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A LOGISTIC REGRESSION ANALYSIS OF DETERMINANTS OF CHILD MALNUTRITION IN UTTAR PRADESH, INDIA

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***Abstract**: This paper examines the effects of socio-economic determinants on child malnutrition in Uttar Pradesh- the most populous and malnourished state of India. Using data from NFHS-4, this study highlights district-wide variations in nutritional status of children less than five years in the state. The percentage of stunted, wasted, and underweight have been taken as dependent variables, while main explanatory variables of child malnutrition were female education, maternal malnutrition (BMI), breastfeeding practices, children's place of residence, father's education, wealth index of household, family planning, sex of the child, sex of the household and age cohort of mother. Logistic regression models have been applied in order to observe the association between explanatory variables and malnutrition. The findings revealed a high incidence of less stunted, wasted, and underweight infants in case of an educated parents, particularly educational level of mother. Wealth index representing the possession of assets by the household found to be an important indicator in the sense that children born to households with richer and richest quintiles showing better-nourished children aged under-5. The modern method of using contraceptive, breastfeeding practices, maternal malnutrition were also important indicators influencing the rate of malnutrition in children. The study suggested that imparting education to females, breastfeeding practices, economic status, and contraceptive use can play an important role in reducing nutritional status of children.*

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

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1. Introduction

Malnutrition, defined as deficiency or imbalances in a person's nutrients intake, is considered a sensitive indicator and most common nutritional disorder for any developing nation. The high prevalence of child malnutrition reflects not only a country's past health status but also its future health trails (Subramanyam et al., 2010). Addressing the problem of malnutrition, the sustainable development goals (SDG) adopted by United Nations (2019) indicates '*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*' under Goal 2.

In this context, monitoring child malnutrition is crucial for planners and policy makers in a country like India, a country which is facing the high prevalence of child malnutrition, accounting for one third of the world's wasted (height-for-age). UNICEF contends that in India, the percentage of underweight and stunted children less than five years were 43 percent and 48 percent respectively because of enduring undernutrition. It is estimated that worldwide, India executes poorly in child malnutrition status and ranked 114 out of 132 countries, just prior to Afghanistan and Pakistan (IFPRI, 2016) and in the early 2000s, it was around one-third of all malnourished children in the world (Svedberg, 2008).

Several studies indicated that child malnutrition affected child morbidity, health-care expenditure and economic progress of any country (Measham & Chatterjee,1999; Mishra, Lahiri & Luther, 1999) which further increase the risk of child ailment, retardation in mental and physical growth, resulting into low ability to work, loss of output and efficiency, high burden of health care expenditures and lastly can pledge the poverty trap (World Bank, 2006; Grantham et al., 2007; Tarozzi & Mahajan, 2007; Walker et al., 2007). Also. It is considered that severe or chronic malnutrition increase the educational attainment and outcome of the children (Ahmed et al., 2012). International Food Policy Research Institute (IFPRI) reports that in developing countries, one out of every three children under-five, is malnourished. It is clearly noted that the high prevalence of malnutrition not only cause severe cognitive and physical loss of children but also it is a collapse or exploitation of a child's human right (Das & Sahoo, 2011).

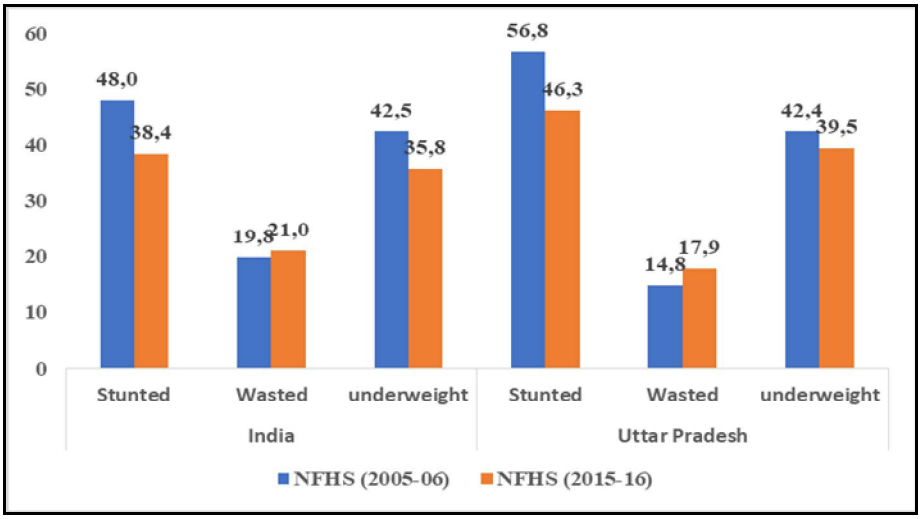
The population of Uttar Pradesh is 199.5 million (India's most populated state) and 39 percent of the total child population of India resides in the state. According to the report published by UP State Nutrition Mission, in this state, half of all children age-5 are stunted, and 10 percent were wasted in 2014. In Uttar Pradesh, infant mortality rate (IMR) and malnutrition rate are the highest in the country. National Family Health Survey-4 (NFHS) data revealed that in Uttar Pradesh, the percentage of malnourished children has declined significantly in the last ten years. In 2005-06, 56.8 percent of children under-5 years of age were stunted, and 42.4 percent were underweighted; these figures fell to 46.3 percent and 39.5 percent respectively, in 2015-16 (figure 1).

As per the report published by National Sample Survey Office (NSSO), the percentage of poor in the state is 30.4 percent higher than all India (25.7%) poor. IMR is 48 per

thousand live births, the under-5 mortality rate is 73 per thousand live births, and life expectancy is 62.9 years for male and 65.4 years for female. However, the mortality rate among the children under-5 years of age fell by 18 percent from 2005-06 to 2015-16, and IMR fell by 9 percent during the same period. Improvement in child nutrition during the inter-survey period is the result of interventions such as broader coverage of midday meals to children at school and rigorous operation of Integrated Child Development Scheme (ICDS) at a more disaggregated level, underpinning of health outreach facilities to rural and poor ménages for on-time vaccination of children and strengthening of the public distribution system (PDS) of providing food grains at promoted prices to the weaker section.

However, undernutrition of children remains a major health problem at the disaggregated level in India. There has been a remarkable difference in IMR across the districts; for example, highest in Shrawasti (96) while lowest in Kanpur Dehat (37). In Uttar Pradesh, a considerable variation has been observed between rural and urban in terms of child malnutrition. In rural areas of Uttar Pradesh, prevalence of stunted and underweight among children was 48.5 percent and 41 percent respectively, as compared with 37.9 percent and 33.7 percent among urban children. In this framework, a study of child malnutrition and its important determinants is required for policy implications and therefore, the present study examined the effects of various socio-economic factors on child malnutrition children less than five years in Uttar Pradesh, employing the data from NFHS-4 (2015-16).

Figure 1: Malnutrition trends in India and Uttar Pradesh children among aged 0-5 years



2. Previous research

There are several socio-economic and demographic factors (place of residence, age, and nutritional status; and maternal education) responsible for poor nutritional status of children (Bangladesh Demographic and Health Survey, 2007). The benefits of mother's education and its impact on child health status is well documented in literature which lowers the rate of child malnutrition, in other words, the prevalence of malnutrition is lower in case of educated mother (Frost, Forste & Hass, 2005; Basu & Stephenson, 2005; Miller & Rodgers, 2009; Cleland, 2010; Bbaale, 2014; Burroway, 2016). A study by Mosle & Chen (1985) reported that effect of mother's education on children's nutritional status works through a set of 'proximate determinants', such as, fertility factors, environmental amenities, breastfeeding practices, and utilization of childcare services. Similarly, a host of studies contend that more educated mothers may have more nourished children because they have better knowledge about child rearing practices and heath care and utilization (Thomas et al., 1991; Desai & Alva, 1998; Glewwe 1999; Currie & Moretti, 2003).

A substantial range of literature in the domain of health and education have discussed the casual relationship between mother's education and nutritional status of children and given some possible trails to find the link. The important studies include: (1) more educated mothers can take better care of their children about nutrition and health care, for example, washing of clothes, feeding practices, treatment during sickness and availing timely vaccination services etc. (Caldwell 1979; Mondal et al., 2009) and better sanitation such as flushing toilets and running water (Horton, 1998; Case, 2001, Choudhury, 2015) (2) An educated mother can make healthier choices for themselves during pregnancy that effectively prevent fatal childhood diseases (Govindasamy & Ramesh, 1997) and directly affected the health of the child at birth (Miller & Rodgers, 2009); (3) Educated mother can give better level of living as previous research documented that education provides women ample 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).

However, a growing body of literature has drawn attention towards the impact of father's education in improving child nutritional status (Case et al., 2002). It is well-established fact now that educational level of father plays a crucial role in family's financial status which in turn ensures better access to child health facilities and further better child nutritional status (Choudhury, 2015). India's NFHS data also revealed a very high percentage of maternal malnutrition which shows the worse-off condition of women. Studies claimed that mother's nutritional status had a positive association with child nutritional status (Sethuraman, 2006).

Poor breast-feeding practices in early childhood contribute to the burden of malnutrition and infant and child mortality (Patel et al., 2010). It is observed that working mothers have limited time for breastfeeding and to manage other nutritional and health services to their children. Working mothers are dependent on a caretaker for their child and caretaker's poor attention, affection and involvement in child feeding are the major causes for undernutrition of children. Moreover, a large body of empirical research claimed that caretakers might not make the best use of offered resources due

to less information of optimal feeding behaviours and inappropriate cultural beliefs and practice about nourishing (Allen and Gillespie, 2001; Moore, Akhter and Aboud, 2006).

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 demonstrated that wealth status of a family has a significant and positive impact on nutritional status of children (Smith & Haddad, 2000; Haddad et al., 2003; Heltberg, 2009; Headey, 2013). A variety of indicators has been used to measure economic status of the household, however, sorting of households according to income level is more relevant proxy. While 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.

To improve child nutritional status, 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 of the factors that drive child malnutrition, especially in poor and bigger states like Uttar Pradesh. In this connection, in order to formulate appropriate strategies related to child health outcomes, policy makers and planners must prerequisite familiarity of the factors responsible for poor child outcome such as stunting, wasting and underweight.

Therefore, the main objectives of this paper are to understand nutritional status based on stunted, wasted and underweight of children less than the age of five and to examine the factors which influence child malnutrition in respect of certain socio-economic variables, for instance, father's education, place of residence, wealth status, family planning, sex of the child, sex of the household, religion; and maternal indicators like mother's malnutrition (BMI) and age cohort of mother. This study examined the various socio-economic and household factors which are responsible for child malnutrition in Uttar Pradesh.

3. 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 responsible for providing coordination and technical assistance for the NFHS-4[13].

[13] NFHS-4 is funded by the United States Agency for International Development (USAID), DFID, the Bill and Melinda Gates Foundation (BMGF), UNICEF, UNFPA, the MacArthur Foundation and the Ministry of Health and Family Welfare (MoHFW), Government of India.

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 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 on children's height, weight and underweight have been collected less than 5 years. Mother's education, place of residence (rural-urban), sex of the child (boys-girls), sex of the household, father's education, wealth index (based on an ownership-of-goods index), family planning (use of contraceptive), mother's BMI, breastfeeding practices and mother's age cohort are the important indicators that are assumed to effect nutritional status of a child. The logistic regression analysis has been employed in the analysis for estimation of the odds of being malnourished in the children of Uttar Pradesh.

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 details of explanatory variables have been given in table 1 and thus results obtained are compared with reference category. In order to compute variables, research design and sample weights, statistical tool is carried out using SPSS (20.0 version) software for window and the significance levels of $p<0.01$, 0.05 and 0.10 were taken.

Table 1: Symbolization and definition of variables used in the logistic regression

Symbolization	Independent variables	Definition
Mother's education	Educational level of the mother (dummy variable)	
Mother_illit^{R}	Mother is illiterate	=1, if mother is illiterate =0, otherwise
Mother_elemedn	Mother received elementary level of education	=1, if mother is having 1-8 years of schooling =0, otherwise
Mother_secedn	Mother received secondary level of education	=1, if mother is having 9-10 years of schooling =0, otherwise
Mother_hiedn	Mother received senior secondary or above level of education	=1, if mother is having 11 or more years of schooling =0, otherwise
Sex_child	Sex of child (dummy variable)	
Child_boy^{R}	Boy child	=1, if the child is boy =0, otherwise
Child_girl	Girl child	=1, if the child is girl =0, otherwise

Symbolization	Independent variables	Definition
Father's education	Educational level of the father (dummy variable)	
Father_illiterate[R]	Father is illiterate	=1, if father is illiterate =0, otherwise
Father_elemedn	Father received elementary level of education	=1, if father is having 1-8 years of schooling =0, otherwise
Father_secedn	Father received secondary level of education	=1, if father is having 9-10 years of schooling =0, otherwise
Father_hiedn	Father received senior secondary or above level of education	=1, if father is having 11 or more years of schooling =0, otherwise
Sex_hhn	Sex of Household (Dummy variable)	
Male[R]	Male member	=1, if the sex of household is male =0, otherwise
Female	Female member	1, if the sex of household is female =0, otherwise
Place_residence	Place of residence (dummy variable)	
Urban[R]	Place of residence in urban areas	=1, if the location of household is urban =0, otherwise
Rural	Place of residence in rural areas	=1, if the location of household is rural =0, otherwise
Contraceptive_use	Use of contraceptive or family planning by household (dummy variable)	
Trad_method[R]	Household using traditional method	=1, if the household is using traditional method =0, otherwise
Mode_method	Household using modern method	=1, if the household is using modern method =0, otherwise
Others_method	Household using other method	=1, if the household is using other method excluding traditional and modern =0, otherwise
Wealth Index	Wealth index reflecting the ownership of some basic assets by the household (dummy variable)	
Poorest[R]	Household is belonging to the poorest income category	=1, if the household is belonging to the poorest category =0, otherwise
Poor	Household is poor	1, if the household is poor =0, otherwise

Symbolization	Independent variables	Definition
Middle	Household is belonging to the middle-income category	1, if the household is belonging to the middle-income category =0, otherwise
Richer	Household is belonging to the richer income category	1, if the household is belonging to the richer income category =0, otherwise
Richest	Household is belonging to the richest income category	1, if the household belonging to the richest income category =0, otherwise
Body Mass Index (BMI) of mother	BMI of the mother (dummy variable)	
BMI ≤18.5 kg/m2[R]	Mother's BMI is BMI ≤18.5 kg/m2	=1, if the mother's BMI is BMI ≤18.5 kg/m2 =0, otherwise
BMI ≥18.5 kg/m2	Mother's BMI is BMI ≥18.5 kg/m2	=1, if the mother's BMI is BMI BMI ≥18.5 kg/m2 =0, otherwise
Breastfeeding	Breastfeeding practices by mother (dummy variable)	
Within 1st hour[R]	Child received breastmilk within 1st hour	=1, if child received breast-milk within 1st hour =0, otherwise
More than 1st hour	Child received breastmilk more than 1st hour	=1, if child received breast-milk more than 1st hour =0, otherwise
Mother's Age Cohort	Age of the mother (dummy variable)	
15-19[R]	Mother is 15-20 years old	=1, if the mother is 15-20 years old =0, otherwise
20-24	Mother is 20-24 years old	=1, if the mother is 20-24 years old =0, otherwise
25-29	Mother is 25-29 years old	=1, if the mother is 25-29 years old =0, otherwise
30-34	Mother is 30-34 years old	=1, if the mother is 30-34 years old =0, otherwise
35-39	Mother is 35-39 years old	=1, if the mother is 35-39 years old =0, otherwise
40-44	Mother is 40-44 years old	=1, if the mother is 40-44 years old =0, otherwise
45-49	Mother is 45-49 years old	=1, if the mother is 45-49 years old =0, otherwise

4. Results and discussion

Table 2 clearly depicted that the percentage of underweight and stunted children increased up to one year for the boys and then decreased to about 4 years. The percentage of wasted children increased up to one year and then decreased up to 4 years for both, boys and girls. The data demonstrates that the percentage of underweight, stunted and wasted below the age of five was 39.7 percent, 46.5 percent and 19.2 percent, respectively for boys and it was 39.8 percent, 46.2 percent and 16.7 percent for girls. The data also revealed that the percentage of underweight was less in girls in comparison to boys, but it contrasts with the case of stunted and wasted.

District-wide variations in frequencies and ranks among the under-five children by sex were given in appendix (Table 1A). It is clearly noted that inter-district variation is high in terms of stunted, wasted and underweight in Uttar Pradesh. In terms of boys stunted, the top five poor performer districts were Gautam Buddha Nagar, Jhansi, Ballia, Meerut and Saharanpur. While all the bottom five performer districts where the prevalence of stunting was high were; Bahraich, Shrawasti, Balrampur, Gonda and Siddharth Nagar, located in the eastern region of Uttar Pradesh.

Despite being placed in the western region in the state, Gautam Buddha Nagar and Saharanpur, both have a high percentage of stunted children. In terms of boys wasted, Mahamaya Nagar, Etah, Farrukhabad, Gonda and Sant Kabir Nagar were the top five performers, while Hamirpur, Lucknow, Lalitpur, Kaushambi and Jalaun were the bottom five performers. The districts which fall under the top five performers in boys underweight include Mathura, Mahamaya Nagar, Gorakhpur, Gautam Buddha Nagar and Firozabad. In contrast, Budaun, Kaushambi, Chitrakoot, Jaunpur and Pilibhit were the bottom five performers.

In terms of girls stunted, Ghaziabad, Baghpat, Lucknow, Gautam Buddha Nagar and Rae Bareli were the top five performers while, Bahraich, Balrampur, Shrawasti, Siddharth Nagar and Maharajganj were the poor performers. In girls wasted category, Lalitpur, Chitrakoot, Rae Bareli, Lucknow and Hamirpur were the bottom five performers while, Mainpuri, Farrukhabad, Kanshiram Nagar, Gonda and Deoria were the top five performers. In terms of girls underweight, districts fall into the five top categories were Firozabad, Mathura, Ghaziabad, Ballia and Gautam Buddha Nagar while, Shahjahanpur, Jaunpur, Budaun, Jalaun and Sant Ravidas Nagar were the bottom five performers in the state.

Districts with a high prevalence of stunted for both the boys and girls were observed in Bahraich, Balrampur, Shrawasti, Siddharth Nagar while the low prevalence for both sexes was observed in Gautam Buddha Nagar. Likewise, in terms of wasted, the high prevalence for both sexes have been observed in some districts like Hamirpur, Lalitpur and Lucknow. In contrast, the low prevalence for boys and girls has been observed in Gonda. High prevalence of underweight for both boys and girls has been observed in Budaun. In contrast, low prevalence of underweight for both has been seen in the districts of Mathura, Forozabad and Gautam Buddha Nagar.

The percentage of stunted is higher in girls in comparison to boys in the districts like, Rampur, Shahjahanpur, Unnao, Jalaun, Fatehpur, Basti, Ballia, Chandauli and Etah.

Some districts in the state where the percentage of stunted was lower in girls in comparison to their boy's counterpart include Jyoptiba Phule Nagar, Firozabad, Pilibhit, Hardoi, Lalitpur, Faizabad, Ambedkar Nagar, Jaunpur, Ghazipur and Sonbhadra. No substantial differences between boys and girls were observed in case of wasting. Although, considerable variation between boys and girls were found in some districts such as Saharanpur, Mahamaya Nagar, Bareily, Hamirpur, Fatehpur, Balrampur, Sant Kabir Nagar and Gorakhpur where the prevalence of underweight was higher in boys than girls. On the other hand, there were some districts where the percentage of underweight was higher in boys in comparison to girls include Mainpuri, Pilibhit, Kanpur Nagar, Kanpur Dehat, Barabanki, Sultanpur, Bahraich, Maharajganj and Jaunpur.

Table 2: Age and sex wise nutritional status of under- five children in Uttar Pradesh

Sex of child	Year	Stunted		Wasted		Underweight	
		N	%	N	%	N	%
Boy	0	914	24.9	1113	30.3	1185	32.3
	1	2032	53.2	826	21.6	1618	42.4
	2	1982	52.9	629	16.8	1573	42.0
	3	2046	52.5	588	15.1	1611	41.4
	4	1860	48.1	499	12.9	1557	40.3
	Total	8834	46.5	3655	19.2	7544	39.7
Girl	0	724	21.7	955	28.6	1032	30.9
	1	1659	48.1	642	18.6	1322	38.3
	2	1889	55.3	460	13.5	1467	43.0
	3	1970	54.0	415	11.4	1562	42.8
	4	1719	51.1	396	11.8	1468	43.6
	Total	7961	46.2	2868	16.7	6851	39.8

Source: Calculated from NFHS-4 data, Government of India.

Table 3 reveals the parameter estimates for stunting. Coefficient of covariates and the related standard error is shown in parentheses. Mother's level of education is an important factor in determining stunting of a child. It was found that mothers who received elementary (OD=1.598, SE=.129), secondary (OD=1.762, SE=.137) and higher (OD=1.442, SE=.117) level of education lower the rates of stunting. This finding is unfailing and supported by many studies such as Roy (2000); Smith & Hadded (2000); Headey (2013) and many others.

Likewise, father's education also has a significant influence on stunting. The result indicates that fathers who have completed elementary (OD=1.347, SE=.125) and secondary (OD=1.451, SE=.128) level of education condense the rate of stunting and it is statistically significant at 1 percent level of significance. Though, the result is not found to be statistically significant if father has above secondary or higher level of education.

However, household's location of children no longer affected the rate of stunting. The association between sex of household and stunting is negative and statistically

significant at 1 percent level of significance with low odd ratio. It confirms that if the of household is headed by female (OD=.760, SE=.082) it lowers the rate of stunting.

Another important and determining factor of stunting is wealth index. It demonstrates that children born to families with richer and richest wealth quintiles showing lower stunting 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 stunting of children.

Use of modern method of contraceptive is significant indicator which also lowers the rate of stunting. The results display that if family is using modern method (OD=1.291, SE=.255) of contraceptive, they reduce stunting.

The association between mother's BMI (OD=2.654, SE=.082) and stunting is robust and highly significant with high odd ratio. The result is statistically significant at 1 percent level of significance which indicates if mother's nutritional status is better, they can lower the rate of stunting.

Our logistic regression results indicate a significant and negative relationship between children belonging to the age up to 5 years who have never been breastfed within first hour of birth (OD=.876, SE=.063) and stunting. There is no significance association found between mother's age cohort and stunting.

Table 3: Determinants of stunting using multiple logistic regression results

Variable	B	Sig.	Odd ratio	95% C.I.
Mother's Education				
Mother_illit^{R}				
Mother_elemedn	.469 (.129)	.000	1.598	1.241-2.058
Mother_secedn	.567 (.137)	.000	1.762	1.347-2.306
Mother_hiedn	.366 (.117)	.002	1.442	1.147-1.814
Sex of Child				
Child_boy^{R}				
Child_girl	.093 (.056)	.099	1.097	.983-1.225
Sex of Household				
Male^{R}				
Female	-.275 (.082)	.001	.760	.646-.893
Father's Education				
Father_illiterate^{R}				
Father_elemedn	.298 (.125)	.017	1.347	1.054-1.720
Father_secedn	.373 (.128)	.004	1.451	1.130-1.864
Father_hiedn	.101 (.104)	.331	1.106	.903-1.356
Place of Residence				
Rural	.132 (.079)	.095	1.142	.977-1.333
Use of Contraceptive				
Trad_method^{R}	.089 (.101)	.380	1.093	.896-1.332
Mode_method	.255 (.110)	.021	1.291	1.040-1.602
Others_method	.064 (.092)	.489	1.066	.890-1.276
Wealth Index				

Variable	B	Sig.	Odd ratio	95% C.I.
Poorest[R]				
Poor	1.121 (.130)	.000	3.069	2.379-3.960
Middle	.866 (.124)	.000	2.377	1.865-3.030
Richer	.593 (.122)	.000	1.810	1.424-2.300
Richest	.366 (.124)	.003	1.442	1.131-1.840
Body Mass Index (BMI)				
BMI ≤18.5 kg/m2[R]				
BMI ≥18.5 kg/m2	.976 (.082)	.000	2.654	2.260-3.116
Breastfeeding				
Within 1st hour[R]				
More than 1st hour	-.132 (.063)	.037	.876	.774-.992
Mother's Age Cohort				
15-19[R]				
20-24	-.524 (.460)	.255	.592	.241-1.459
25-29	-.263 (.369)	.476	.769	.373-1.585
30-34	-.048 (.367)	.896	.953	.464-1.957
35-39	.008 (.369)	.983	1.008	.489-2.075
40-44	-.070 (.375)	.852	.933	.447-1.947
45-49	.011 (.403)	.979	1.011	.458-2.229
N	41751			
Cox & Snell R Square	0.085			
Nagelkerke R Square	0.113			
-2 Log-likelihood	7608.059			

R, reference category
Figures in the parentheses are SE of estimates
Source: Author's calculation

Table 4 represents that mother's education has a robust and positive effect on wasting relative to mothers with no education (model 1). The odds ratios for elementary (OD=1.633, SE=.127), secondary (OD=1.781, SE=.135) and higher level of education (OD=1.425, SE=.116) are more than one for all levels of education.

Father's educational status also has a significant effect on wasting. The prevalence of wasting is lower in the children whose father's level of education is elementary (OD=1.364, SE=.123) and secondary (OD=1.465, SE=.126). However, father's education above secondary level is not a necessary condition for wasting.

The prevalence of wasting is higher in children who are residing in rural areas. The result demonstrates a significant effect on wasting with high odd ratio (OD=1.168, SE=.078). As expected, due to poverty, rural people have low access to the health care facility and better sanitation that result in a high percentage of wasting.

Also, sex of the household is another variable which determines wasting. The prevalence of wasting is higher in the households which is headed by female (OD=.759, SE=.081). The result is statistically significant at 1 percent level of significance. Similar to this result, Burroway (2016) revealed an important finding that females are more efficient than their male counterpart to use resources on nourishment and other basic domestic needs.

There is a positive association between use of contraceptive and wasting. The prevalence of wasting is lower in those families who are using modern method of contraceptive (OD=1.307, SE=.109).

The forgoing analysis depicts that income is an important variable which determines wasting. The results confirm that wealth index of household has a strong and positive effect on reducing wasting in children. As expected, poor households do not provide nutritional food and better health and medical facilities to their children which result in a high rate of death and mortality. Due to low purchasing power, poor households do not afford the cost of expenditure and improved sanitation.

Here, BMI is used as a proxy of nutritional status of mother which has a significant and positive effect on wasting with high odd ratio (OD=2.597, SE=089). The coefficient is statistically significant at 1 percent level of significance.

In this model, mothers age cohort and sex of the child do not have a significant effect on wasting.

Table 4: Determinants of wasting using multiple logistic regression results

Variable	β	Sig.	Odd ratio	95% C.I.
Mother's Education				
Mother_illit^{R}				
Mother_elemedn	.490 (.127)	.000	1.633	1.273-2.094
Mother_secedn	.577 (.135)	.000	1.781	1.366-2.321
Mother_hiedn	.354 (.116)	.002	1.425	1.136-1.787
Sex of Child				
Child_boy^{R}				
Child_girl	.075 (.055)	.172	1.078	.968-1.202
Sex of Household				
Male^{R}				
Female	-.275 (.081)	.001	.759	.648-.890
Father's Education				
Father_illiterate^{R}				
Father_elemedn	.310 (.123)	.012	1.364	1.071-1.736
Father_secedn	.382 (.126)	.002	1.465	1.145-1.875
Father_hiedn	.108 (.102)	.292	1.114	.911-1.362
Place of Residence				
Rural	.155 (.078)	.047	1.168	1.002-1.360
Use of Contraceptive				
Trad_method^{R}	.100 (.100)	.317	1.105	.909-1.343
Mode_method	.267 (.109)	.014	1.307	1.055-1.617
Others_method	.075 (.091)	.410	1.078	.902-1.288
Wealth Index				
Poorest^{R}				
Poor	1.103 (.128)	.000	3.013	2.346-3.868
Middle	.836 (.122)	.000	2.307	1.818-2.928
Richer	.561 (.120)	.000	1.752	1.385-2.217
Richest	.348 (.122)	.004	1.416	1.116-1.798

Variable	β	Sig.	Odd ratio	95% C.I.
Body Mass Index (BMI)				
BMI ≤18.5 kg/m2R				
BMI ≥18.5 kg/m2	.954 (.080)	.000	2.597	2.218-3.040
Breastfeeding				
Within 1st hourR				
More than 1st hour	-.187 (.055)	.001	.829	.744-.924
Mother's Age Cohort				
15-19R				
20-24	-.495 (.443)	.264	.610	.256-1.452
25-29	-.222 (.354)	.530	.801	.400-1.603
30-34	-.031 (.352)	.929	.969	.486-1.932
35-39	.033 (.354)	.927	1.033	.517-2.066
40-44	-.069 (.360)	.849	.934	.461-1.893
45-49	-.023 (.387)	.953	.978	.458-2.087
N	41751			
Cox & Snell R Square	0.087			
Nagelkerke R Square	0.116			
-2 Log-likelihood	7595.278			

R, reference category
Figures in the parentheses are SE of estimates
Source: Author's calculation

The logit estimates of table 5 demonstrates that the effect of mother's education on child underweight is negative, with the high odds ratio more than one in each level of education and coefficients are statistically significance at 1 percent levels of significance. The rates of underweight were lower among children whose mothers have elementary (OD=1.984, SE=.136), secondary (OD=1.764, SE=.146) and higher level of education (OD=1.497, SE=.126) in comparison to mothers with no education.

This result is supported by many other studies in the domain of health and education research which prove that educated and qualified mothers are contributing factors for reducing malnutrition (Frosta et al., 2005; Basu & Stephenson, 2005; Miller & Rodgers, 2009; Cleland, 2010; Bbaale, 2014). Waihenya et al. (1996) described that child whose mothers have received elementary education they lower malnutrition rate in comparison to those whose mothers have completed higher education, especially in case of stunting.

The effect of father's education on children underweights at (OD=1.459, SE=.131), secondary (OD=1.368, SE=.134) level is found to be statistically significant, with the high odd ratio. However, our result is unfavourable in case of fathers who have earned higher education. It suggests that there is essential to provide education to the fathers up to the secondary level for dipping underweight in children.

Girl children have higher relative odds of 1.059 for underweight in comparison with their boy counterparts and though, this association is not statistically significant. In our society, it is hypothesized that girl children are supposed to be nutritionally ignored due to their low status in society and hence are expected to be more underweight. No significant association is found between sex of household and underweight. However, a

significant association is observed between location of household and underweight. Children residing in rural areas (OD=1.154, SE=.082) are at higher risk of underweight as that of children residing in urban areas, however, the coefficient is statistically significant at 10 percent level of significance.

The estimated results indicate a significant and robust association between family using the modern method of contraceptive and underweight. The rates of underweight in children were lower whose family is using modern method of contraceptive (OD=1.485, SE=.113) in reference to a family not using any contraceptive.

Similarly, a significant association is observed between the wealth status of the households and underweight. Higher odds of underweight were observed among children who belonged to poor wealth quartile (OD=2.562, SE=.131) than that of the richest income quartile. Household's level of living also determine the children's nutritional status as result shows that children from the poorest household are more likely to malnourished than children from the richer and richest wealth quintile.

The findings of logit regression demonstrate that children whose mother's BMI is ≥18.5 have statistically significant at 1 percent level of significance with a low odds ratio (OD=.091, SE=.083). According to NFHS-4 report, the percentage of women whose BMI was below normal (BMI<18.5 kg/m^2) was 25.3 percent and children age 6-59 months who were anemic, was 63.2 percent. It is appalling to note that in Uttar Pradesh, more than half of pregnant women (51%) aged 15-49 years were anemic in 2016. However, in out result there is no significant association found between mother's age cohort and underweight in children.

Table 5: Determinants of underweight using multiple logistic regression results

Variable	B	Sig.	Odd ratio	95% C.I.
Mother's Education				
Mother_illit^R				
Mother_elemedn	.685 (.136)	.000	1.984	1.518-2.592
Mother_secedn	.567 (.146)	.000	1.764	1.325-2.348
Mother_hiedn	.404 (.126)	.001	1.497	1.171-1.915
Sex of Child				
Child_boy^R				
Child_girl	.057 (.058)	.323	1.059	.945-1.187
Sex of Household				
Male^R				
Female	-.089 (.085)	.296	.915	.774-1.081
Father's Education				
Father_illiterate^R				
Father_elemedn	.377 (.131)	.004	1.459	1.128-1.886
Father_secedn	.313 (.134)	.019	1.368	1.052-1.780
Father_hiedn	.160 (.111)	.149	1.173	.944-1.457
Place of Residence				
Rural	.143 (.082)	.081	1.154	.983-1.354
Use of Contraceptive				

Variable	B	Sig.	Odd ratio	95% C.I.
Trad_method[R]	.133 (.105)	.204	1.142	.930-1.402
Mode_method	.395 (.113)	.000	1.485	1.189-1.854
Others_method	.037 (.096)	.699	1.038	.860-1.252
Wealth Index				
Poorest[R]				
Poor	.941 (.136)	.000	2.562	1.961-3.348
Middle	.728 (.131)	.000	2.072	1.604-2.677
Richer	.542 (.129)	.000	1.719	1.334-2.215
Richest	.460 (.131)	.000	1.584	1.224-2.049
Body Mass Index (BMI)				
BMI ≤18.5 kg/m2[R]				
BMI ≥18.5 kg/m2	-1.657 (.083)	.000	.191	.162-.225
Breastfeeding				
Within 1st hour[R]				
More than 1st hour	-.015 (.065)	.821	.985	.867-1.120
Mother's Age Cohort				
15-19[R]				
20-24	-.466 (.469)	.320	.628	.251-1.573
25-29	-.166 (.368)	.652	.847	.411-1.743
30-34	.034 (.366)	.927	1.034	.505-2.118
35-39	.023 (.367)	.949	1.024	.498-2.102
40-44	.042 (.374)	.910	1.043	.501-2.172
45-49	.251 (.402)	.533	1.285	.584-2.826
N	41751			
Cox & Snell R Square	0.118			
Nagelkerke R Square	0.159			
-2 Log-likelihood	6973.408			

R, reference category
Figures in the parentheses are SE of estimates
Source: Author's calculation

5. Conclusions

This paper examined the effect of socio-economic factors on child malnutrition status in Uttar Pradesh using data from NFHS-4. This study accounts for maternal level information such as the educational level of mother, malnutrition of mother (BMI as a proxy) and age cohort of the mother that appears to cause malnutrition in children. Among socio-economic determinants, mother's education beyond elementary level emerged as a significant factor that influenced stunting, wasting and underweight of children belonging to the age of five. This result was buttressed by other empirical studies and their results confirmed that mother's educational level beyond secondary level reduces the child nutrition outcomes (Bbaale, 2014).

However, the result was not supportive in case of father's educational level more than secondary. It indicated that father's educational level up to secondary was necessary to lower the rate of stunting, wasting and underweight in children. The analysis revealed

that sex of the household, sex of the child and mother's age cohort no longer affected the rate of stunting, wasting and underweight of children. However, place of residence determines a significant and positive effect on nutritional status of the 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 improved ailment prevention forces. 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, National Rural Health Mission in April 2005 with the aim of enlightening the accessibility of and access to universal health care for individuals living in rural areas. The study finds that wealth index is also more likely to be an imperative factor which exhibits a 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.

Based on 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, Government of India has launched many programmes, however, more emphasis should also be given to improvement in female education, employment opportunities to enhance economic status, access to rural nutrition, awareness about use of contraceptive. Wealth status is another determinant which indicates high incidence of poverty is a persistent problem affecting the ability to access and attain an adequate diet.

This estimate shows the scarcity of material possession and unavailability of basic needs to the poor which results in 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 recommends 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 that civic programmes to ensure education to female on how to feed infants and safe them from infection, and adequate, accessible health services to avoid and treat infections can collectively reduce malnutrition in children. Our results show that family using modern of contraceptive is 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.

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