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Mother's Education and Child Health in India: Multinomial Logit Estimation of Malnutrition

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Abstract: Globally childhood malnutrition manifesting as stunting, wasting, underweight and overweight is the biggest cause of disease burden and millions of deaths of children under five years. India is home to more than one-third of the world's malnourished children despite being one of the first countries in the world to implement a strong and universal immunisation programme. Empirical evidence suggests a strong positive effect of maternal education on the health of children. This paper analyses the effect of maternal education on the nutritional status of children in India using the 2015-16 fourth round National Family Health Survey (NFHS-IV) data and applying the multinomial logistic regression method. The estimated odds ratios show that maternal education significantly reduces the risks of the child being stunted or wasted or underweight or all of these. A woman, with at least primary education gives better care and health to her child and helps reduce the risk of the child being malnourished. Months of breastfeeding, child's birth weight, mother's age, and place of delivery are the other determinants of the nutritional status of children in India.

Keywords: Mother's education, empowerment, intra-household allocation, child health, malnutrition, multinomial logit estimation.

INTRODUCTION

Child malnutrition is the biggest missed opportunity for a healthy society. Malnourishment is caused by a poor diet that lacks nutrients. In famine-stricken areas around the world, the most extreme form of malnutrition, severe acute malnutrition, an extreme condition that leaves young victims frail and even skeletal, which is entirely preventable, ended so many young lives. Deeply intertwined with poverty and lack of access to basic services and the poor knowledge of mothers, the causes and consequences of

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malnutrition are wide-ranging and very complex. The physical and cognitive damages caused by malnourishment during the first two years of a child's life are largely irreversible. Children who survive may face a long list of devastating side effects that last over their lifetime, like increased vulnerability to diseases, developmental delays, stunted growth and even blindness that prevent children from achieving success in school and pursuing meaningful work in adulthood leading to productivity and earning loss in future.

According to the World Health Organisation, malnutrition manifests in four comprehensive types viz. stunting, wasting, underweight and overweight, measured by standardised anthropometric measures viz. height-for-age, weight-for-height, weight-for-age and weight-for-height indexes respectively. Stunting or chronic protein-energy malnutrition is a deficiency of calories and protein available to the body tissues. It is caused by the inadequate intake of food over a long period or by persistent and recurrent ill-health. Wasting or acute protein-energy malnutrition is the failure to receive adequate nutrition caused by recent episodes of illness, diarrhoea in particular or acute food shortage. Underweight is a composite of both stunting and wasting due to chronic or acute malnutrition. A low height-for-age (stunting) reflects the cumulative effects of undernutrition and infections since and even before birth that retard a child's growth. Children who have low weight-for-age (underweight) can reflect wasting i.e. low weight-for-height, indicating acute weight loss, stunting, or both.

Globally, maternal and child malnutrition accounts for nearly 3.5 million deaths annually and about 35% of the disease burden in children under five years of age. India is the home to more than one-third of the world's malnourished children. Among these, half of the children under three years are underweight and a third of the wealthiest children are over-nourished. India ranks 114 out of 132 countries in terms of child malnutrition (Haddad *et al.*, 2015; IFPRI, 2016). Roughly half of all children under five years show evidence of chronic malnutrition. According to the NFHS, 38% of children under five are stunted and 36% are underweight. In 2016, 97 million children were underweight, the highest in the world, and 62 million children were stunted, which is about 40% of global stunting (Khan & Mohanty, 2018). About 72% of infants have anaemia and among children under the age of five, 44% are underweight and 69% of deaths are caused by malnutrition. According to a 2019 UNICEF report, every second child under the age of five is affected by some form of malnutrition like stunting (35%), wasting (17%) and being overweight (2%). Only 42% of children in the age group of six to twenty-three months are fed an adequately diverse diet. Timely complementary feeding is initiated for only 53% of infants aged six to eight months.

Ironically this disturbing scenario of child malnutrition in India persists despite the fact that India is one of the fastest-growing economies and one of the first countries in the world that immediately adopted the Expanded Immunisation Programme in 1978 after its global initiation. In 1985-86, the Government of India launched the Universal Immunisation Programme with much dynamism to attain universal vaccination of infants against the vaccine-preventable diseases - pertussis, tetanus, polio, measles, childhood tuberculosis, hepatitis B, hemophilus influenza type b (Hib) and diarrhoea. Universal immunisation has also been incorporated in subsequent health and population policies such as Child Survival and Safe Motherhood Programme (1992), Reproductive and Child Health Programme (1997), National Population Policy (2000) and National Rural Health Mission (2005). Despite the all-round continuous efforts, India has failed to achieve the target of universal immunisation coverage, as only 54% of the children aged 12-23 months received the recommended doses of all the vaccines. Further, the immunisation coverage is largely skewed across regions and socioeconomic groups. In Tamil Nadu, full immunisation coverage is as high as 82% compared to as low as 30% in Uttar Pradesh. Among socioeconomic groups, only 36% of the poorest people received full immunisation compared to 73% among the richest people.

Figure 1 presents the trend of child immunisation in India between 1999 and 2013 showing a slow increase in child immunisation over the period. The BCC (Bacilli Calmette-Guerin) vaccination increased from 74% to 91%, DTP1 from 74% to 90%, DTP3 from 59% to 83%, third dose of oral polio from 57% to 82%, and the first dose against measles from 56% to 83%.

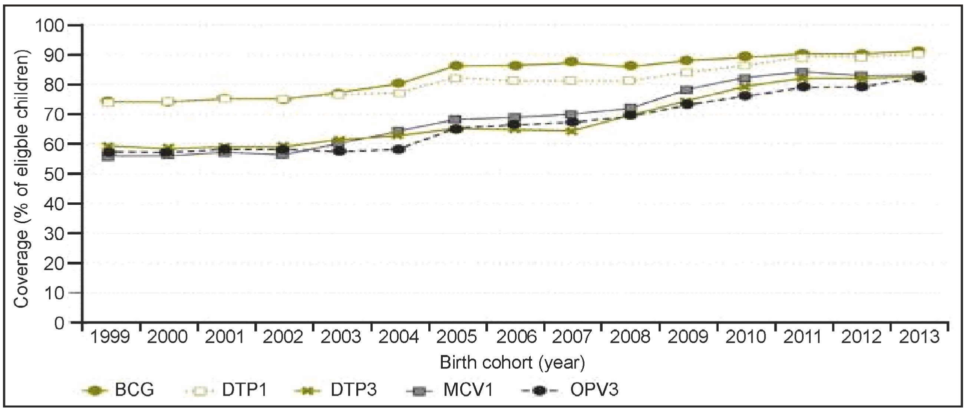

Figure 1: Trends in Child Immunisation in India

Source: WHO (2016)

The 2016-18 Comprehensive National Nutrition Survey (CNNS) survey of 1.2 lakh children by the Ministry of Health and Family Welfare revealed that higher educated mothers were likely to provide better and more nutritious diets to their children. Children born to educated women suffered less from malnutrition which manifested as being underweight, wasting and stunting in children. While 31.8% of children with at least 12th grade educated mothers received an adequate diverse diet, only 11.4% of children of uneducated mothers received diverse meals. Mothers with no schooling failed to provide the minimum acceptable diet (3.9%) with iron-rich food (7.2%) to children relative to mothers who attended school (9.6% and 10.3% respectively). While 50.4% of children aged between 6-23 months of literate mothers received the minimum frequency of meals, only 36.2% of children of illiterate mothers received the minimum frequency of meals. While 44.1% of children of uneducated mothers suffered from anaemia, 34.6% of children of educated mothers also had anaemia. However, children of educated mothers had more access to sugar products and thus were at the risk of higher cholesterol and early diabetes. The pre-diabetes level in the children of the educated mother was 15.1% as against 9.6% of the children of uneducated mothers. The level of cholesterol in children had a reading of 6.2% versus 4.8%.

Given the high prevalence of childhood malnutrition in India, what is the role of mothers, particularly educated mothers in the prevention of child malnourishment? Studies conducted in different settings show that there exists a strong linkage between maternal education and the health of children. A well-educated woman is likely to look after her child's health far more than those who are not. Studies on the relationship between child health and female education go back to the early 1970s when Caldwell (1979) demonstrated that "ceteris paribus, children of educated mothers experience lower mortality than do children of uneducated mother". Many studies have established the link between female education and different aspects of child health in every country, both developing and developed. However, the mechanisms that link the mother's education and child health, in general, are still not well understood. Basically, there are a few linking factors between the mother's education and the child's nutritional status. Maternal education raises the child's nutritional and health levels as educated women have better socioeconomic status, higher income and live in better neighbourhoods. Formal education of mothers directly transfers health knowledge to future mothers. The literacy and numeracy skills that women acquire in school enhance their ability to recognise illness and seek treatment for their children, especially in modern medicine.

Against this background, this paper aims to understand the relationship between maternal education and the nutritional status of children in India. This paper focuses on the socioeconomic and demographic determinants of poor health outcomes in children in the context of poverty in different regions of India. The paper used the 2015-16 fourth round National Family Health Survey (NFHS-IV) data. Empirically, as the dependent variable - the child's nutritional status - is a categorical variable, the multinomial logistic regression (MNL) estimation method was followed.

REVIEW OF LITERATURE

Behrman and Wolfe (1987) emphasise that a mother's education is significant for her own and her children's health and nutrition in developing economies. They observe that the mother's schooling has a strong positive effect on the health and nutrition of children. However, the effect evaporates when the maternal endowment i.e. abilities, habits, and health status related to childhood family background is considered when estimating the effect of maternal schooling on health and nutrition.

Shariff and Ahn (1995) analyse the determinants of the height-for-age and weight-for-height of children less than five years of age in Uganda by applying a two-stage method. The analysis reveals a significant effect of the mother's education on the long-term health measure (height-for-age) of children. Parental education has a positive but not significant association with the short-term (weight-for-height) measure of health. A mother's education improves the child's height for age more in urban areas than in rural areas and the benefits of the mother's education are greater for sons than for daughters.

Block (2007) analyses the roles of maternal schooling versus maternal nutrition knowledge as determinants of micronutrient status (haemoglobin concentration) in Indonesian children by applying parametric and nonparametric techniques. The study finds that maternal schooling contributes to child micronutrients not only directly but also through its effects on nutrition knowledge and household expenditures. Maternal nutrition knowledge substitutes for schooling, particularly at lower levels of income and schooling.

Pradhan (2010) tries to identify factors associated with the nutritional status of children less than five years of age using the 2006 Demographic and Health Survey of Nepal and applying the multinomial logistic regression method. The MNL estimates show that increasing the body mass index of mothers and wealth index significantly decreases the likelihood of child malnutrition and the size at birth is significantly associated with nutrition during childhood. Rural children have a higher likelihood of different forms of underweight and wasting compared to urban children. Female children are more likely to be stunted, underweight and wasted as compared to male children. Female-headed households are more likely to have moderately and mildly stunted children and the evidence for underweight and wasting is mixed. The likelihood for all forms of malnutrition is higher among children smaller than the average size at birth.

Das and Rahman (2011) try to identify the determinants of child malnutrition in Bangladesh using the 2014 Bangladesh Demographic and Health Survey data and apply the ordinal logistic regression method. The study finds that age of the child, birth interval, mothers' education, maternal nutrition, household wealth status, child feeding, the incidence of fever, ARI and diarrhoea are the significant predictors of child malnutrition measured in terms of the weight-for-age anthropometric index.

Fadare *et al.* (2019) investigate the effect of a mother's education and nutrition-related knowledge on the nutrition outcomes of young children in rural Nigeria using the 2013 Demographic and Health Survey data and applying the regression method. They argue that mothers' limited knowledge about food choices, feeding, and healthcare-seeking practices contribute significantly to negative nutrition outcomes for children in most developing countries Further, mothers' knowledge of health and nutrition may substitute for education in reducing under-nutrition in young children among populations with limited access to formal education. The study finds that the mother's knowledge is independently and positively associated with height-for-age and weight-for-height z-scores in young children. The association between child height-for-age and weight-for-height z-scores and levels of mother's education is significantly positive. Mothers' knowledge of health and nutrition may substitute for education in reducing undernutrition in young children among populations with limited access to formal education.

Khanam *et al.* (2019) measure the prevalence of childhood undernutrition and assess the role of various factors on childhood undernutrition in Bangladesh using the 2014 Bangladesh Demographic and Health Survey data. The study reports the prevalence of 36.5% stunting, 14.6% wasting, and 32.5% underweight among children younger than five years of age in Bangladesh. The study finds that the age of the child, child with fever or diarrhoea, type of birth, mother's education and BMI of the mother, household wealth, and the number of under-five children in the household are significant risk factors for childhood undernutrition. A mother's education is a significant predictor of a child's nutritional status, as the likelihood of being underweight increases for children of mothers with no, primary, and secondary education compared to that of higher education status. The study finds that children of mothers with no education are 72% more likely to have stunting compared to children of mothers with higher education.

In the Indian context, Bhargava (2003) examines the proximate determinants of infant survival in the most populous Indian state, Uttar Pradesh using the National Family Health Survey data on 11,500 women during the period 1982-1992 and probit estimation. The study finds that maternal education has a significant effect on child survival.

Chowdhury *et al.* (2014) use the Bangladesh Food Security Nutritional Surveillance Project (FSNSP) data to determine the effect of the mother's education on the child's nutritional status. The study finds that 30% of children are stunted, 40% are underweight and 11% are wasted in Bangladesh. The rates of under-nutrition are significantly lower among children of higher educated mothers - 17.2% stunting, 26.3% underweight and 10% wasting, compared to children of illiterate mothers - 37.5% stunting, 46% underweight and 13.6% wasting. The proportion of mothers with knowledge from a proper source about child feeding increases significantly with the increase of maternal education - from 17% for illiterate to 36% for educated mothers.

Syed and Rao (2015) assess the nutritional status of 394 school students in 2014 in an urban slum of Hyderabad and its association with socioeconomic and demographic factors. The study finds that 29% of children are undernourished, 17% stunted and 10% wasted. Maternal illiteracy is associated with more than 62% of malnourished as compared to 48.3% of normal children.

Alderman and Headey (2017) assess the effect of parental education on child nutrition using 134 Demographic and Health Surveys from 56 developing countries consisting of 3,76,992 preschool children and applying the least square model that includes cluster fixed effects and cohort-based educational rankings. They find that the estimated nutritional returns to parental education are larger for mothers than for fathers and generally increasing, with a low for primary education. The results imply that higher levels of female education would only lead to modest reductions in stunting rates in high-burden countries. We speculate that education might have more impact on the nutritional status of the next generation if school curricula focused directly on improving the health and nutritional knowledge of future parents.

Nie *et al.* (2019) analyse the socioeconomic and demographic factors contributing to changes in the nutritional status of children aged 0-5 years in India using the 2004-2005 and 2011-2012 Indian Human Development Survey. A decomposition approach is adopted to identify the contribution of different socioeconomic conditions of households to the changes in stunting, underweight and a composite index of anthropometric failure (CIAF). The study finds that maternal body mass index and education, along with household economic condition, account for much of the changes in child nutrition, the incidence of stunting and underweight has declined by 7 and 6 percentage points respectively.

DATA AND METHODOLOGY

This paper used the nationwide data of the fourth round National Family Health Survey (NFHS-IV) 2015-2016 in all the 29 states of India, a sample size of 2,33,045 individual observations. The outcome variable was the child's nutritional status, conventionally determined through anthropometric measures of underweight - children with two standard deviations or more below the median weight-for-age, stunted - children with two standard deviations or more below the median height-for-age, and wasted - children with two standard deviations or more below the median weight-for-height. However, these indicators overlap. From the anthropometric measures, adjusted anthropometric indicators of child nutritional status are constructed into six categories: children with (i) stunted, (ii) wasted, (iii) underweight, (iv) multiple anthropometric failures with at least two malnutrition problems, (v) stunted, wasted and underweight or all three malnutrition, and of course (vi) no malnutrition.

MULTINOMIAL LOGISTIC REGRESSION METHOD

Multinomial logistic regression is used to predict the probabilities of different possible outcomes of a categorically distributed dependent variable given a set of independent variables. The multinomial logit assumes that the odds of one outcome over another do not depend on the presence or absence of other alternatives i.e. or the relative probability does not change if another outcome is added as an additional possibility. This allows the choice of J alternatives to be modelled as a set of J-1 independent binary choices in which one alternative is chosen as a pivot and the other J-1 compared against it, one at a time. The purpose of multinomial logit is to know the probability of an outcome variable y being in each potential outcome $j \epsilon p(y = j \mid x)$.

The multinomial logistic classifier uses a generalisation of the sigmoid, called the softmax function, to compute the probability $p(y = j \mid x)$. The softmax function takes a vector $z = [z_1, \ldots, z_k]$ of k arbitrary values and maps them to a probability distribution, with each value in the range [0, 1], and all the values summing to 1. Like the sigmoid, the softmax function is an exponential function. For a vector z of dimensionality k, the softmax is defined as:

$$softmax(z_i)\frac{e^{z_i}}{\Sigma_{i=1}^{k} e^{z_i}} \qquad 1 \le i \le k \tag{1}$$

The softmax of an input vector = [z_1,…, z_k] is thus a vector itself:

$$softmax(z)\frac{e^{z_1}}{\Sigma_{i=1}^{k} e^{z_i}}, \frac{e^{z_2}}{\Sigma_{i=1}^{k} e^{z_i}}, \ldots, \frac{e^{z_k}}{\Sigma_{i=1}^{k} e^{z_i}} \tag{2}$$

The denominator $\Sigma_{i=1}^{k} e^{z_i}$ is used to normalise all the values into probabilities.

The logistic regression model is specified as:

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i \tag{3}$$

Given that all J of the probabilities must sum to one, the individual probabilities are then calculated as:

$$pr(y_i = 1) = \frac{e^{\beta_1 x_i}}{1 + \Sigma_{j=1}^{J-1} e^{\beta_j x_i}}$$

$$pr(y_i = 2) = \frac{e^{\beta_2 x_i}}{1 + \Sigma_{j=1}^{J-1} e^{\beta_j x_i}} \tag{4}$$

Thus, when y_i ranges over J categories, the probability of the j^{th} category is given by:

$$pr(y_i = j) = e^{\beta_j x} / (1 + \Sigma e^{\beta_j x}) \tag{5}$$

In the multinomial logistic regression model, the linear component is equated to the log of odds of j^{th} outcome compared to the J^{th} outcome. That is, considering the Jth category to be the baseline category, the logits of the first J-1 categories are constructed as:

$$\log\left[\frac{p_j}{p_J}\right] = \log\left[\frac{p_j}{1 + \Sigma_{j=1}^{J-1} p_j}\right] = \log\left[\frac{e^{\beta_j x}}{1 + \Sigma e^{\beta_j x}}\right] = \Sigma_{k=0}^{K} \beta_{jk} x_{ik} \tag{6}$$

Solving for p_j:

$$p_j = \frac{e^{\Sigma_{k=0}^{K} \beta_{jk} x_{ik}}}{1 + \Sigma_{j=1}^{J-1} \Sigma_{k=0}^{K} \beta_{jk} x_{ik}} = \frac{1}{1 + \Sigma_{j=1}^{J-1} e^{\Sigma_{k=0}^{K} \beta_{jk} x_{ik}}} \qquad j < J \tag{7}$$

The joint probability density function is given by:

$$f(y \mid \beta) = \Pi_{i=1}^{N}\left[\frac{n_i!}{\Pi_{j=1}^{J} y_{ij}!} \Pi_{j=1}^{J} \pi_{ij}^{y_{ij}}\right] \tag{8}$$

The likelihood function expresses the unknown values of ? in terms of known fixed constant values for y. The log-likelihood function for the multinomial logistic regression model is specified as:

$$L(\beta) = \Sigma_{i=1}^{N} \Sigma_{j=1}^{J-1} \left(y_{ij} \Sigma_{k=1}^{K} \beta_{jk} x_{ik} \right) - n_i \log \left(\frac{1}{1 + \Sigma_{j=1}^{J-1} e^{\Sigma_{k=0}^{K} \beta_{jk} x_{ik}}} \right) \quad (9)$$

By maximising the above equation, the estimates of β are obtained.

The relative risk ratio (RRR) is computed from the multinomial logit estimates as a ratio of the probability of an outcome j - the child being stunted or wasted or underweight to the probability of the child not being malnourished. Together with risk difference and odds ratio, the relative risk measures the association between the exposure and the outcome. Assuming a causal effect between the exposure and the outcome, the relative risk ratio implies that (i) RRR = 1 means the exposure does not affect the outcome, (ii) RRR < 1 means the risk of the outcome decreases with the exposure, and (iii) RRR > 1 means the risk of the outcome increases with the exposure.

EMPIRICAL ANALYSIS

Table 1 presents the description and distribution of the variables used in the paper. In terms of nutritional status, the NFHS-IV data shows that in India in 2015-2016 about one-third of children (28.95%) out of 2,33,045 had no malnutrition problem. About 8.17% were stunted, 14.56% were wasted, 6.44% were underweight, while 24.65% of children had at least 2 malnutrition problems and 17.23 children had all three malnutrition problems. While 45.04% of mothers attended secondary education, 31% of mothers were not educated. Most children were not even getting breastfeeding in the initial six months indicating a lack of nutrition from breastfeeding. More than half of children (57.19%) were under the required weight by birth and 64.92% of mothers did not visit antenatal care facilities at least once. About 54.66% of births were born at traditional birth attendance. Nearly 64.8% of households were socio-economically poor and 81.24% households belonged to SC/ST/OBC community. The average number of children per woman was 2.14%.

Table 1: Descriptive Statistics of Variables

Variable	*Description*	*%*	*Observations*
Child nutritional status	Stunted	8.17	19041
	Wasted	14.56	33931
	Underweight	6.44	15003
	Any two anthropometric failure	24.65	57443

contd. table 1

Variable	*Description*	%	*Observations*
	All three anthropometric failure	17.23	40156
	No malnutrition	28.95	67471
Mother's age (MA)	18-24 years	32.49	75722
	25-29 years	38.61	89987
	30-35 years	22.02	51310
	36+ years	6.88	16026
Mother's education (ME) - highest level of school attended	No education	31.10	72486
	Primary	14.61	34056
	Secondary	45.04	104953
	Higher	9.25	21550
Mother's marital status (MS)	Married	98.58	229744
	Never in union	0.14	322
	Living with partner	0.63	1472
	Divorced	0.65	1507
Pregnancy intentions (PI) - proxy for family planning intention	Now	91.99	214374
	Later	3.80	8857
	Never	4.21	9814
Place of child delivery (PD)	Institutional	24.26	56545
	Home/traditional attendants	54.66	127381
	Others	21.08	49119
Weight of child at birth (BW)	< 2.5kg	57.19	133287
	> 2.5 kg	42.81	99758
Gender of child (GC)	Male	52.01	121213
	Female	47.99	111832
Breastfeeding (BF)	< 6 months	56.76	132274
	> 6 months	43.24	100771
Antenatal care (AC)	No visits	64.92	151298
	At least one visit	35.08	81747
Socioeconomic status (SES)	Poor	64.8	151002
	Middle	17.62	41067
	Rich	17.58	40976
Community (COM)	SC/ST/OBC	81.24	182198
	General	18.76	42071
Region (RN)	North	19.11	44542
	East	21.23	49470
	Central	29.47	68676
	North-East	14.28	33277
	West	6.78	15797
	South	9.13	21283
Parity (MP)	Number of children per woman	2.146 (0.531)*	233045
Observations		2,33,045	

Note: * Mean and standard deviation (in parentheses).

The estimating logistic regression equation is specified as:

$$\ln\left[\frac{p_j}{1-p_j}\right] = \beta_0 + \beta_1 MA_i + \beta_2 ME_i + \beta_3 MP_i + \beta_4 MS_i + \beta_5 PI_i + \beta_6 PD_i + \beta_7 GC_i + \beta_8 BW_i + \beta_9 BF_i + \beta_{10} AC_i + \beta_{11} Com_i + \beta_{12} SES_i + \beta_{13} RN_i + \varepsilon_i \quad (10)$$

where $\ln\left[\frac{p_j}{1-p_j}\right]$ is the multinomial log of odds. The multinomial logit estimates of child nutritional status with the base category of children with no malnutrition problem have been presented in Table 2.

Table 2 presents the logistic regression estimates of the determinants of child malnutrition in India. In all specifications, the coefficients of the mother's education are negative and statistically significant. Relative to illiterate mothers, the odds of child stunting are lower by 4% for mothers with primary educated mothers, 3% for secondary educated mothers and more than 5% for mothers with higher education. Similar maternal education effects also hold for child wasting and underweight. The negative effects of maternal education on all three indicators of child malnutrition are higher for higher educated mothers. Hence, maternal education is crucial for reducing child malnutrition in India.

Increasing the mother's age decreases the probability of child stunting and being underweight but increases child wasting. The marital status of women has an insignificant positive effect on child malnutrition. Mother's parity significantly moderately increases the probability of the child being in anyone as well as all categories of malnutrition. More children in the household reduce both the economic resources as well as the mother's care available to each child. Surprisingly, male child relative to female chid has slightly higher odds of being malnourished, contrary to the literature on infanticide and discrimination against female children. Further, children delivered at home by attendants and others have a significantly lower probability of malnutrition compared to children born in hospitals.

Childcare practices reduce the risk of child malnutrition. Children with a birth weight greater than 2.5kg have significantly lower chances of being malnourished. Higher birth weight of children is associated with a 1% of lesser chance of being stunted, 3% of lesser chance of wasting and 5% of lesser chance of being underweight compared to children with lower birth weight. Children breastfed for less than six months have a significantly higher probability of being stunted and underweight. Breastfeeding a child for lesser than six months increases the risk of child stunting by about 4%.

Antenatal care significantly reduces the probability of child malnutrition. At least one antenatal visit decreases the probability of child stunting by 2%, wasting and underweight by about 1%.

Household socioeconomic status has a negligible effect on child malnutrition. However, children born in higher social strata have a significantly lower probability of being malnourished relative to children of SC/ST/OBC communities. The probability of child stunting is lesser by 1%, wasting and underweight by 2% for children of general community than socially backward community children. Region-wise, the results are mixed. The probability of child stunting is low in most regions, but the chances of a child being wasted and underweight are higher in almost all regions. Overall, children in central and eastern regions of India have a higher probability of child malnutrition while in the northeast region children have a lesser probability of the child being malnourished.

Table 2: Multinomial Logit Estimates of Child Nutritional Status

Variable	*Stunted*	*Wasted*	*Underweight*	*Any two*	*All three*
Mother's age-25-29 years	-0.048** (0.028)	0.183* (0.017)	-0.043*** (0.022)	0.044* (0.014)	0.217* (0.017)
Mother's age 30-35 years	-0.119* (0.024)	0.176* (0.020)	-0.176* (0.027)	-0.017 (0.017)	0.192* (0.019)
Mother's age 36+ years	-0.139* (0.038)	0.283* (0.031)	-0.181* (0.045)	0.036* (0.020)	0.281* (0.030)
Mother's education-primary	-0.046*** (0.028)	-0.213* (0.023)	-0.069** (0.032)	-0.167* (0.020)	-0.344* (0.021)
Mother's education-secondary	-0.272* (0.022)	-0.522* (0.018)	-0.252* (0.025)	-0.595* (0.016)	-0.983* (0.017)
Mother's education-higher	-0.551* (0.033)	-0.972* (0.028)	-0.503* (0.036)	-1.203* (0.025)	-2.105* (0.037)
Mother-never in union	-0.274 (0.228)	0.060 (0.172)	0.021 (0.241)	-0.201 (0.163)	-0.098 (0.187)
Mother living with partner	0.119 (0.106)	0.056 (0.089)	0.034 (0.124)	0.162** (0.076)	0.102 (0.085)
Mother-divorced	0.155 (0.095)	0.174 (0.084)	0.0007 (0.125)	0.222* (0.74)	0.267 (0.088)
Intend later pregnancy	0.013 (0.044)	0.081** (0.036)	-0.007 (0.048)	0.070** (0.031)	0.019 (0.037)
Intend no pregnancy	0.096** (0.044)	0.010 (0.036)	0.006 (0.051)	0.063** (0.031)	-0.028 (0.034)
Male child	0.045* (0.017)	0.025*** (0.014)	0.046** (0.018)	0.058* (0.012)	0.047* (0.014)
Child delivery at home/ attendants	-0.149* (0.024)	-0.255* (0.019)	-0.220* (0.027)	-0.344* (0.017)	-0.421* (0.019)

contd. table 2

Variable	*Stunted*	*Wasted*	*Underweight*	*Any two*	*All three*
Other child delivery	-0.251*	-0.640*	-0.406*	-0.645*	-0.996*
	(0.029)	(0.024)	(0.032)	(0.021)	(0.024)
Child birth weight >2.5kg	-0.112*	-0.272*	-0.473*	-0.456*	-0.542*
	(0.019)	(0.015)	(0.021)	(0.013)	(0.016)
< 6 months breastfed	0.353*	-0.010	0.065*	0.337*	0.491*
	(0.017)	(0.015)	(0.019)	(0.012)	(0.015)
At least one antenatal visit	-0.228*	-0.156*	-0.085*	-0.338*	-0.560*
	(0.019)	(0.016)	(0.020)	(0.014)	(0.016)
Middle SES	-0.004	0.007	-0.005	0.012	0.039**
	(0.023)	(0.019)	(0.025)	(0.016)	(0.018)
Rich SES	-0.007	0.030***	0.040	0.042*	0.038**
	(0.023)	(0.019	(0.025)	(0.016)	(0.018)
General community	-0.136*	-0.242*	-0.180*	-0.303*	-0.502**
	(0.021)	(0.018)	(0.024)	(0.016)	(0.019)
East region	-0.154*	0.547*	0.226*	0.485*	0.921*
	(0.029)	(0.022)	(0.030)	(0.020)	(0.022)
Central region	0.121*	0.349*	0.277*	0.526*	0.792*
	(0.024)	(0.021)	(0.027)	(0.018)	(0.021)
North-East region	0.157*	-0.090*	-0.448*	-0.268*	-0.498*
	(0.027)	(0.025)	(0.036)	(0.022)	(0.019)
West region	-0.062	0.579*	0.379*	0.576*	1.045*
	(0.041)	(0.031)	(0.039)	(0.027)	(0.031)
South region	-0.141*	0.029	0.024	0.101*	0.162*
	(0.033)	(0.028)	(0.035)	(0.024)	(0.031)
Parity	0.033***	0.070*	0.048**	0.099*	0.136*
	(0.019)	(0.014)	(0.020)	(0.013)	(0.013)
Constant	-0.940*	-0.285*	-0.959*	0.341*	-0.089**
	(0.053)	(0.042)	(0.059)	(0.037)	(0.040)
Log-likelihood	-361374.06				
LR-Chi square	26394.24				

Note: Standard errors in parentheses. *, **, *** Significant at 1, 5, 10% levels.

The relative risk ratios for all categories of child malnutrition are presented in Table 3. The relative risk of stunting for children whose mother has primary education relative to the mother who has no education would decrease by a factor of 0.95, stunting by 0.76 and underweight by 0.57. Compared to the children of uneducated mothers, the relative risk of children of educated mothers would decrease by a factor of 0.11 to 0.37 in all categories of child malnutrition. The relative risk of children being malnourished would increase by a factor of 0.14 with increasing parity of children. The relative risk of malnourishment of children of higher aged mothers would be lesser by a factor of 0.2 and that of mothers living with a partner would be lower by a factor of 0.10. Children delivered at home by attendants would have a lower relative risk by a factor of 0.65 to be malnourished.

The relative risk of a child being malnourished would be lesser by a factor of 0.58 if the birth weight is greater than 2.5kg. Breastfeeding of a child less than six months would increase the relative risk of malnutrition by a factor of 0.63. The relative risk of child malnutrition would decrease by a factor of 0.57 with at least one antenatal care visit. Children from higher social groups would have a factor of 0.61 lower relative risks of being malnourished.

Table 3: Relative Risk Ratios of Child Malnutrition

Variable	*Stunted*	*Wasted*	*Underweight*	*Any two*	*All three*
Mother's age-25-29 years	0.953** (0.019)	0.201* (0.020)	0.958** (0.021)	1.045* (0.015)	1.243* (0.021)
Mother's age 30-35 years	0.888* (0.022)	1.192* (0.024)	0.838* (0.023)	0.983* (0.017)	1.212* (0.023)
Mother's age 36+ years	0.870* (0.033)	1.327* (0.041)	0.834* (0.037)	1.037* (0.028)	1.325* (0.040)
Mother's education-primary	0.955 (0.028)	0.808* (0.019)	0.935** (0.030)	0.846* (0.017)	0.709* (0.015)
Mother's education-secondary	0.762* (0.017)	0.594* (0.011)	0.777* (0.019)	0.551* (0.009)	0.374* (0.006)
Mother's education-higher	0.576* (0.019)	0.378* (0.011)	0.605* (0.022)	0.300* (0.007)	0.122* (0.005)
Mother-never in union	0.760 (0.173)	1.062 (0.183)	1.021 (0.246)	0.818 (0.134)	0.906 (0.169)
Mother living with partner	1.127 (0.119)	1.058 (0.095)	1.034 (0.129)	1.176** (0.089)	1.107 (0.094)
Mother-divorced	1.168 (0.111)	1.190** (0.101)	.125 (0125)	1.248* (0.092)	1.306* (0.115)
Intend later pregnancy	1.013 (0.045)	1.084** (0.039)	0.993 (0.045)	1.072** (0.033)	1.019 (0.037)
Intend no pregnancy	1.100** (0.049)	1.010 (0.036)	1.006 (0.052)	1.065** (0.033)	0.972 (0.033)
Male child	1.046* (.0177)	1.025** (0.014)	1.047** (0.019)	1.059* (0.013)	1.049* (0.014)
Child delivery at home/ attendants	0.862* (0.021)	0.775* (0.015)	0.803* (0.022)	0.709* (0.012)	0.656* (0.012)
Other child delivery	0.778* (0.022)	0.527* (0.013)	0.666* (0.021)	0.525* (0.011)	0.369* (0.009)
Child birth weight >2.5kg	0.894* (0.017)	0.762* (0.012)	0.623* (0.013)	0.634* (0.009)	0.581* (0.009)
< 6 months breastfed	1.424* (0.025)	0.990 (0.014)	1.067* (0.021)	1.401* (0.017)	1.634* (0.023)
At least one antenatal visit	0.796* (0.015)	0.856* (0.013)	0.918* (0.019)	0.713* (0.010)	0.571* (0.009)
Middle SES	0.996 (0.023)	1.007 (0.019)	0.995 (0.025)	1.012 (0.016)	1.040** (0.019)

contd. table 3

Variable	*Stunted*	*Wasted*	*Underweight*	*Any two*	*All three*
Rich SES	0.993	1.031	1.040	1.043	1.039**
	(0.023)	(0.019)	(0.026)	(0.017)	(0.019)
General community	0.873*	0.785*	0.835*	0.739*	0.606*
	(0.019)	(0.014)	(0.020)	(0.011)	(0.012)
East region	0.857*	1.728*	1.253*	1.625*	2.512*
	(0.025)	(0.038)	(0.037)	(0.032)	(0.056)
Central region	1.129*	1.418*	1.320*	1.693*	2.208*
	(0.028)	(0.029)	(0.035)	(0.030)	(0.046)
North-East region	1.170*	0.914*	0.639*	0.765*	0.608*
	(0.032)	(0.023)	(0.022)	(0.017)	(0.017)
West region	0.940	1.785*	1.461*	1.778*	2.844*
	(0.038)	(0.055)	(0.057)	(0.048)	(0.089)
South region	0.868*	1.029	1.025	1.116*	1.176*
	(0.029)	(0.029)	(0.036)	(0.027)	(0.037)
Parity	1.033***	1.072*	1.049**	1.104*	1.146*
	(0.020)	(0.015)	(0.021)	(0.014)	(0.015)
Constant	0.391*	0.752*	0.383*	1.406*	0.915**
	(0.021)	(0.032)	(0.023)	(0.052)	(0.037)

Note: Standard errors in parentheses. *, **, *** Significant at 1, 5, 10% levels.

CONCLUSION

Education makes a woman empowered and this, in turn, helps the woman in acquiring information and knowledge to take fruitful decisions at home, especially on the health and education of children. Increasing maternal education is crucial in achieving better child health outcomes, especially complete nutritional intake. Many studies have shown a strong negative association between a mother's education levels and child malnutrition and improving maternal education reduces the risks of children being malnourished. Studies that use the anthropometric measures of child stunting, wasting and underweight underline the significance of maternal education in reducing the prevalence and risk of malnutrition in children below the age of five years. This paper analysed the effect of the mother's education on a child's nutritional status in India using the 2015-16 National Family Health Survey-IV data consisting of 2,33,045 observations. In the empirical analysis, multinomial logistic regression estimation was used as the child nutritional outcomes of stunting, wasting and underweight are categorical measures.

The estimated odds ratios show that the child's nutritional status is positively influenced by the mother's education and age, parity, breastfeeding, birth weight, antenatal care, place of delivery and socioeconomic status. Significantly, the mother's education dominates among the factors that influence the nutritional outcomes in children in

India. This paper finds that a woman with at least primary education will give better care and health to her child and reduce the risk of the child being malnourished. Maternal education significantly reduces the risks of the child being stunted or wasted or underweight or all of these. Months of breastfeeding, child's birth weight, mother's age, place of delivery also show some influence on the nutritional status of children. The results of this paper imply that an integrated approach that includes improvising mother's schooling, increasing mother's healthcare knowledge and developing a positive attitude toward modern healthcare among mothers is important in reducing child malnutrition. This will help in reducing the infant and child mortality rates in India bringing India a step closer to achieving the millennium development goals.

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