Socioeconomic Determinants of Child Under-nutrition in India: Evidence from National Family Health Survey-III

Debaprasad Sarkar
Assistant Professor, Dept. of Economics, Barrackpore Rastraguru Surendranath College

Abstract:

Using household data of National Family Health Survey-III, the present study has explored the important socioeconomic and demographic factors causing under-nutrition among under-five children in India. Descriptive statistics of Z-Score (below -2 SD) indicate that 48.0%, 20.89% and 42.5% of the sample children are found to be stunted, underweight and wasted respectively. The ordered logit analysis shows that the probability of severe under-nourishment is significantly influenced by the age of child, second and higher order birth, mother's education, mother's underweight, wealth of the households, household size, and the presence of toilet in the households. The findings of the present study are assumed to have some important policy relevance in the context of future effective human capital formation by way of combating under-nutrition in India.

***JEL Classification**: C25, I18, J13, O15*

***Keywords:** Under-nutrition, Stunting, Underweight, Wasting, Ordered Logit.*

1. Introduction

It has long been recognized that the well-being of a population is not solely captured by the levels and growth of consumption and income. Macro level health indicator such as life expectancy, infant and child mortality and educational outcome serve as complementary in economic development. Long term health-human capital is severely affected if the individual does suffer from under-nourishment which may cause an intergenerational vicious cycle, a worse health capital stock may be passed from adults to their children (Strauss and Thomas 1998; Alderman, Hoddinott & Kinsey 2006; World Bank 2006; Pathak & Singh 2011) as shown in Fig.1. There is enough evidence that health is positively associated with other dimensions of economic prosperity and the causality moves in both directions: people with higher incomes invest more in their human capital and hence health, while healthier workers tend to be more productive and achieve higher earnings (Thomas and Frankenberg 2002; Sala-i-Martin 2005). Such considerations are not new that basically originates from the efficiency theory of wages which presents one aspect of the transmission mechanism, goes back at least to Leibenstein (1957).

Figure1: The vicious cycle of poverty and under-nutrition.

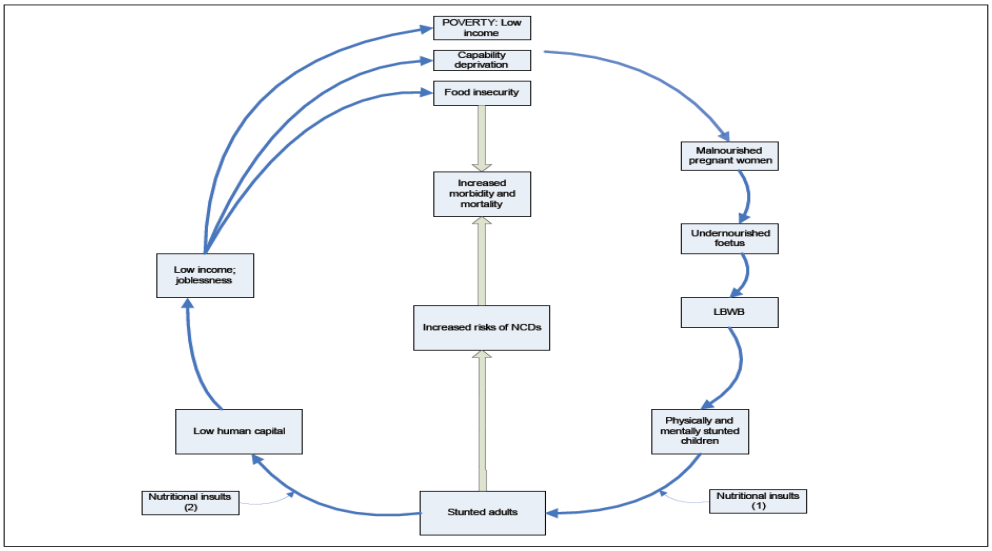

FIGURE 1
The vicious cycle of poverty and malnutrition

Source: H. Vorster; 2010

Children that are under-nourished tend to have increased risk of morbidity and mortality and often suffer delayed mental development, poor school performances and reduced intellectual achievement (Strauss 1990, World Bank 2006). About 230 million under-five children are estimated to be chronically under-nourished where 54 percent deaths are caused by under-nutrition in developing countries (FAO 2008; Van de Poel, Hosseinpoor, Jehu-Appiah & Speybroeck 2008). India shares about 36 and 17 per cent of the world's poverty and population, respectively; but it contributes to one-fifth of the world's share of diseases (World Bank 2008). According to the National Family Health Survey (NFHS)-III-2005-06, child under-nutrition in India is disproportionately high. The results are striking: 46 per cent of children under three are underweight, compared with 28 per cent in Sub-Saharan Africa and 8 per cent in China (Mendelson 2010).

India has experienced an unprecedented growth in per capita GDP during last two decades but the progress towards reduction of under-nourishment is found to be unsatisfactory. Moreover, growing income inequality during post-reform period causes twin burden of under and over nutrition in India (Kanjilal, Guha Majumdar, Mukherjee, & Rahman, 2010; Pathak & Singh, 2011; Svedberg 2006; Subramanian, Kawachi, & Smith, 2007). The burden of under-nourished children in India is amongst the highest in the world; nearly 60 million Indian children are estimated to be underweight, more than 50 percent suffer from anemia and a similar proportion lacks full immunization (Deaton & Dreze 2009, Rajaram, Zottarelli, & Sunil 2007). Future demographic dividend which is expected to be enjoyed by India after 2025 largely depends on the quality of the future human resources. But major health challenges posed by the specific phases of the demographic transition that India is going through is related to lower status of

reproductive health and child under-nutrition causing higher incidence of mortality among children (Bhattacharya and Haldar 2014). Is our country ready to transform demographic dividend into economic dividend under the present circumstances of chronic under-nourishment? The answer lies in the fact that how quicker we are able to combat and eradicate under-nutrition from our country.

Numerous studies have already been conducted pertaining to the determinants of under-nourishment and its consequences in the developing countries especially in India (Armar-Klemesu, Ruel, Maxwell, Levin, & Morris 2000; Barrera, 1990; Cuesta, 2007; Das and Sahoo, 2011; Gwatkin, Rutstein, Johnson, Suliman, Wagstaff, & Amouzou, 2007; Som, Pal & Bharati 2007; Haddad, Alderman, Appleton, Song, & Yohannes 2003; Hong, Banta & Betancourt 2006; Kanjilal et al 2010; Pal, 1999; Radhakrishna, & Ravi, 2004; Raghupathy,1996; Rosenzweig & Schultz,1982; Smith & Haddad, 1999; Strauss 1990). Using cross-country data, Smith and Haddad (1999) have argued that malnutrition is caused due to insufficient, excessive or imbalance consumption of dietary energy and nutrients. In a robust study, using household survey data from 12 countries, Haddad et al (2003) have found a strong effect of income at the household and national level in reduction of malnutrition. A multi-country study using Demographic and Health Survey (DHS) data from more than 50 developing countries Gwatkin et al., 2007 have found that the poorest quintile fares worse than better-off groups on nutritional status; on average stunting is three times more likely among children in the poorest quintile than among those in the wealthiest quintile. Higher incomes at the household level mean that families can invest more in food consumption, access to healthcare, good hygiene, clean water and effective childcare arrangements. Radhakrishna, & Ravi (2004) have used NFHS-II data in the logit model and have observed that the risk of under-nourishment decreases with standard of living of the households but descriptive statistics suggest that it persists even among the top quintiles. Kanjilal et al.(2010) have used NFHS-III data and employed multi-level OLS for finding out the relationship between socio-economic status (SES) and nutritional status of children across 15 major states and observed that children from the highest SES quintile posses 50 percent better nutritional status compared to those from the poorest quintile. Broadly speaking, these findings are more or less consistent with the findings of Das and Sahoo (2011) who have used NFHS-III data of Madhya Pradesh and employed logistic regression models which revealed that education of the mother, poverty, social group membership, birth order, nutritional status of mother etc are important predictors of child under-nutrition. Most of the studies on under-nutrition in India confirm a wide range of inter- state difference; but it is more pronounced in the states of Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan (Bharati, Chakrabarty, Som, Pal, Bharati 2010; Pathak and Singh, 2011; Kanjilal et al. 2010).

Using household level data from Columbia, Rosenzweig and Schultz (1982) have argued for substitutability between education and availability of a health facility in a village as they believe that such services would narrow the educational differences in utilization behavior. Barrera (1990) has observed a substitutive relationship between mother's education with community cleanliness and water connection in the Philippines, but there exists complementarities between maternal education and toilet connections as well as

with health care facilities (Raghupathy, 1996). Community-based piped water provision and flush toilets have the greatest potential to reduce malnutrition in Philippines (Cuesta, 2007).

Most of the studies on under-nutrition so far conducted in India are based on either OLS or logistic regression. Only Pal (1999) has adopted ordered probit method in her model for finding out the nutritional status of children among the rural households in West Bengal. Keeping in mind the heterogeneous socio-cultural and geo-political environment, state specific results may not always unravel the true causal factors of under-nourishment. Most of the studies have used logistic regression to explore the determinants of only one category (viz. either stunting or wasting or under-weight) of under-nourishment of children using NFHS-II data in India and have used logistic regression but no such studies do exist which deals with ordered logit or probit model applied on NFHS-III data for determining under-nourishment of different categories. Ordered logit model differs from univariate logit one in that the dependent variable is no longer a dummy variable but an ordered variable taking values 0,1, 2, 3 etc. The details about ordered logit model is given in methodology section. Following WHO (1995), we have considered Z score (0>Z>-2) which will help us to determine the predicted probability of being mild under-nourishment with higher proportion in addition to moderate and severe categories. An in-depth understanding of the determinants of under-nutrition is useful in order to formulate strategic health intervention programmes in India at the aggregate level.

2. Theoretical framework

The nutritional status of children follows from the household production framework developed by Becker (1965), Strauss and Thomas (1995). In this study it is assumed that a household has preferences that can be characterized by the utility function (U) which depends on consumption of a vector of commodities (C), leisure (L) and the quality of children represented by their nutritional status (CM):

$$U = u(C, L, CM) \ldots\ldots\ldots (1)$$

Where CM is under-nutrition measured by Z score. The assumption in such a model is that good nutrition, as represented by the vector of nutritional status of children is desirable in its own right, and it is assumed that households make consumption decisions on the basis of reasons other than nutrition (Pitt and Rozenzweig, 1995).

Household maximizes its utility from the quantity and quality of the children and also the consumption of other commodities subject to a budget constraint which, in turn, determines the optimal levels of consumption and also quantity and quality of children. Representative household maximizes a quasi-concave utility (assuming household's preferences are inter-temporally separable) as a function of average consumption (C) of commodities by household members and child under-nutrition index (CM) subject to current period budget constraints, including income constraints (which depends on household income or wealth and also prices of consumption and child health goods) and a time specific nutrition production function (which depends on age and sex of child, birth

characteristic, the duration of breast feeding, mother's health conditions, child health care facilities and other household and community level factors). Along with determining the optimum value of average consumption (C), this constrained maximization exercise determines the household demand for i-th child's under-nutrition level CM_i (in implicit form) as follows:

$$CM_i = cm_i(X_c, X_P, X_h, \varepsilon_i) \quad ....(2)$$

where X_c be the individual child characteristics (e.g., gender, age, birth character), X_p is the set of maternal health characteristics and X_h stand for the household and community level environment where the child is born. Assuming all the right hand side variables are exogenous; eqn. (2) can be considered as a reduced form of under-nutrition (Behrman and Skoufias 2004; Thomas and Strauss 1992).

3. Data, Variable definitions and Methodology:

The present analyses uses information on child nutritional status and its covariates, for about 51,556 children from NFHS-III, 2005-2006. Out of 51,556 children, 35,084 (68%), 37,960 (74%) and 34,361 (67%) children are found to be under-nourished (negative z-scores) related to height-for-age, weight-for-age and height-for-weight respectively.

3.1 Variable definitions:

Child Nutritional measures

Following Conde-Agudelo, A., J. Belizan, & C. Lammers (2005); Strauss, & Henriques (1991); and Lanjouw, & Ravallion, (1995); WHO (1995, 2006), the present study has categorized the factors determining under-nutrition into three broad heads as outlined in Table-1. Wealth scores, the proxy for living standard of households, is derived using principal component analysis from 33 items of household requirement following the approach developed by Filmer and Pritchett (1998).

Table 1: Definition of the variables for empirical analysis

Variable	Definition
Dependent variables	
Child Under-nutrition point scale	Assessment of under-nutrition on a three- 1= Severe under-nutrition (z-score ≤ -3), 2= Moderate under-nutrition (-2 ≥ z-score > -3), 3= Mild under-nutrition (0 > z-score > -2)
Independent variables	

Variables		Definition
Child Characteristics	**Age in month**	Continuous ranging from 0-59 months,
	Age^2	**-**

	2nd Birth Order	= 1 if child is second child, 0 otherwise.
	Higher Birth Order	= 1 if child birth order is 3& more, 0
	Birth Interval 0-24 months	= 1 if gap between two consecutive births is 0-24 months, 0 otherwise.
	Birth Interval 25-48 months	= 1 if gap between two consecutive births is 25-48 months, 0 otherwise.
	Female child	= 1 if child is female, 0 otherwise.
	Very low size Birth	= 1 if size of child birth is very low, 0
	Low size Birth(< avg)	= 1 if size of child birth is lower than the
Maternal Characteristics	**Breastfeeding (months)**	Continuous in months,
	Mother age 1st birth	Continuous in years,
	Underweight mother	= 1 if the mother's BMI of the child is <
	Mother's education	Continuous in completed school years,
	Square of Mother's education	-
Household Level Variables	**Log Wealth-score**	Continuous
	Square of wealth-	-
	Rural	= 1 if child lives in rural area, 0 otherwise.
	Family size (<6)	= 1 if number of family member including
	Access to health	= 1 if child visited health facility in last 3
	No safe Water facility	= 1 if household not avail piped water or
	No toilet facility	= 1 if household has not proper
	SC	= 1 if household from scheduled caste
	ST	= 1 if household from scheduled tribe
	OBC	= 1 if household from scheduled tribe
	Muslim	= 1 if household from Muslim
	Other Religion	= 1 if household from other than Hindu and

Source: Definitions are followed from NFHS-III, 2005-'06.

Empirical specification for Ordered Logit Model:

Following Greene (1995), let CM_i be a continuous, latent variable which could be interpreted as representing the child under-nutrition. It is assumed, a linear dependence between the latent variable CM_i and X_i, β and the random disturbance term v_i and X does not contain a constant.

$$CM_i = \sum_m \beta_{mi} X_{mi} + \sum_j \beta_{ji} X_{ji} + \sum_k \beta_{ki} X_{ki} + v_i,\ v_i \sim N(0,\sigma^2). \quad \ldots.(3)$$

where, β the set of regression parameters and v the random disturbance term following a normal distribution with zero mean and constant variance σ^2. What we observe is as follows:

$$CM_i = \begin{cases} 1\ if\ CM_i \leq \mu_0 \\ 2\ if\ \mu_0 < CM_i \leq \mu_1 \\ 3\ if\ \mu_1 < CM_i \end{cases}$$

where μ_i are the unobservable thresholds or cut points which are to be estimated along with the regression parameters βs.

4. Results and Discussion

Due to inadequate data pertaining to under-nutrition in respect of stunting, wasting and underweight and their covariates, I have taken 41,306 numbers of children out of 51,556 for our analysis. The descriptive statistics of under-nourishment in respect of stunting, wasting and underweight is reported in Table-2.

Table 2: Descriptive statistics of Child Under-nourishment and Corresponding Variables

	Stunting(%)		Wasting (%)		Underweight (%)	
	$Z_h < -3$	$Z_{ha} < -2$	$Z_{wh} < -3$	$Z_{wh} < -2$	$Z_{wa} < -3$	$Z_{wa} < -2$
Child level variables						
Age in month						
<6	8.4	20.4	12.8	29.9	10.9	29.5
6--8	10.8	25.9	10.1	29.3	13.7	34.7
9--11	12.8	32	10.9	28.9	14.1	35.9
12--17	22.4	46.8	7.7	23.6	14.2	41.0
18--23	31.4	58.8	7.6	22.2	19.2	45.9
24--35	28.9	54.9	5.5	16.7	17.7	44.9
36--47	27.3	54.3	4.7	15.5	16.6	45.8
48--59	23.4	49.8	4.1	15.7	15.3	44.8
Birth Order						
1	17.2	41.5	6.4	18.8	11.9	36.1
2--3	24.1	49.3	8.1	21.2	14.4	44.9
4-and above	36.9	58.5	8.9	24.6	23.8	53.4
Birth interval						
1st birth	17.4	44.1	5.4	16.8	12.1	34.1
<25	30.4	55.6	6.6	19.1	18.7	50.6
25- 48	25.3	51.9	8.3	22.8	17.9	46.2

>48	22.9	46.7	6.9	20.4	14.5	39.3
Size of birth						
Very small	30.0	55.6	9.6	28.7	23.9	54.8
Small	28.3	58.9	10.2	27.8	21.5	53.5
Average and above	21.1	44.5	5.9	18.2	14.2	36.1
Sex						
Female	23.4	48	6.9	21.1	18.6	44.1
Male	23.9	47.1	6.3	19.5	15.3	41.9
Maternal Characteristics						
Duration (month) of breastfeeding						
<6	11.3	30.3	5.8	20.7	13.3	29.3
7--12	18.2	41.7	9.1	18.8	17.1	33.6
13-18	21.6	49.3	10.6	16.87	20.8	29.7
19 & above	22.3	78.8	13.6	28.6	19.8	48.4
Mother age at first birth						
< 21 year	23.2	50.7	9.6	28.7	23.8	53.4
>21 years	6.5	19.8	5.4	17.8	15.3	31.9
Under weight mother						
BMI<18.5	27.3	53.5	7.9	25.2	20.9	52
Mother education						
Illiterate	32.0	59.2	8.8	23.5	21.4	52.6
Primary	23.5	52.4	6.9	20.8	15.6	44.8
Secondary	14.6	37.8	4.97	16.87	9.4	33.4
Higher	7.3	22.2	4	12.8	4.5	17.9
Household and Community level Characteristics						
Wealth Index						
wq1	35.8	58.9	8.7	25	25.1	57.6
wq2	28.3	55.3	6.7	22	20.4	50.1
wq3	23.1	48.9	6.2	18.8	14.1	41.4
wq4	15.9	40.8	5	16.6	9.5	32.6
wq5	8.2	25.3	4.2	12.7	4.9	19.7
Residence						
Rural	28.6	50.9	6.9	21.7	19.5	46.6
Urban	15.6	37.6	5.4	15.9	10.0	31.7
Household size						
<6	30.8	68.2	6.9	20.8	24.9	54.5
6 & above	12.4	30.1	4.6	16.2	13.7	34.4
Access to health facility in last 3 month						

Yes	12.4	29	5	21.6	15.6	33.2
No	16.8	34.9	6.7	28.7	16.1	36.4
No safe water						
Yes	20.8	46.6	6.1	24.5	18.9	43.4
No	19.6	25.6	4.2	19.4	17.5	42.8
No toilet facility						
Yes	35	72.7	13.6	28.6	33.8	63.4
No	14.1	37.9	8.7	25	15.3	31.9
Caste						
SC	26.9	54.2	7.2	22.1	18.9	46.8
ST	29.1	53.9	9.3	27.6	26.9	55.5
OBC	25.5	49.5	6.3	18.8	15.7	43.2
Others	20.1	23.8	4.2	15.2	13.7	32.4
Religion						
Hindu	21.6	48.6	6.1	20.0	17.1	44.2
Muslim	28.2	52.3	6.9	19.4	15.1	43.8
Other	17.9	41.3	6.1	19.4	15.6	34.5

Source: Computed by authors using NFHS-III (2005-'06) unit level records. Total Sample Children, N=41306

From Table 2, it is found that almost half of the children (48 percent) under five years of age are stunted and 43 percent are underweight. In India, 24 percent children are severely stunted and 16 percent are severely underweight. Wasting is also a problem in India, affecting 20 percent of children under five years of age. Proportion of children who are stunted or underweight increases with the age up to 18-23 months (see table 2). Under-nutrition decreases thereafter for stunting and levels off for underweight. For both of these measures, under-nutrition reaches to its peak at age around 20 months. Wasting generally decreases as age increases. Even during the first six months of life, when most of the babies are breastfed, 20-30 percent of children are undernourished in respect of the three nutritional indices. It is noted that at age 18-23 months, when most of the children are being weaned from breast milk, 30 percent of children is found to be severely stunted and one-fifth is severely underweight. Overall, there is no significant difference between girls and boys in respect of under-nourishment. Under-nutrition is generally lower for first births than for subsequent births and consistently increases with increasing birth order for all measures of nutritional status. Short birth intervals are associated with higher levels of under-nutrition, except in the case of wasting.

Under-nutrition is substantially higher in rural areas than in urban areas. Even in urban areas, however, 40 percent of children are stunted and 33 percent are underweight. Children having smaller size at the time of birth are more likely to be undernourished compared with those having higher than average size. Under-nutrition has a strong negative relationship with the mother's education. Severity of underweight is more

pronounced among the children whose mothers are illiterate. Hindu and Muslim children are more or less equally undernourished, but children from other religions are found to be better-off. Children belonging to Scheduled Castes, Scheduled Tribes and Other Backward Classes have relatively higher levels of under-nutrition according to all three measures. Children belonging to Scheduled Tribes community have the poorest nutritional status in almost every measure.

The nutritional status of children is strongly related to maternal nutritional status. Under-nutrition is much more common for children of mothers whose body mass index is below 18.5 than for children whose mothers are not underweight. All of the measures decrease steadily with an increase in the wealth index of the household.

Determinants of under-nutrition

Instead of reporting coefficients, the odd ratios and the corresponding marginal effects have estimated of each explanatory variable in three types of under-nourishment in each of three cases (viz. mild, moderate and severe) as shown in Table-3(a), Table-3(b) and Table-3(c). If the odd-ratio (OR)<1, one can argue that the probability of being under-nourishment increases, the opposite will happen if OR>1. There exists a non-linearity between age of the child and probability of under-nourishment in three cases.

Table 3(a): Odd Ratio and Marginal Effects of Under-nutrition (z-score(h/a))

			Marginal Effect of Stunting		
Variable	**Odd**	**z-**	**Severe**	**Moderate**	**Mild**
Predicted Probability	-	-	0.18	0.27	0.55
Age in month	0.98	-22.35	0.0024***	0.0017***	-0.004***
Age^2	1.00	21.13	-	-	0.0002***
2^{nd} Birth Order	0.71	14.60	0.051***	0.032***	-0.084***
Higher Birth Order	0.63	4.50	0.068***	0.045***	-0.113***
Birth Interval 0-24 months	0.64	-11.93	0.063***	0.045***	-0.109***
Birth Interval 25-48	0.85	-4.67	0.024***	0.016***	-0.04***
Female child	0.92	-3.97	0.012***	0.009***	-0.021***
Very low size Birth	0.75	-6.48	0.044***	0.026***	-0.071***
Low size Birth(< avg)	0.80	-7.42	0.033***	0.021***	-0.055***
Breastfeeding (months)	0.998	-2.81	0.0003***	0.0002***	-
Mother age 1^{st} birth	1.02	7.62	-0.003***	-0.002***	0.006***
Underweight mother	0.87	-6.39	0.020***	0.014***	-0.034***
Mother's education(y)	1.05	15.83	-0.007***	-0.005***	0.012***
Square Mother's	0.999	-3.73	0.0001***	0.0001***	-
Log Wealth-score	1.57	17.57	-0.065***	-0.046***	0.112***
Square wealth score	1.15	8.90	-0.02***	-0.014***	0.035***
Rural	1.10	5.11	-0.02***	-0.014***	0.034***

Family size(>6 persons)	1.19	7.93	-0.025***	-0.018***	0.043***
Access to health facility	1.06	2.76	-0.009***	-0.006***	0.015***
No safe Water facility	1.06	2.12	-0.008**	-0.006**	0.014**
No toilet facility	0.91	-3.54	0.014***	0.010***	-0.024***
SC	0.63	-14.92	0.07***	0.042***	-0.115***
ST	0.58	-16.67	0.089***	0.047***	-0.136***
OBC	0.68	-14.36	0.058***	0.037***	-0.095***
Muslim	0.88	-4.25	0.019***	0.012***	-0.030***
Other religion	1.10	3.04	-0.014***	-0.010***	0.024***

Source: Computed by author using NFHS 3 (2005-06) unit level records. Note: *** p<.01,** p<.05, LR chi^2(26) =4694.53***, Pseudo R^2= 1 - LU/LR=0.067, where LU is the unrestricted log likelihood values and LR is the restricted log likelihood values. N = 35084

Table 3(b): Odd Ratio and Marginal Effects of Under-nutrition (z-score (w/a))

			Marginal Effect of Underweight		
Variable	**Odd**	**z-**	**Severe**	**Moderate**	**Mild**
Predicted Probability	-	-	0.12	0.34	0.54
Age in month	0.99	-18.39	0.001***	0.0019***	-0.003***
Age^2	1.00	29.78	-	-	0.0003***
2nd Birth Order	1.05	1.31	-0.005	-0.007	0.012
Higher Birth Order	0.97	-0.94	0.004	0.005	-0.009
Birth Interval 0-24 months	0.76	-7.59	0.03***	0.038***	-0.067***
Birth Interval 25-48	0.90	-3.28	0.011***	0.016***	-0.027***
Female child	0.89	-5.88	0.013***	0.018***	-0.030***
Very low size Birth	0.64	-11.36	0.052***	0.057***	-0.11***
Low size Birth(< avg)	0.68	-13.13	0.043***	0.051***	-0.095***
Breastfeeding (months)	0.999	-1.65	0.0001	0.0002*	-0.0003
Mother age 1st birth	1.02	5.39	-0.002***	-	0.005***
Underweight mother	0.61	-22.23	0.053***	0.067***	-0.123***
Mother's education(y)	1.04	12.08	-0.004***	-0.006***	0.011***
Square Mother's	0.999	3.63	0.0001***	0.0001***	-
Log Wealth-score	1.50	16.23	-0.042***	-0.059***	0.101***
Square wealth score	1.07	4.50	-0.007***	-0.01***	0.017***
Rural	1.11	3.86	-0.011***	-0.015***	0.025***
Family size(>6 persons)	1.10	4.71	-0.01***	-0.014***	0.025***
Access to health facility	1.03	1.27	-0.003	-0.004	0.007

No safe Water facility	1.04	1.49	-0.004	-0.006	0.009
No toilet facility	0.88	-4.86	0.013***	0.019***	-0.033***
SC	0.79	-7.65	0.026***	0.033***	-0.059***
ST	0.86	-4.34	0.016***	0.021***	-0.036***
OBC	0.83	-6.86	0.019***	0.026***	-0.045***
Muslim	1.04	1.50	-0.004	-0.006	0.011
Other religion	1.51	12.94	-0.038***	-0.062***	0.10***

Source: Computed by author using NFHS 3 (2005-06) unit level records. Note: LR $chi^2(26)$ =5422.35***, *** p<.01,** p<.05, Pseudo R^2= 1 - LU/LR=0.073, where LU is the unrestricted log likelihood values and LR is the restricted log likelihood values. Iterations completed by 4 for all cases. N=37905.

Table 3(c): Odd Ratio and Marginal Effects of Under-nutrition Z-score (w/h)

			Marginal Effect of Categorical		
Variable	Odd	z-	Severe	Moderate	Mild
Predicted Probability	-	-	0.03	0.15	0.81
Age in month	1.01	10.76	-0.0003***	-0.001***	0.0015***
Age^2	1.00	4.14	-	-	0.00004***
2^{nd} Birth Order	0.89	-2.37	0.004**	0.014**	-0.018**
Higher Birth Order	0.88	-2.70	0.004***	0.015***	-0.02***
Birth Interval 0-24	1.13	2.54	-0.004***	-0.014***	0.018***
Birth Interval 25-48	1.04	0.88	-0.001	-0.0044***	0.006
Female child	1.06	2.29	-0.002**	-0.0075**	0.01**
Very low size Birth	0.69	-7.76	0.014***	0.048***	-0.063***
Low size Birth(< avg)	0.74	-7.94	0.011***	0.037***	-0.048***
Breastfeeding (months)	0.999	-0.70	0.00002	0.00007	-0.0001
Mother age 1^{st} birth	0.994	-1.16	0.0002	0.0006	-0.0008
Underweight mother	0.66	-14.37	0.015***	0.050***	-0.065***
Mother's education(y)	1.01	3.09	-0.0004***	-0.0015**	0.0019***
Square Mother's	1.0	2.29	0.00001**	0.00005**	-0.00006**
Log Wealth-score	1.14	4.41	-0.004***	-0.016***	0.020***
Square wealth score	0.99	-0.74	0.0003	0.0012	-0.0015
Rural	1.14	3.69	-0.004***	-0.015***	0.02***
Family Size(>6 persons)	0.99	2.16	0.0003	0.0012	-0.0015
Access to health facility	1.03	1.17	-0.001	-0.0038	0.005
No safe Water facility	0.94	-1.96	0.002	0.0075	-0.009*
No toilet facility	0.86	-3.99	0.005***	0.017***	-0.022***
SC	0.76	-6.83	0.01***	0.034***	-0.044***

ST	0.64	-10.55	0.017***	0.057***	-0.073***
OBC	0.82	-5.67	0.007***	0.024***	-0.030***
Muslim	1.09	2.20	-0.003**	-0.01**	0.013**
Other religion	1.11	1.15	-0.003**	-0.012**	0.016**

Source: Computed by author using NFHS 3 (2005-06) unit level records. LR $chi^2(26)$ =903.64***, Note: *** p<.01,** p<.05, Pseudo R^2= 1 - LU/LR=0.03 where LU is the unrestricted log likelihood values and LR is the restricted log likelihood values. N=34360.

Age of the child is positively related to the probability of stunting and under-weight (in case of severity and moderate but not in case of mild), as shown in Table-3(a) and Table-3(b) but this is not happened in case of wasting. The marginal effects of the square of age in all three cases of under-nourishment are significant which means that the probability of under-nourishment falls as the child gets older; this is consistent with the study undertaken by Kabubo-Mariara, Ndenge, & Kirii, 2006. Chronic under-nutrition as revealed from our study is also compatible with earlier studies by Babatunde and Qaim, 2011. Probability of stunting (moderate and severe) is found to be increasing with birth order, birth intervals, birth size and female child. Birth history of child has likely to increase probability of being severely stunted by 5.1% for 2nd birth order, 6.8% for higher birth order, 6.3% lower birth interval and 4.4% for very low size of birth. The same result is obtained in case of under-weight (moderate and severe) except 2nd order birth; however, in case of wasting (moderate and severe) the opposite result is found in case of birth-intervals and gender. Mother's education has a significant negative impact on under-nourishment of a child, almost all the studies do support this evidence. It is observed that educated mothers are better aware about the nutritional requirements of their children and they usually provide improved healthcare as a result of their general awareness (Webb and Block, 2004). Our results also reveal that probability of under-nutrition of all three types will decrease with better body mass index of child's mother. This is expected as body mass index represents an indicator of the nutritional status of the mothers and their ability to adequately breastfed their children. This finding is consistent with the previous studies (Smith and Haddad, 1999; Pal 1999). Mother age at first birth is negatively related to the probability of stunting and underweight, no such significant impact is obtained in case of wasting. Duration of breastfeeding (in months) accentuates the probability of being stunted but no such significant impact is found in other two cases of under-nourishment.

An increase in wealth-scores of households reduces the chances of under-nourishment. Unit increase in wealth score would decrease the chance of reporting severely stunted and moderately stunted by 6.5% and 4.6% points respectively as against only 1.1% increase in the probability of being mild under-nourished (h/a). The chance of reporting severely stunted and moderately stunted are more or less same for underweight (severe and moderate by 4.2% and 5.9% points respectively as against only 1.0% in mild underweight case) but much higher than wasting (severe and moderate by 0.4% and 1.6% points

respectively as against only 2.0% increase in mild case). The probability of under-nourishment increases in urban counterpart compared to rural children. Probability of being stunted and underweight reduces as family size (>6 persons in a household) increases which is contrary to the earlier findings done by Lanjouw and Ravallion, 1995; Pal, 1999 but no such significant impact is observed in case of wasting. In a larger family size, the older persons generally look after the siblings which may reduce the probability of being under-nourished. Access to health facility reduces the probability of being stunted but no such impact is observed in case of underweight and wasting. Safe water facility at the household level reduces the chance of being under-nourished in case of stunting but it does not have any significant role in wasting and under-weight. Toilet facility at the household level is found to have a strong effect on all kinds of under-nourishment. Probability of being under-nourished in all three cases is influenced by social class (SC/ST/OBC), this means that chances of under-nourishment increases significantly if the child either belongs to SC or ST or OBC community. A mixed result is found in case of religion; probability of stunting is found to be higher if the child belongs to Muslim community; contrary to this the probability of wasting is found to be declined if the child belong to Muslim but no such significant result is obtained in case of under-weight.

Predicted probability of categorical Under-nutrition:

Logit coefficients are in log-odds units cannot be read as regular OLS coefficients. The estimated coefficients (β_i) shift the z-score by that amount, this may change the prediction of the category of the dependent variable, or it may not and this study deals with only the prediction of being in the same category of dependent variable.

Figure 2: Interpretation of predicted probability

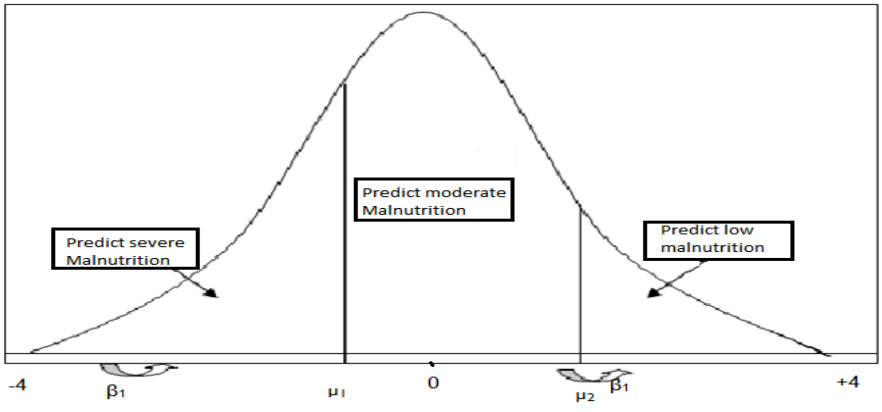

Table 4a: Predicted Probability (PP) of under-nutrition Z-score (h/a)

		Severe	S.E.	**Moderate**	S.E.	**Mild**	S.E.
Child Level Variables	**Age in month**	0.11	0.003	0.22	0.003	0.67	0.006
	Age^2	0.22	0.003	0.30	0.003	0.48	0.004
	2nd Birth Order	0.21	0.005	0.30	0.003	0.49	0.007
	Higher Birth Order	0.22	0.004	0.30	0.003	0.48	0.006
	Birth Interval 0-24 months	0.21	0.004	0.30	0.003	0.50	0.005
	Birth Interval 25-48 months	0.19	0.004	0.29	0.003	0.52	0.006
	Female child	0.18	0.003	0.28	0.003	0.54	0.004
	Very low size Birth	0.22	0.008	0.30	0.004	0.48	0.011
	Low size Birth(< avg)	0.20	0.005	0.29	0.003	0.50	0.007
Maternal Characteristics	**Breastfeeding (months)**	0.17	0.003	0.27	0.003	0.56	0.004
	Mother age 1st birth	0.25	0.012	0.31	0.005	0.44	0.016
	Underweight mother	0.19	0.003	0.28	0.003	0.53	0.005
	Mother's education(y)	0.20	0.003	0.29	0.003	0.50	0.004
	Squire Mother's education(y)	0.17	0.002	0.27	0.003	0.55	0.003
Household and Community Level Variables	**Log Wealthscore**	0.96	0.010	0.03	0.007	0.01	0.003
	Squire wealthscore	0.17	0.002	0.27	0.003	0.56	0.003
	Rural	0.17	0.002	0.27	0.003	0.56	0.004
	Family size	0.16	0.003	0.26	0.003	0.57	0.004
	Access to health facility (<6)	0.17	0.003	0.27	0.003	0.56	0.004
	No safe Water facility	0.17	0.003	0.27	0.003	0.56	0.006
	No toilet facility	0.18	0.003	0.28	0.003	0.54	0.004
	SC	0.24	0.005	0.31	0.003	0.46	0.007
	ST	0.25	0.006	0.31	0.003	0.43	0.007

	OBC	0.22	0.004	0.30	0.003	0.49	0.005
	Muslim	0.19	0.004	0.29	0.003	0.52	0.007
	Other Religion	0.16	0.004	0.27	0.004	0.57	0.007

Source: Computed by author using NFHS 3 (2005-06) unit level records, all P-P are significant.

Table4b: Predicted Probability(PP) of under-nutrition z-score(w/a)

		Severe	S.E.	**Moderate**	S.E.	**Mild**	S.E.
Child Level Variables	**Age in month**	0.082	0.002	0.285	0.004	0.633	0.006
	Age^2	0.159	0.002	0.391	0.003	0.450	0.004
	2nd Birth	0.113	0.003	0.339	0.005	0.548	0.007
	Higher Birth	0.119	0.003	0.347	0.004	0.534	0.006
	Birth Interval	0.140	0.004	0.373	0.005	0.486	0.007
	Birth Interval	0.124	0.003	0.354	0.004	0.521	0.006
	Female child	0.123	0.002	0.353	0.003	0.524	0.004
	Very low size	0.166	0.005	0.397	0.005	0.438	0.009
	Low size	0.155	0.004	0.387	0.004	0.458	0.007
Maternal Characteristics	**Breastfeeding**	0.115	0.002	0.341	0.003	0.544	0.004
	Mother age 1st	0.155	0.008	0.387	0.008	0.458	0.015
	Underweight	0.154	0.003	0.387	0.003	0.460	0.004
	Mother's	0.133	0.002	0.365	0.003	0.502	0.004
	Squire Mother's	0.115	0.002	0.341	0.003	0.544	0.003
Household and Community Level Level Variables	**Log Wealth-**	0.910	0.022	0.075	0.018	0.015	0.004
	Squire wealth-	0.114	0.002	0.340	0.003	0.546	0.003
	Rural	0.113	0.002	0.339	0.003	0.548	0.004
	Family size	0.111	0.002	0.335	0.003	0.554	0.004
	Access to	0.115	0.002	0.342	0.003	0.543	0.004
	No safe Water	0.114	0.002	0.340	0.004	0.546	0.005
	No toilet	0.123	0.002	0.353	0.003	0.524	0.004
	SC	0.138	0.004	0.371	0.004	0.491	0.007
	ST	0.130	0.004	0.361	0.005	0.509	0.008
	OBC	0.130	0.003	0.361	0.004	0.509	0.005
	Muslim	0.113	0.003	0.339	0.004	0.548	0.006
	Other Religion	0.085	0.003	0.290	0.005	0.626	0.007

Source: Computed by author using NFHS 3 (2005-06) unit level records, all P-P are significant.

Table 4c: Predicted Probability(PP) of under-nutrition z-score(w/h)

		Severe	S.E.	Moderate	S.E.	Mild	S.E.
Child Level Variables	Age in month	0.045	0.002	0.189	0.004	0.766	0.005
	Age^2	0.036	0.001	0.159	0.003	0.805	0.003
	2^{nd} Birth Order	0.037	0.002	0.161	0.005	0.802	0.006
	Higher Birth	0.037	0.001	0.160	0.004	0.803	0.005
	Birth Interval 0-	0.031	0.001	0.140	0.005	0.829	0.006
	Birth Interval 25-	0.033	0.001	0.148	0.004	0.819	0.005
	Female child	0.033	0.001	0.147	0.003	0.820	0.003
	Very low size	0.047	0.002	0.196	0.007	0.756	0.009
	Low size Birth(<	0.043	0.002	0.183	0.005	0.774	0.006
Parent Level Variables	Breastfeeding	0.034	0.001	0.150	0.003	0.817	0.003
	Mother age 1^{st}	0.031	0.003	0.140	0.009	0.828	0.012
	Underweight	0.044	0.001	0.185	0.003	0.771	0.004
	Mother's	0.036	0.001	0.157	0.003	0.807	0.003
	Squire Mother's education(y)	0.034	0.001	0.150	0.002	0.816	0.002
Household Level Variables	Log Wealth-score	0.128	0.036	0.359	0.045	0.513	0.081
	Squire wealth-	0.034	0.001	0.152	0.002	0.814	0.002
	Rural	0.032	0.001	0.146	0.002	0.822	0.003
	Family size	0.034	0.001	0.152	0.003	0.814	0.003
	Access to health	0.033	0.001	0.149	0.003	0.817	0.003
	No safe Water	0.036	0.001	0.157	0.004	0.808	0.004
	No toilet facility	0.036	0.001	0.159	0.003	0.804	0.003
	SC	0.042	0.002	0.180	0.005	0.778	0.006
	ST	0.049	0.002	0.200	0.005	0.752	0.007
	OBC	0.039	0.001	0.167	0.004	0.794	0.004
	Muslim	0.032	0.001	0.143	0.004	0.825	0.005
	Other Religion	0.031	0.001	0.141	0.005	0.828	0.006

Source: Computed by author using NFHS 3 (2005-06) unit level records, all P-P are significant.

In this section, the predicted probability of childhood under-nutrition of different degrees of z-scores of all three types of under-nutrition is calculated to interpret the significant effect of change in explanatory variable (Table 5a-5c). Out of all explanatory variables, as expected, household wealth score, mother's educations are the crucial instruments of severity of under-nutrition. The present distribution of wealth in the population explain the fact that the probability of being in severe under-nutrition stunting are quite high stunting (96%) and underweight (91%) as against only 13% in sever wasting. Similarly,

birth history, mother's education and age at first birth explains about 25% probability of being in severe stunting which are about 15% in severe underweight and 4% in severe wasting. The estimated probabilities of being in mild under-nourishment of all forms are found to be higher compared to moderate and severe under-nourishment. Probability of being in under-lnourished increases with decrease in birth interval and birth size. The predicted probability would decline from mild to severity for the following variables like, age of child, female child, underweight mother, access to health to health facilities, toilet facilities, family size etc. The similar trends will hold good for societal variables like Caste and Religion.

5. Concluding Observations and Policy Suggestions

The present analysis finds that 23.6%, 16% and 6.4% of the sample children are severely stunted, underweight and wasting respectively. The regression analysis has revealed that child's variables (age and gender), mother's variables (education and nutrition) and household-community level variables (wealth score, family size and toilet facility) are the significant predictors of child under-nutrition. The probability of persisting with the prevalence of under-nourishment is high in mild under-nutrition type irrespective of explanatory variables of all forms of under-nutrition only except wealth scores. Thus it include that part in our analysis over the previous analysis with the general cutoff level (> -2) of under-nutrition. It is found that female children are in disadvantageous in respect of stunting and under-weight whereas male are worse off compared to female in respect of wasting. Under-weight mothers and child under-nutrition is interlinked which generates some kind of health-poverty trap. This low level health-poverty nexus is augmented in presence of illiterate mother, poverty and low reproductive health status. In order to overcome from this health-poverty nexus, government has already been adopted various programmes like Integrated Child Development Services (ICDS), provision of Mid-Day Meal, Health for All, Janani Surakshya Yoyona (Mother Reproductive Security) under National Rural Health Mission, National Rural Employment Guarantee Act (NREGA) etc. The performance of all these programmes is not satisfactory as a result under-nutrition persists in India even though income poverty (published by Planning Commission, Government of India) has reduced marginally from 36 % in 1992-93 to 29.8 % in 2009-10. Poor oversight of nutrition programmes, faulty project design and a lack of focus on the most needy population groups (viz. SC/ST/OBC) are frustrating India's efforts to reduce child under-nutrition (Ganapati 2009). Keeping in mind the importance of future effective human capital, eradication of under-nutrition should be our prime objective. Therefore, in order to get rid of the problem, the study suggests allocating more funds in social sector for strengthening the existing policies and programmes. A proper monitoring is needed to the existing programmes.

……

Notes : 1. The NFHS-3 is the third pan-India survey conducted in 2005-'06 (started since 1992, covering 2,00,000 people from 15-54 years, and the definitive guide to Indian health statistics).

2. Wealth score is derived on the basis of the following 33 assets and housing characteristics: household electrification; type of windows; drinking water source; type of toilet facility; type of flooring; material of exterior walls; type of roofing; cooking fuel; house ownership; number of household members per sleeping room; ownership of a bank or post-office account; and ownership of a mattress, a pressure cooker, a chair, a cot/bed, a table, an electric fan, a radio/transistor, a black and white television, a colour television, a sewing machine, a mobile telephone, any other telephone, a computer, a refrigerator, a watch or clock, a bicycle, a motorcycle or scooter, an animal-drawn cart, a car, a water pump, a thresher, and a tractor.

……

References

Alderman, H., J. Hoddinott, and J. Kinsey (2006): "Long Term Consequences of Early Childhood Malnutrition", *Oxford Economic Papers*, Vol. 58(3), pp. 450-474.

Armar-Klemesu, M., Ruel, M.T., Maxwell, D.G., Levin, C.E. & Morris, S.S. (2000). Poor Maternal Schooling isthe Main Constraint to Good Childcare Practices in Accra. *Journal of Nutrition, 130*, 1597-1607.

Babatunde and Qaim, 2011 Prevalence and Determinants of Malnutrition among Under-five Children of Farming Households in Kwara State, Nigeria. *Journal of Agricultural Science* Vol. 3, No. 3.

Barrera, A. (1990): "The role of maternal schooling and its interaction with public health programs in child health production", *Journal of Development Economics*, Vol. 32(1), pp. 69-91.

Becker, G. (1965). A Model of the Allocation of Time. *Economic Journal*. 75, 493-517.

Behrman, J., and E. Skoufias (2004): "Correlates and determinants of child anthropometrics in Latin America: background and overview of the symposium", *Economics and Human Biology*, Vol. 2(3), pp. 335-351.

Bharati S, Chakrabarty S, Som S, Pal M, Bharati P (2010) Socio-economic determinants of underweight children in West Bengal, India, *Asian Pacific Journal of Tropical Medicine*, 322-327

Bhattacharya, G. and Haldar, S.K(2014): Trend, Differential and Determinants of Deprivation of Reproductive and Child Health in the Districts of West Bengal, India. Journal of Health Management 16(1), 93-112

Conde-Agudelo, A., J. Belizan, and C. Lammers (2005): "Maternal-perinatal morbidity and mortality associated with adolescent pregnancy in Latin America: Cross-

sectional study", *American Journal of Obstetrics and Gynecology*, Vol. 192, pp. 342-349.

Cuesta, J.(2007): Child malnutrition and the provision of water and sanitation in the Philippines, *Journal of the Asia Pacific Economy*, 12(2), 125-157.

Das S and Sahoo H (2011): An Investigation into Factors Affecting Child Undernutrition in Madhya Pradesh, *Anthropologist*, 13(3): 227-233

Deaton, A., & Dreze, J.(2009): Nutrition in India: facts and interpretation, *Economic and Political Weekly*, XLIV(7), 42-65.

FAO. (2008). *The State of Food Insecurity in the World 2008*. Food and Agriculture Organization, Rome.

Filmer, L., and L. Pritchett (1998): "Estimating wealth effects without expenditure data – or tears: with an application to educational enrollments in states of India", *World Bank Policy Research*, Working Paper no. 1994.

Ganapati, M.(2009): Progress on child malnutrition in India is minimal, *British Medical Journal*, 339(7723), 714-715.

Greene, W.(1995): *Econometric Analysis*, Second Ed., Macmillan Publishing Company, New York.

Gwatkin, DR., Rutstein S., Johnson K., Suliman E., Wagstaff A., Amouzou A.(2007): Socio-economic differences in health, nutrition and population within developing countries: An overview, *Country report on HNP and Poverty, World Bank.*

Haddad, L., H. Alderman, S. Appleton, L. Song, and Y. Yohannes (2003): "Reducing child malnutrition: how far does income growth take us?", *World Bank Economic Review*, Vol. 17, pp. 107-131.

Hong R., Banta JE., Betancourt JA.(2006): Relationship between household wealth inequality and chronic childhood under-nutrition in Bangladesh, *International Journal for Equity in Health*, 5(15)

Kabubo-Mariara, J., Ndenge, G.K. & Kirii, D.M. (2006). *Determinants of Children's Nutritional Status in Kenya*: Evidence from Demographic and Health Surveys. Paper Presented at the Centre for the Study of African Economies Conference, University of Oxford, March 17-21, 2006.

Kanjilal, B., Guha-Majumdar, P., Mukherjee, M., & Rahman, M.H.(2010): Nutritional status of children in India: household socio-economic condition as the contextual determinant, *International Journal for Equity in Health*, 9(19), 1-13. available at http://www.equityhealthj.com/content/9/1/19

Leibenstein, H. (1957): *Economic backwardness and economic growth: Studies in the theory of economic development*, New York: Wiley and Sons.

Lanjouw, P. and Ravallion, M. (1995) Poverty and household size. *The Economic Journal*, 1415-1434.

Mendelson, S. (2010): CINI Report. Titled 'Child malnutrition in India: Why does it persist?' available at http://www.im4change.org/siteadmin/tinymce//uploaded/CINI.pdf

National Family Health Survey (NFHS-3), 2005–06: India. *International Institute for Population Sciences (IIPS) and Macro International, 2007.*

Pal, S. (1999). An Analysis of Childhood Malnutrition in Rural India: Role of Gender, Income and Other Household Characteristics. *World Development*, 27, 1151-1171.

Pathak, PK., and Singh, A.(2011): Trends in malnutrition among children in India: Growing inequalities across different economic groups, *Social Science & Medicine*, 73, 576-585.

Pitt, M. & Rosenzweig, M. (1995). Estimating the Intra Household Incidence of Illness: Child Health and Gender Inequality in the Allocation of Time. *International Economic Review* 31, 1139-1156.

Radhakrishna R., Ravi C.(2004): Malnutrition in India, *Economic and Political Weekly*, 39(7), 671-676.

Raghupathy, S. (1996): "Education and the use of maternal health care in Thailand", *Social Science and Medicine*¸ Vol. 43 (4), pp. 459-471.

Rajaram, S., Zottarelli LK, Sunil TS.(2007): Individual, household, programme and community effects on childhood malnutrition in rural India, *Maternal and Child Nutrition*, 3, 129-140.

Rosenzweig, M., and T. Schultz (1982): "Child mortality and fertility in Colombia: individual and community effects", *Health Policy Education*, Vol. (2), pp. 305-348.

Smith, L.C. & Haddad, L. (1999). *Explaining Child Malnutrition in Developing Countries:* A Cross-Country Analysis. IFPRI FCND Discussion Paper No. 60, IFPRI, Washington, D.C. USA.

Sala-i-Martin, X. (2005): On the Health Poverty Trap: In G Lopez-Casanovaz et al, (Eds.), *Health and Economic Growth: Findings and Policy Implications*: 95-113; The MIT Press.

Som, S., Pal M., Bharati P.(2007): Role of individual and household level factors on Stunting: A Comparative Study of three Indian States, Annals of Human Biology, 34(6), 632-646.

Strauss, J. (1990): "Households, communities and preschool children's nutrition outcomes: Evidence from rural Cote d'Ivoire", *Economic Development and Cultural Change*, Vol. 36(2), pp. 231-262.

Strauss J. & Thomas, D. (1995). Human Resources: Empirical Modeling of Household and Family Decisions. In J. Behrman and T.N. Srinivasan, eds., *Handbook of Development Economics*, Vol. 3. Amsterdam; North-Holland.

Strauss, J., and D. Thomas (1998): "Health, Nutrition, and Economic Development", *Journal of Economic Literature*, Vol. XXXVI, pp. 766-817.

Subramanian, SV., Kawachi, I., and Smith, GD.(2007): Income inequality and double burden of under and over nutrition in India, *Journal of Epidemiology and Community Health*, 61, 802-809.

Svedberg, P.(2006): Declining child malnutrition: a reassessment, *International Journal of Epidemiology*, 35(5), 1336-1346.

Thomas, D., and E. Frankenberg (2002): "Health, nutrition and prosperity: a microeconomic perspective", *Bulletin of the World Health Organization*, 80(2), pp. 106-113.

Thomas, D., and J. Strauss (1992): "Prices, infrastructure, household characteristics and child height", *Journal of Development Economics*, Vol. 39 (2), pp. 301-331.

Thomas, D., J. Strauss, and M. Henriques (1991): "How Does Mother's Education Affect Child Height?", *The Journal of Human Resources*, Vol. 26(2), pp. 183-211.

Van de Poel, E., Hosseinpoor, A., Jehu-Appiah, C. & Speybroeck, N. (2008). Malnutrition and Socioeconomic Gap in Malnutrition in Ghana. *Mimeo*.

Vorster, H.H.(2010), 'The link between poverty and malnutrition: A South African perspective', *Health SA Gesondheid* 15(1), 6 pages. DOI: 10.4102/hsag.v15i1.435

Webb P. & Block, S. (2004). Nutritional Information and Formal Schooling as Inputs to Child Nutrition. *Economic Development and Cultural Change*, 55, 801-820. doi:10.1086/420901, http://dx.doi.org/10.1086/420901

World Bank (2008). World Health Report, *World Health Organization*. Monograph. World Bank.

World Health Organization. (1995). "Physical Status: The Use and Interpretation of Anthropometry. Report of a WHO Expert Committee." *World Health Organ Tech Rep Ser* 854: 1–452.

———. 2006. *WHO Child Growth Standards: Length/Height-for-Age, Weight-for-Age, Weight-for- Length, Weight-for-Height, and Body Mass Index-for-Age: Methods and Development.* Geneva, Switzerland: World Health Organization.