed to the same socio-economic situations, it was education of the mother beyond secondary level that makes a difference in the child nutrition outcomes (Bbaale, 2005). The analysis revealed that place of residence and sex of child were important factors determining wasting; however, they no longer affected the rate of stunting and underweight of children. It means if children reside in rural areas, they were more wasted in reference to those who were residing in urban areas as given the fact that urban settings usually have better ailment prevention forces. Also, this study highlights gender exclusion in child malnutrition in the state as female children are more malnourished in comparison to male children. The result shows that wealth index is also more likely to be an imperative factor which exhibits lower level of child malnutrition. It also represents if households belonging to the richest quintile of wealth index, children's live better quality of life and low mortality. Other factors found to be imperative in influencing child nutrition outcomes include the family planning, religion and mother's age cohorts.

Bihar is the third most populous state, located in eastern India with the population density as 1106, which is much higher than all India population density of 420. Principally, the state is backward in many socio-economic development indicators and ranks 36th position in Human Development Index which is the lowest across Indian states. The data revealed that the percentage of malnourished children is very high in comparison to other states which is the significant cause for poor human development. In this state around 90 percent population lives in rural areas and dependent of agriculture and allied activities for their livelihood. The per capita GDP is very low in all the districts except the capital city of Patna. Thus, highly dependency on agriculture and low returns from this sector identified as the important factor retarding improvement in standard of living and child health status. On the basis of our findings, the present study suggests that malnutrition in children is the result of multiple factors. Low rate of

female education is the principal factor for child malnutrition and this happens due to many socio-cultural reasons. To improve the status of health and nutritional outcome, the Government of India has launched many programmes, however, more emphasis should also be given to improvement in female education, economic status, access to rural nutrition, awareness about use of contraceptive. Wealth status is another determinant which indicates that the high incidence of poverty is a persistent problem affecting the ability to access and attain an adequate diet. As per Multi-dimensional Poverty Index, 55.2 percent of population are poor and 22.1 percent are severely poor in Bihar. This estimate shows the scarcity of material possession and unavailability of basic needs to poor which results low demand for energy and protein intake. To improve nutritional status of children, the state needs to eradicate all forms of poverty and to provide employment opportunities to the poor. The study suggests that efforts to improve female education need to be combined with more specific schemes to progress and better child rearing practices. Also, it is important to recommend community programmes to ensure education to females on how to feed infants and save them from infection, and adequate, accessible health services to prevent and treat infections can collectively reduce malnutrition in children. Our results show that mother using modern contraception methods are associated with positive child health outcomes. Therefore, the present study suggests that government, donors and private players/NGO can perform an imperative role in improving women's access to modern healthcare services by ensuring affordability at the regional level.

Authorship

Reena Kumari has done data collection, data analysis, modeling and interpretation of the results and prepared the manuscript. Aashita has done manuscript drafting and analysis of the results.

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The authors declare no conflicting interests.

References

Ahmed, T., Roy, S., Alam, N., & Hossain, M. I. (2012). Determinants of undernutrition in children under 2 years of age from rural Bangladesh. *Indian Pediatrics*, 49(10), 821-824.

Bangladesh Demographic and Health Survey (2007). Dhaka, Bangladesh and Calverton, Maryland [USA]: National Institute of Population Research and Training, Mitra and Associates, and Marco International.

Basu, A. M., & Stephenson, R. (2005). Low levels of maternal education and the proximate determinants of childhood mortality: a little learning is not a dangerous thing. *Social Science & Medicine*, 60(9), 2011-2023.

Bbaale, E. (2014). Maternal Education and Child Nutritional Status: Evidence from Uganda, Africa. *Journal of Economic and Management Studies*, 5(1), 52-74.

Cleland, J. (2010). The Benefits of Educating Women. *The Lancet*, 376(9745), 933-934.

Das, S., & Sahoo, H. (2011). An investigation into factors affecting child undernutrition in Madhya Pradesh. *The Anthropologist*, 13(3), 227-233.

Dasgupta, M., Lokshin, M., Gragnolati, M. and Ivaschenko, O. (2005). Improving Child Nutrition Outcome in India-Can the Integrated Child Development Services Program be More Effective? World Bank Policy Research Working Paper No. 3647. World Bank, Washington, DC.

Frost, M. B., Forste, R., and Haas, D.W. (2005). Maternal Education and Child Nutritional Status in Bolivia: Finding the Links. *Social Science & Medicine*, 60(2), 395-407.

Grantham-McGregor, S., Cheung, Y.B., Glewwe, P., Richter, L. and Strupp, B. (2007). Developmental Potential in the First 5 Years for Children in Developing Countries. *Lancet*, 369 (9555): 60-70.

Haddad, L., Alderman, H., Appleton, S., Song, L. and Yohannes, Y. (2003). Reducing Child Malnutrition: How Far Does Income Growth Take Us? *The World Bank Economic Review*, 17 (1), 107–131.

Headey, D., (2013). Developmental Drivers of Nutritional Change: A Cross-Country Analysis. *World Development*, 42, 76–88.

Heltberg, R., (2009). Malnutrition, Poverty, and Economic Growth. *Health Economics*, 18 (S1), S77–S88.

Mazumdar, S. (2010). Determinants of Inequality in Child Malnutrition in India. *Asian Population Studies*, 6(3), 307-333.

Measham, A.R., & Chatterjee M. (1999), Wasting Away: The Crisis of Malnutrition in India, Washington, DC: World Bank.

Miller, J. E., and Rodgers, Y. (2009). Mother's Education and Children's Nutritional Status: New Evidence from Cambodia. *Asian Development Review*, 26(1), 131-165.

Mishra VK, Lahiri S. and Luther, NY. (1999), Child Nutrition in India. National Family Health Survey Subject Reports 14 (June 1999), Mumbai, India: International Institute for Population Sciences, and Honolulu, Hawaii, USA: East-West Center.

Nussbaum, M. (2004). Women's Education: A Global Challenge. *Signs: Journal of Women in Culture and Society*, 29(2), 325-355.

Sastry, N., (1997). What Explains Rural-Urban Differentials in Child Mortality in Brazil? *Social Science and Medicine*, 44(7), 989-1002.

Sen, A. (1999). Development as Freedom, New York, NY: Anchor Books.

Shetty, P.S. and James, W.P.T. (1994), Body Mass Index: A Measure of Chronic Energy Deficiency in Adults, Rome, Italy: Food and Agriculture Organization of the United Nations, (FAO food and nutrition paper 56).

Smith, L.C., and Haddad, L.J., (2000). Explaining Child Malnutrition in Developing Countries, Technical report, International Food Policy Research Institute (IFPRI), Washington, DC.

Subramanyam, M.A., Kawachi, I., Berkman, L.F. and Subramanian, S.V., (2010). Socioeconomic Inequalities in Childhood Undernutrition in India: Analyzing Trends Between 1992 and 2005. *PLoS One*, 5(6), e11392.

Svedberg, P. (2008). Why Malnutrition in Shining India Persist, 4th Annual Conference on Economic Growth and Development, New Delhi, 2008.

Tarozzi, A., & Mahajan, A. (2007). Child nutrition in India in the nineties. *Economic Development and Cultural Change*, 55(3), 441-486.

United Nations (2019). Transforming Our World: The 2030 Agenda for Sustainable Development. https://sustainabledevelopment.un.org/post2015/transformingourworld.

Walker, S.P., Wachs, T.D., Gardner, M., Lozoff, B., Wasserman, G.A., Pollitt, E. and Carter, J.A. (2007). Child Development: Risk Factors for Adverse Outcomes in Developing Countries. *The Lancet*, 369(9556), 145-157.

Wemakor, A., Garti, H., Azongo, T., Garti, H., and Atosona, A., (2018). Young Maternal Age is a Risk Factor for Child Undernutrition in Tamale Metropolis, Ghana. *BMC Research Note*, 11: 877.

WHO (1978), A Growth Chart for International Use in Maternal and Child Health Care. WHO: Geneva.

WHO (2010), Nutrition Landscape Information System (NLIS) Country Profile Indicators. Geneva, Switzerland.

World Bank (2006), Repositioning Nutrition as Central to Development A Strategy for Large-Scale Action, Washington DC, USA.