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The Effect of Maternal Education on Child Health in India: Multinomial Logit Estimation of Child Malnutrition

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Abstract: Globally childhood malnutrition manifesting as stunting, wasting, underweight and overweight is the biggest cause for disease burden and millions of deaths of children under five years. India is the home for more than one-third of the world's malnourished children despite being one of the first countries in the world that implements 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 of a child. A woman with at least primary education gives better care and health to her child and reduce the risk of the child being malnourished. Months of breastfeeding, child's birth weight, mother's age, place of delivery are the other determinants of the nutritional status of children in India.

Introduction

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, the 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 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 is largely irreversible. Children who survive may face a long list of devastating side effects that last over the lifetime, 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 earnings 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 child 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.

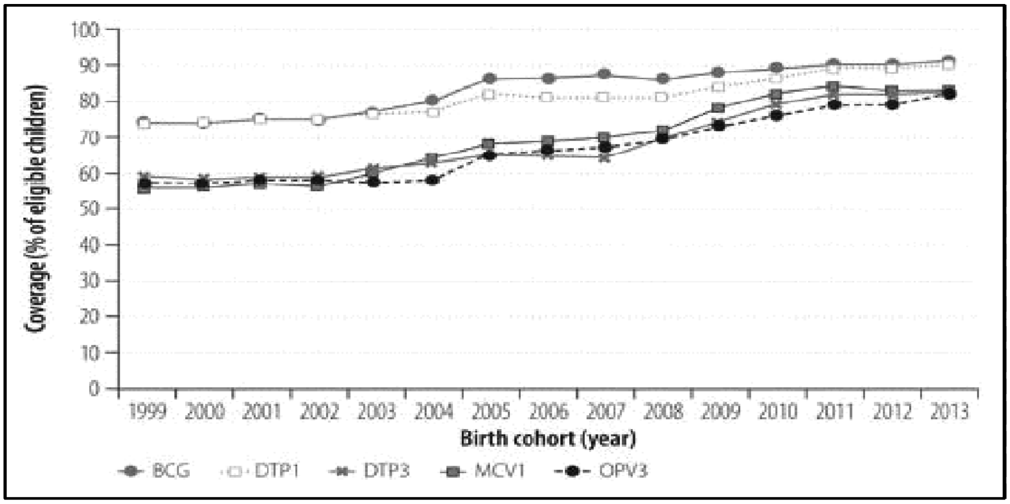
Globally, maternal and child malnutrition accounts for nearly 3.5 million deaths annually and to 35 percent of the disease burden in children under five years. India is the home for more than one-third of the world's malnourished children. Among these, half of the children under three years are underweight and a third of the wealthiest children are over-nourished. India ranks at 114 out of 132 countries in terms of child malnutrition (Haddad L. *et al.* 2015; IFPRI, 2016). Roughly half of all children under five years show evidence of chronic malnutrition. According to the NFHS, 38 percent of children under five are stunted and 36 percent are underweight. In 2016, 97 million children are underweight, the highest in the world and 62 million children are stunted, about 40 percent of global stunting (Khan and Mohanty, 2018). About 72 percent of infants have anaemia and among children under the age of five, 44 percent are underweight and 69 percent 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 percent), wasting (17 percent) and overweight (2 percent). Only 42 percent 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 percent 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 economy 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 the 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 failed to achieve the target of universal immunisation coverage, only 54 percent of 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 percent compared to as low as 30 percent in Uttar Pradesh. Among socioeconomic groups, only 36 percent of the poorest people received full immunisation compared to 73 percent 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 has increased from 74 percent to 91 percent, DTP1 from 74 percent to 90 percent, DTP3 from 59 percent to 83 percent, third dose of oral polio from 57 percent to 82 percent, and the first dose against measles from 56 percent to 83 percent.

The 2016-18 Comprehensive National Nutrition Survey (CNNS) survey of 1.2 lakh children by the Ministry of Health and Family Welfare reveals that higher educated mothers are likely to provide better and nutritious diets to their children. Children born to educated women suffer less from malnutrition which manifests as underweight, wasting and stunting in children. While 31.8 percent of children with at least 12th grade educated mother received an adequate diverse diet, only 11.4 percent of children of uneducated mothers received diverse meals. Mothers with no schooling

Figure 1: Trends in Child Immunisation in India



Source: WHO (2016).

fail to provide the minimum acceptable diet (3.9 percent) with iron-rich food (7.2 percent) to children relative to mothers who attended the school (9.6 percent and 10.3 percent respectively). While 50.4 percent of children aged between 6-23 months of literate mothers received the minimum frequency of meal, only 36.2 percent of children of illiterate mothers received the minimum frequency of meals. While 44.1 percent of children of uneducated mothers suffer from anaemia, 34.6 percent of children of educated mothers also have anaemia. However, children of educated mothers have more access to sugar products and thus are at the risk of higher cholesterol and early diabetes. The pre-diabetes level in the children of the educated mother is 15.1 percent against 9.6 percent of the children of uneducated mothers. The level of cholesterol in children had a reading of 6.2 percent versus 4.8 percent.

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 the poor health outcomes in children in the context of poverty in different regions of India. The paper uses 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 is 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 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. 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) analyse the roles of maternal schooling versus maternal nutrition knowledge as determinants of micronutrient status (haemoglobin concentration) in Indonesian children applying parametric and nonparametric techniques. The study finds that maternal schooling contributes to child micronutrient 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) try to identify factors associated with the nutritional status of children under 5 years 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 decrease 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 are mixed. The likelihood for all forms of malnutrition is higher among children with 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 applying the ordinal logistic regression method. The study finds that age of the child, birth interval, mothers' education, maternal nutrition, household wealth status, child feeding, 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 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 regression method. They argue mother's limited knowledge about food choices, feeding, and healthcare-seeking practices contribute significantly to negative nutrition outcomes for children in most developing countries Further, mother's 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. Mother's 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 percent stunting, 14.6 percent wasting, and 32.5 percent underweight among children younger than 5 years old in Bangladesh. The study finds that 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-5 children in the household are significant risk factors for childhood undernutrition. Mother's education is a significant predictor of child nutritional status, as the likelihood of being underweight increases for children of mothers with no, primary, and secondary education compared to higher education status. The study finds that children of mothers with no education are 72 percent more likely to have stunting compared to children of mothers with higher education.

In the Indian context, Bhargava (2003) examine 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 nutritional status. The study finds that 30 percent of children are stunted, 40 percent are underweight and 11 percent are wasted in Bangladesh. The rates of under-nutrition are significantly lower among children of higher educated mothers - 17.2 percent stunting, 26.3 percent underweight and 10 percent wasting, compared to children of illiterate mothers - 37.5 percent stunting, 46 percent underweight and 13.6 percent wasting. The proportion of mothers with knowledge from a proper source about child feeding increases significantly with the increase of maternal education - from 17 percent for illiterate to 36 percent 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 percent of children are undernourished, 17 percent stunted and 10 percent wasted. Maternal illiteracy is associated with more than 62 percent of malnourished as compared to 48.3 percent 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 include 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 on directly 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 uses 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 is 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

The 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 does not depend on the presence or absence of other alternatives i.e. or the relative probability do 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 jϵp $(y = j|x)$.

The multinomial logistic classifier uses a generalisation of the sigmoid, called the softmax function, to compute the probability $p(y = j|x)$. The softmax function takes a vector $z = [z_1, ..., z_k]$ 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:

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

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

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

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

The logistic regression model 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:

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

$$pr\left(y_i = 2\right) = \frac{e^{\beta_2 x_i}}{1 + \sum_{j=1}^{J-1} e^{\beta_j x_i}}$$

... ...

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

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 J^{th} 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:

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

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

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

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 is not malnourished. Together with risk difference and odds ratio, the relative risk measures the association between the exposure and the outcome. Assuming causal effect between the exposure and the outcome, the relative risk ratio implies that (i) RRR = 1means 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 percent) out of 2,33,045 have no malnutrition problem. About 8.17 percent are stunted, 14.56 percent are wasted, 6.44 percent are underweight, while 24.65 percent of children have at least 2 malnutrition problems and 17.23 children all the three malnutrition problems. While 45.04 percent of mother's attended secondary education, 31 percent of mother's are not educated. Most children are not even getting breastfeeding in the initial six months indicating lack of nutrition from breastfeeding. More than half of children (57.19 percent) are under the required weight by birth and 64.92 percent of mother's do not visit antenatal care facility at least once. About 54.66 percent of births are born at traditional birth attendance. Nearly 64.8 percent of households are socioeconomically poor and 81.24 households belong to SC/ST/OBC community. The average number of children per women is 2.14.

Table 1: Descriptive Statistics of Variables

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

contd. table

Variable	*Description*	*Percent*	*Observations*
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 are 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 percent for mothers with primary educated mothers, 3 percent for secondary educated mothers and more than 5 percent 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 mother's age decreases the probability of child stunting and 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 any one as well as all categories of malnutrition. More number of children in the household reduces both the economic resources as well as the mother's care available to each child. Surprisingly, male child relative to female chid has a 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 birth weight greater than 2.5kg have significantly lower chances of being malnourished. Higher birth weight of children is associated with 1 percent of lesser chance of being stunted, 3 percent of wasting and 5 percent of underweight compared to children with lower birth weight. Children breastfed less than six months have a significantly higher probability of being stunted and underweight. Breastfeeding of a child for lesser than six months increases the risk of child stunting by about 4 percent. Antenatal care significantly reduces the probability of child malnutrition. At least one antenatal visit decreases the probability of child stunting by 2 percent, wasting and underweight by about 1 percent.

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 percent, wasting and underweight by 2 percent 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 Indian have a higher probability of child malnutrition, while in the north-east 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**	0.183*	-0.043***	0.044*	0.217*
	(0.028)	(0.017)	(0.022)	(0.014)	(0.017)
Mother's age 30-35 years	-0.119*	0.176*	-0.176*	-0.017	0.192*
	(0.024)	(0.020)	(0.027)	(0.017)	(0.019)
Mother's age 36+ years	-0.139*	0.283*	-0.181*	0.036*	0.281*
	(0.038)	(0.031)	(0.045)	(0.020)	(0.030)
Mother's education-primary	-0.046***	-0.213*	-0.069**	-0.167*	-0.344*
	(0.028)	(0.023)	(0.032)	(0.020)	(0.021)
Mother's education-secondary	-0.272*	-0.522*	-0.252*	-0.595*	-0.983*
	(0.022)	(0.018)	(0.025)	(0.016)	(0.017)
Mother's education-higher	-0.551*	-0.972*	-0.503*	-1.203*	-2.105*
	(0.033)	(0.028)	(0.036)	(0.025)	(0.037)
Mother-never in union	-0.274	0.060	0.021	-0.201	-0.098
	(0.228)	(0.172)	(0.241)	(0.163)	(0.187)
Mother living with partner	0.119	0.056	0.034	0.162**	0.102
	(0.106)	(0.089)	(0.124)	(0.076)	(0.085)
Mother-divorced	0.155	0.174	0.0007	0.222*	0.267
	(0.095)	(0.084)	(0.125)	(0.74)	(0.088)
Intend later pregnancy	0.013	0.081**	-0.007	0.070**	0.019
	(0.044)	(0.036)	(0.048)	(0.031)	(0.037)
Intend no pregnancy	0.096**	0.010	0.006	0.063**	-0.028
	(0.044)	(0.036)	(0.051)	(0.031)	(0.034)
Male child	0.045*	0.025***	0.046**	0.058*	0.047*
	(0.017)	(0.014)	(0.018)	(0.012)	(0.014)

contd. table 2

Variable	*Stunted*	*Wasted*	*Underweight*	*Any two*	*All three*
Child delivery at home/attendants	-0.149*	-0.255*	-0.220*	-0.344*	-0.421*
	(0.024)	(0.019)	(0.027)	(0.017)	(0.019)
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.

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 of 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 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**	0.201*	0.958**	1.045*	1.243*
	(0.019)	(0.020)	(0.021)	(0.015)	(0.021)
Mother's age 30-35 years	0.888*	1.192*	0.838*	0.983*	1.212*
	(0.022)	(0.024)	(0.023)	(0.017)	(0.023)
Mother's age 36+ years	0.870*	1.327*	0.834*	1.037*	1.325*
	(0.033)	(0.041)	(0.037)	(0.028)	(0.040)
Mother's education-primary	0.955	0.808*	0.935**	0.846*	0.709*
	(0.028)	(0.019)	(0.030)	(0.017)	(0.015)
Mother's education-secondary	0.762*	0.594*	0.777*	0.551*	0.374*
	(0.017)	(0.011)	(0.019)	(0.009)	(0.006)
Mother's education-higher	0.576*	0.378*	0.605*	0.300*	0.122*
	(0.019)	(0.011)	(0.022)	(0.007)	(0.005)
Mother-never in union	0.760	1.062	1.021	0.818	0.906
	(0.173)	(0.183)	(0.246)	(0.134)	(0.169)
Mother living with partner	1.127	1.058	1.034	1.176**	1.107
	(0.119)	(0.095)	(0.129)	(0.089)	(0.094)
Mother-divorced	1.168	1.190**	.125	1.248*	1.306*
	(0.111)	(0.101)	(0125)	(0.092)	(0.115)
Intend later pregnancy	1.013	1.084**	0.993	1.072**	1.019
	(0.045)	(0.039)	(0.045)	(0.033)	(0.037)

contd. table 3

Variable	*Stunted*	*Wasted*	*Underweight*	*Any two*	*All three*
Intend no pregnancy	1.100**	1.010	1.006	1.065**	0.972
	(0.049)	(0.036)	(0.052)	(0.033)	(0.033)
Male child	1.046*	1.025**	1.047**	1.059*	1.049*
	(.0177)	(0.014)	(0.019)	(0.013)	(0.014)
Child delivery at home/attendants	0.862*	0.775*	0.803*	0.709*	0.656*
	(0.021)	(0.015)	(0.022)	(0.012)	(0.012)
Other child delivery	0.778*	0.527*	0.666*	0.525*	0.369*
	(0.022)	(0.013)	(0.021)	(0.011)	(0.009)
Child birth weight >2.5kg	0.894*	0.762*	0.623*	0.634*	0.581*
	(0.017)	(0.012)	(0.013)	(0.009)	(0.009)
< 6 months breastfed	1.424*	0.990	1.067*	1.401*	1.634*
	(0.025)	(0.014)	(0.021)	(0.017)	(0.023)
At least one antenatal visit	0.796*	0.856*	0.918*	0.713*	0.571*
	(0.015)	(0.013)	(0.019)	(0.010)	(0.009)
Middle SES	0.996	1.007	0.995	1.012	1.040**
	(0.023)	(0.019)	(0.025)	(0.016)	(0.019)
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.

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 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 analyses the effect of the mother's education on child 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 has been used as the child nutritional outcomes of stunting, wasting and underweight are categorical measures.

The estimated odds ratios show that the child 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 of a child. Months of breastfeeding, child's birth weight, mother's age, place of delivery also show some influence over 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 towards 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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