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ANALYSIS OF CHILD ANTHROPOMETRIC INDICATORS AND THEIR RESPECTIVE DETERMINANTS IN INDIA

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Abstract

With the MDG's set to expire this year (2015), the achievements in the progress of child health indicators in India has failed to distribute the fruits of the development evenly among the States and also within states; as in one State performing well in one indicator and not in another indicator. The main objective is to identify the predictors of child under nutrition and to analyze the differences in the impact of determinants across the three indicators and between States. With NFHS 3 data, the SUR technique is used to improve the efficiency of regression estimates as one hand errors in the measurement in individual height for age and weight for age and weight for height is likely to be correlated (contemporaneous correlation) and on the other hand other household level omitted variables for a child belonging to the same household could also be correlated. Breusch-Pagan LM Diagonal *Covariance Matrix Test* was used to check the appropriateness of SUR model. Different regressors are found to be significant for three indicators. The CDF plot indicates there is a clear convergence after the threshold point. The outcome of ICDS adoption varies across wealth groups where from the poorest to richest category, median is increasing as a step function. Since nutrition depends on various factors, the linkage of nutrition with sanitation policies, environment policies, agriculture related policies and infrastructure is extremely needed to address under-nutrition.

Keywords: Child under-nutrition stunting, underweight, wasting, seemingly unrelated regression, India

INTRODUCTION

Once child health is considered as an end in itself then any health outcome variable based on child health automatically becomes a significant component for economists and policy makers to assess the triumph or malfunction of the various policy interventions. Infants and young children are more susceptible to infections and providing a disease free environment both from a preventive and curative sense is a major public health priority for any nation. Child's height and weight or the nutritional status can be viewed as an outcome of the health production function (Becker, 1964 and Grossman, 1972) where the inputs include intake of nutrients and diet patterns (Bhagowalia, 2010; Smith *et al.*, 2012; Martorell & Young, 2011.) exposures to infections (Ramachandran & Gopalan, 2009), genetic dispositions (Currie & Moretti, 2007 and Ackerson *et. al*, 2009) and access to health care (Mosley & Chen, 1984).

Socio-economic inequalities in health outcomes are becoming the emerging area of research in health literature which ultimately affects the economic growth of the country. In spite of tremendous progress the gains and deprivations are unevenly distributed among the countries. In South Asia moderate and severe stunting is around 38% in 2012 and in Latin America it is around 11%. Some 6.6 million children under 5 years of age died in 2012, mostly from preventable causes (UNICEF, Every Child Counts, 2014). India continues to have high levels of malnutrition in some regions while in regions that have shown reductions in the past three to four decades have somewhat stagnated and slow changes are being observed (IFPRI, The Challenge of Hidden Hunger Report, 2014 and IPPR Report of Tackling Poverty, Hunger and Malnutrition, 2014).

Child undernutrition places a massive burden on the macro economy and also it is a pressing alarm being addressed by the government, and it is prominent to note according to the Summary report of Progress towards Meeting the MDG's, 2012, the child malnutrition target only has a small likelihood of being met in India, further increasing the severity of the situation. With the prevailing measures and methodologies, various research studies have estimated the

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most powerful indicators of child health such as *underweight, stunting and wasting,* which embraces the child level variables, household characteristics, parental (mother and father) characteristics and policy related variables. The methodologies for defining child health outcomes are new and still in development. Major approaches which have been used in the literature are factor analysis (Menon, et al., 2000); cluster analysis, and linear regression techniques, index methodologies (Radhakrishnan & Ravi, 2004; Svedberg, 2007, Kanjilal, *et al.*,2010); Concentration indices (Arokiasamy & Pradhan, 2011, Majumdar,2010), child under nutrition index, composite index, infant and feeding index (Menon *et. al,* 2000; Svedberg, 2007 Ghaiha *et. al,* 2012) and multilevel analysis (Subramanian *et. al,* 2009) .) However, there are very few studies in the empirical literature on child developmental outcomes that consider a unified approach which combines all the important indicators of child growth in particular or child health in general (Ghaiha *et. al*,2012 and Bhangura, 2014) It has been observed that different indicators of child health outcomes like mortality, morbidity or undernutrition as well as its different components like perinatal or neo-natal mortality; stunting or underweight respond to some common interventions but are also quite varied in its temporal changes across different geographical reasons (Viswanathan, 2014b). Such an uneven nature of progress has been rather pronounced for a country like India and evidence based policy making with a unified approach becomes an important tool of analysis for assessing the overall child growth pattern by considering the child's health as a composite indicator.

The objective of this study is to assess the nutritional outcomes of children in India using an empirical framework that not only gives scope for individual assessment but also considers child as a single unit. This is possible using the econometric technique of Seemingly Unrelated Regressions (SUR) by estimating a set of equations jointly, with each representing an anthropometric indicator. More importantly, the aim is also to focus on an important policy intervention viz, Integrated Child Development Services (ICDS) in India on these different indicators while also trying to understand (and control for) several other factors that are likely to influence child growth. The study hopes to provide further insights towards reduction in undernutrition among young children in India.

The next section discusses the data and methodology. Section 3 discusses the main findings of this study and the last section briefly concludes this studies.

DATA AND METHODOLOGY

The study uses the third wave of the National Family Health Survey for the year 2005-06 (IIPS, 2007). This is a nationally representative survey of households (104302) which has anthropometric data for the children(51,555) aged 0-59 months, where 19483(38%) are the urban household children and 32043(67%) are the rural household children and the most recent survey on child nutrition indicators that covers all the states of India with a wide range information on socio-economic aspects. In spite of a vast literature on child nutrition using this database, there are several issues of relevance that are open to as mentioned in the objective of this paper.

The SUR (Seemingly Unrelated Regression) model

This model proposed by Zellner (1962) is used for this study wherein a three-equation system with dependant variables such as HAZ (height for age), WAZ (weight for age) and WHZ (weight for height) for children is specified. The method allows for potentially different set of explanatory variables and hence enriches the analysis further. The z-score is adjusted for sex, age and measurement and how far or close the child is to the median value of the WHO reference standards (2006).[i]The model is represented as : $\boldsymbol{Y = X\beta + U}$

with

$$\begin{bmatrix} \boldsymbol{Y}_1 \\ \boldsymbol{Y}_2 \\ \boldsymbol{Y}_3 \end{bmatrix}_{3Cx1} = \begin{bmatrix} \boldsymbol{X}_1 & \boldsymbol{0} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{X}_2 & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{0} & \boldsymbol{X}_3 \end{bmatrix}_{3Cxk} \begin{bmatrix} \boldsymbol{\beta}_1 \\ \boldsymbol{\beta}_2 \\ \boldsymbol{\beta}_3 \end{bmatrix}_{kx1} + \begin{bmatrix} \boldsymbol{U}_1 \\ \boldsymbol{U}_2 \\ \boldsymbol{U}_3 \end{bmatrix}_{3Cx1}$$

$\mathbf{Y}_1$ is HAZ (height for age), $\mathbf{Y}_2$ is WAZ(weight for age), $\mathbf{Y}_3$ is WHZ(weight for height); $\mathbf{X_i}$ is the vector of child level, parental level and household level characteristics as well as policy relevant and regional variables for the i^{th} anthropometric indicator thus allowing for different set of explanatory variables (k_i) for the different equations. The vector $\boldsymbol{\beta_i}$ are the different coefficients to be estimated with k_1, k_2 and k_3 coefficients for the respective equation such that the total number of coefficients is $k= k_1+k_2 +k_3$. $\boldsymbol{U}$ is the vector of residuals $E(\mathbf{U})=\mathbf{0}$; $E(\boldsymbol{UU'})=\boldsymbol{\Omega}=\boldsymbol{\Sigma}\otimes\boldsymbol{I}$ with $\boldsymbol{\Sigma}=\sigma_{ij}$, where $\sigma_{ij}=E(\boldsymbol{U}_i\boldsymbol{U}_j')$, $i,j=1,2,3$. If c_l is the l^{th} child in the sample, then this correlation structure assumes that the errors are correlated across the indicators for each child but uncorrelated across different children where C the total number of children in the sample.

X is a vector which comprises of the explanatory variables. The model is distinct from OLS as the explanatory variables are not same for all the system of equations and the error terms will be correlated across equations and SUR model requires the sample to be same for each equation. The model was estimated with common set of child variables (child age, gender, birth size, birth order, vaccination, incidence of fever, cough, diarrhea and policy variables) in each of the indicators while parental and

household variables varied across the indicator equations. Along with a brief discussion about the nature of these variables, the next section discusses the findings of the model estimation,

RESULTS

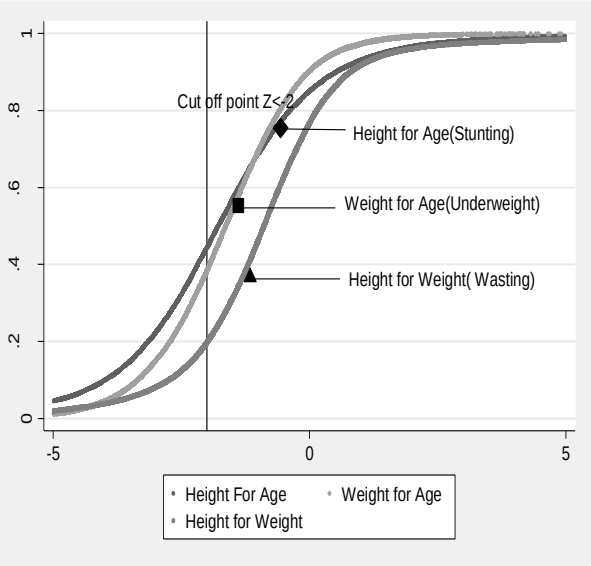

Figure 1: Cumulative Distribution Function (CDF) plots of z-scores for height for age, weight for age and weight for height (All- India)

Figure 1 shows the Cumulative Distribution Function (CDF) of the z-scores of height for age, weight for age and weight for height for children aged 0-5 years in India. As it is well known, if the z-score is below -2 (x-axis values) then the child is considered undernourished and the CDF gives the proportion of children (y-axis values) who are below a certain z-score value. As can be observed from the figure, the stunting rates are far higher than the underweight rates and wasting.

Table 1: Estimation Results of Seemingly Unrelated Regression Model

Dep Var: z-score of		Stunting	Underweight	Wasting
Child Characteristics				
Age		-0.0199***	-.0103***	-.0379***
Birth size: Very Large ref				
	Larger than avg	-.164**	-.162***	-0.331
	Average	-.188***	-.215***	-0.203
	Smaller than average	-.384***	-.483***	-0.195
	Very small	-.436***	-.617***	-0.539
Birth order: 1child ref				
	2 child	-.0987***	-.0889***	-0.18
	>3 child	-.145***	-.159***	-.358**
Any vaccination: No ref				
	Yes vaccinated at least two	-0.0272	-0.0264	-2.7***
	One vaccination	-.0881*	-0.0433	-1.92***
Fever: No ref				
	No	0.0388	.151***	.36*
Diarrhoea: No ref				
	No	.0934**	.0887***	.494**
Cough: No ref				
	No	-0.048	-.0889***	0.248
Mother Characteristics				
Quintiles of Mother height: Group 1 ref				
	Group 2	.254***	.196***	-0.0357
	Group 3	.416***	.314***	-0.018
	Group 4	.532***	.407***	0.0663
	Group 5	.738***	.571***	0.246
Mother BMI: <18.5 ref				
	18.5- 24.9	.164***	.299***	.319**
	25.0-29.9	.275***	.55***	.896***
	>30	.281***	.58***	0.572
Breastfeed: Never ref				
	<3moths	.405***	.215***	3.11***
	3-6 months	.301***	0.0517	-0.506
	>6 months	-0.11	-.0908*	-.765**

Dep Var: z-score of		*Stunting*	*Underweight*	*Wasting*
Mother Characteristics (Contd.)				
Age of mother at first birth: 11-14 years ref				
15-19		0.0788	0.0237	0.06
>19		.139*	0.0303	-0.00431
Mother Working: No ref				
Yes		-.0795***	-.0379*	0.134
Household Characteristics				
Wealth Status: Poorest Ref				
Poor		.131***	.105***	0.0727
Middle		.224***	.196***	0.0315
Richer		.323***	.29***	0.0491
Richest		.516***	.448***	0.318
Sanitation: open defecation ref				
Flush		.192***	.173***	
Pit		.144***	.0744*	
Others		0.033	.2***	
Quality of water: Untreated ref				
Treated Water		.897***		
Fuel: Dirty fuel ref				
Clean Fuel		.0945***	.0962***	
Constant		-1.96***	-1.85***	2.54***
Number of Obs.		40288	40288	40288
R-square		10	15	3
RMSE		1.955	1.319	8.719

legend: * p<.05; p**<.01; *** p<.001

A negative coefficient implies that the particular variable increases a child's risk for undernutrition and a positive coefficient suggests that the variable can improve a child's nutritional status since z-score is the deviation from the reference mean as a proportion of the reference standard deviation. For the categorical variables, wherever applicable, the worse off category was considered as the reference category so that if significant the dummy variables for the other better off categories would have a positive sign.

Child Characteristics: As age increases, stunting, underweight and wasting increases thereby indicating growth faltering (Rehman, et al., 2009; Shrimpton, et al., 2008; and Sullivan & Goulet, 2010). Both birth order and birth size are significant and the negative coefficient implies that as birth size decreases stunting and underweight are on the rise but the impact is more prominent on underweight as birth size proxies for birth weight which has a lot of missing observations in the data. Birth order primarily reflects the impact of reduced care and nutritional input given to later born children which could be due to limited resources among the economically weak households. Recently, studies have also shown that cultural practices could determine later born girls to be more undernourished than older girls due to son preference in the India (Jayachandran & Pande, 2014; Panigrahi & Das, 2014). The study also finds that children born later are more stunted and underweight and the gap is rather pronounced for birth order greater than two. Immunity to diseases preventable through vaccination has a pronounced effect on wasting, limited effect on stunting and no effect on underweight. Short-term morbidity like fever, diarrhea, and cough impact weight gain the most and is expected as weight is a short-term indicator of nutritional status. However, frequent incidence of diarrhea has an impact on stunting, corroborating the findings from earlier studies (Chambers & Von Medeazza, 2013).

Mother characteristics: Mother's characteristics capture the intergenerational transmission of anthropometric status (Balhotra & Rawlings, 2012) as well as the impact of feeding and care practices on child's growth (Menon, et.al, 2000).

Mother's nutritional and health status: Mother's height and BMI both have a strong effect on reducing stunting and underweight. If the mother had her first child during her teens then this affects HAZ alone indicating that longer-term nutrition of the child is more affected than other

indicators. Early child birth affects the overall nutritional status of the mother (Viswanathan, 2014a) thereby affecting the nutritional status of the children she gives birth to. If the mother lost a child (focusing on prenatal, neonatal or infant mortality) it will affect the nutritional status of the future offspring and this was also included to capture intergenerational transmission where it increases the risk of underweight.

Feeding and Care Practices: Breastfeeding has a stronger impact on HAZ than on WAZ/WHZ. WHO recommends the feeding of child solid foods should start when the child is 6 months old along with breastfeeding, the survey collected information about whether the mother gave liquid food, solid food such as non- veg, vegetables and other dairy products. Children who were supplemented with these at least two food groups which were grouped from animal protein, legumes, vitamin A rich foods and other dairy products from their six months along with breastfeeding are less malnourished than those who are not. Participation of the mother in the labour market increases the level of undernourishment of her child thereby showing that the income effect due to her earnings overshadows the quality of care that a mother may be able to provide due to her presence at home all through the day during early years of child growth, in the absence of formal or informal child-care options and the burden of child care falling primarily on the mother than on the father. Feeding and care practices will also be influenced by mother's education level. Undernourishment levels are lower for children whose mother has some education with higher secondary and above level of education having substantial impact. In the Indian context it is observed that women with no education or less education participate in the labour market than with middle or high levels of education (Josey, 2011). Consequently we see that labour market participation and employment show different kinds of impact. Once could also interact these two variables to see if the non-linearity shows up differently and will be attempted in a later study.

In Table 1 we observe that mother's nutritional status captured by her height and BMI levels has a strong impact on child's nutritional status capturing the impact of intergenerational transmissions. Breastfeeding has an impact on undernourishment but the effect is more significant for HAZ than for other indicators. If the mother is employed in the labour market then it lowers the child's nutritional status implying that this affects the time given for early child-care care perhaps in the absence of formal or informal child-care options and the burden of child care falling primarily on the mother than on the father. We also find that if the mother has not had early child birth or not lost a child early on, or if she feeds other food supplements focusing on dietary diversity, or if she is better educated then they have significant positive impact on the child's nutritional status. These results are not reported here for shortage of space. Most of often it is noted that height (HAZ) of the child or long-term nutritional status is impacted by these variables.

Household Characteristics: Economic status, socio-demographic variables like caste, religion and household size as well as access to basic amenities, like sanitation, safe drinking water and less polluting cooking fuels are all considered as household characteristics.

Economic status is captured through a categorical variable with five categories as the data set does not provide income or consumption expenditure. This categorical variable is constructed based on the possession (or not) of several consumer durable goods combined into a wealth index using Principal Component Analysis. The first principal component is then ranked in an increasing order and households with the bottom 20% values are considered as 'poorest', the next 20% values are 'poor; and so on with the top 20% values as the 'richest' household. Compared to children in the lowest economic strata, all the others have better HAZ and WAZ values while WHZ is not affected at all by economic status.

Among the social status variables caste has a significant impact as socially disadvantaged groups have been marginalized and discriminated historically even though economic status has been controlled for. Underweight is more likely among scheduled tribe children while stunting is more among Scheduled Caste children compared to the remaining social groups. Varied dietary habits, socio-cultural practices across different religious groups and discrimination against some religions could reflect in poorer nutritional status for their children compared to those from other religious groups (SCR, 20076). Our results do not show variations in growth patterns across religious groups. Sanitation in terms of open defecation, use of untreated drinking water by the household, use of fuels like wood, charcoal and cow-dung for cooking adversely affect the growth pattern of children. These variables influence the environmental conditions thereby creating disease-prone environment- the former two for illnesses like diarrhea and fever while the latter for respiratory illness. In most cases one observes the impact to be more on HAZ and WAZ than on WHZ.

With respect to demographic variables such as family size, place of living, the results shows that the rural children are in the risk of severe stunting so there is a remarkable difference between rural and urban areas. If the family size is more than 6 then the risk of undernutrition increases.

Since the incidence of diseases spreads through open defecation and usage of unsafe drinking water, fuel consumption it will affect the weight because of morbidity, so variables of *basic amenities* like quality of water,

sanitation(Deaton & Spears, 2013), dirty/clean fuel was added to the underweight and stunting equations and these variables are significant and those children who are using flush toilet and drinking treated safe water and less exposed to dirty fuel are at the lower risk of under nutrition. The gender of the household head implies the women headed families children are facing higher risk of malnutrition than the male headed families.

One of the main interests of this study is to assess the impact of a child development scheme in place in India for more than two decades though had a very varied presence across the country and has been made mandatory by judicial and legislative interventions more recently. Integrated Child Development Services (ICDS) is supposed to be made available to poorer regions and among poorer households and has been shown to perform better in the southern parts of the country. To incorporate this selection problem, usage of ICDS by the child is interacted with wealth status of its household and the coefficients shows expected positive sign for the poorest(0.638) and negative sign(-0.15) for the richest. Without interacting these two variables if one includes only use (or non-use) of ICDS, we find that the coefficients are negative indicating that those with lower nutritional status access ICDS. Figures 2a and 2b shows the inequality in HAZ by wealth groups for the Western and Southern regions of India respectively. These two regions have been selected because the Southern region performs well in terms of ICDS and Western region happens to be worse. And moreover, this comparison has been done only for stunting to highlight the fact that appropriate young child feeding practices even among the highest wealth quintile are extremely poor which badly affects physical growth (World Bank Report, Nutrition in India, 2014). The horizontal line in the middle indicates the median. Without ICDs, median HAZ differs across wealth groups being the lowest for the poorer households. With ICDs, median stunting increases as a step function in Western region. In southern region, even though the access is higher, there exists a problem in program implementation because it is actually not helping the poor as it intends to do so.

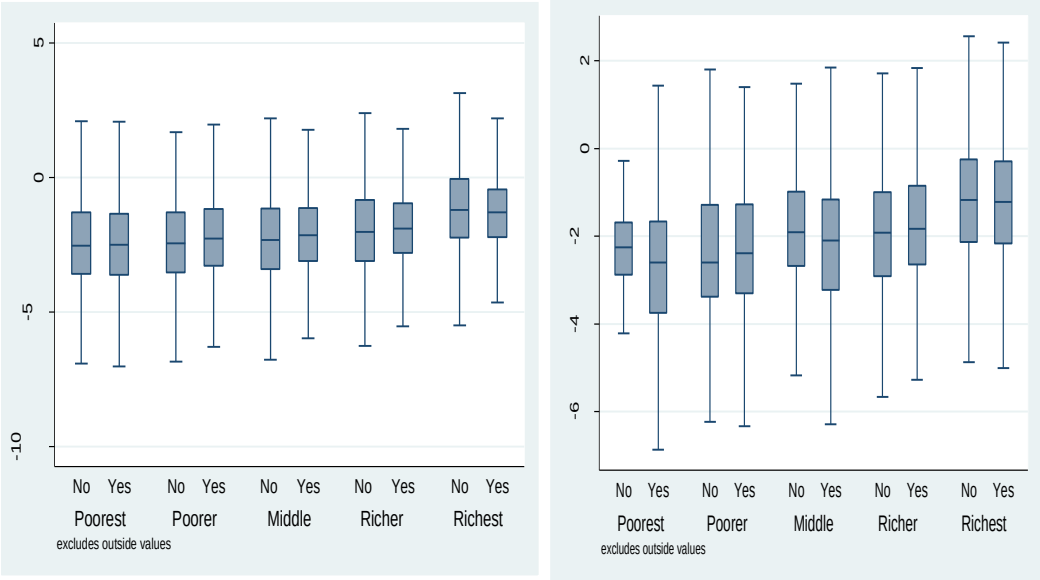

Figure 2: Impact of access to ICDS on HAZ in Western and Southern Region

CONCLUSION

This study examined the determinants of nutritional indicators with the help of SUR technique for children aged 5 and under in India. We find support for the fact that the joint estimation of these three indicators show that the factors affecting anthropometric status of children do vary. The fact that older children loose out more than younger ones, mothers who are undernourished and less educated and less empowered, poverty, poorer access to amenities like clean water, sanitation and less polluting cooking fuels show that there is a lot of scope for public health intervention. This has to come both in terms of investment in improving the quality of facilities provided as well as improving the access and usage of these facilities by creating awareness. A major limitation of this study is in the use of a decade old data in the absence of a representative national level data on nutrition and child growth. In the last decade India has shown tremendous improvements in its economic growth and this should have had a trickle-down effect. However, this growth has mainly come in the non-agricultural sector and how this uneven

growth would have impacted inequality in access to resources and amenities and hence child growth remains a matter of guess. If ICDS services are complemented with better water, sanitation and other environment policies, more lives of children can be saved and the impact of ICDS could have a long term effect.

REFERENCES

Arokiaswamy, P, Pradhan, J (2011). Measuring wealth-based health inequality among Indian children: the importance of equity vs efficiency, Journal of Health Policy and Planning, 26 429-440.

Bhagowalia, P, Chen, S, Masters, W (2010). The distribution of child's nutritional status across countries and over time, paper presented at American Agricultural Economics Association Meeting.

Bangura, S. (2014). Fighting Undernutrition and Child Mortality in Sierra Leone.African Journal of Food, Agriculture, Nutrition and Development, 13(5), 8187-8208.

Chambers, R. and G. Von Medeazza, (2013).Sanitation and Stunting: Undernutrition's Blind Spot, Economic and Political Weekly, June-22, Vol. xlviii(25), 15-18.

Currie, J Moretti, E (2007). Biology as Destiny? Short and long run determinations of intergenerational transmission of birth weight, Journal of Labor economics, vol 25, No. 2, pp.231-264.

Deaton, A et.all (2013). Stunting among children facts and implications, Economic and Political Weekly, 48(34).

Gaiha, R, et.all (2010). Child Under nutrition in India, ASARC working paper.

Jayachandran, S, Pande, R(2013) Choice not genes, probable cause for the India- Africa child height gap, Journal of Economic and Political Weekly, 48(34)

Josey, A.M. (2011), Women's Workforce Participation and Hours of Labour Supplied: Social, Economic and Regional Aspects, Unpublished Master's Thesis, Madras School of Economics, Chennai.

Kanjilal, B., Mazumdar, P. G., Mukherjee, M., & Rahman, M. H. (2010). Nutritional status of children in India: household socio-economic condition as the contextual determinant. Int J Equity Health, 9(1), 19.

Martorell, R., & Young, M. F. (2012). Patterns of stunting and wasting: potential explanatory factors. Advances in Nutrition: An International Review Journal,3(2), 227-233.

Mosley, W. H., & Chen, L. C. (1984). An analytical framework for the study of child survival in developing countries. Population and development review, 25-45.

Nandy, S., & Svedberg, P. (2012). The Composite Index of Anthropometric Failure (CIAF): an alternative indicator for malnutrition in young children. In Handbook of Anthropometry (pp. 127-137). Springer New York.

Panigrahi, A., & Das, S. C. (2014). Undernutrition and Its Correlates among Children of 3–9 Years of Age Residing in Slum Areas of Bhubaneswar, India.The Scientific World Journal, 2014.

Ramachandran, P., & Gopalan, H. S. (2009). Undernutrition & risk of infections in preschool children. Indian J Med Res, 130(5), 579-83.

Radhakrishna, R., & Ravi, C. (2004). Malnutrition in India: Trends and determinants. Economic and Political Weekly, 671-676.

Rehman, A. M., Gladstone, B. P., Verghese, V. P., Muliyil, J., Jaffar, S., & Kang, G. (2009). Chronic growth faltering amongst a birth cohort of Indian children begins prior to weaning and is highly prevalent at three years of age.Nutr J, 8, 44.

Ruel, M. T., & Menon, P. (2002). Child feeding practices are associated with child nutritional status in Latin America: innovative uses of the demographic and health surveys. The Journal of nutrition, 132(6), 1180-1187.

Sachar Committee Report (2006).Social, Economic and Educational Status of the Muslim Community of India, Prime Minister's High Level Committee, Cabinet Secretariat, Government of India.

State of World Children report (2014). Every Child counts, revealing disparities and advancing children's rights, UNICEF

Subramanian S, Ackerson L, Dravey Smith G, John N (2009). Association of maternal height with child mortality anthropometric failure , and anemia in India JAMA vol.301, No.16, pp 1691-1701.

Sullivan, P. B., & Goulet, O. (2010). Growth faltering: how to catch up and quest. European journal of clinical nutrition, 64, S1-S1.

Viswanathan, B. (2014a). Variations in Women's Heights across Social and Religious Groups among Indian States, Social Indicators Research, Vol. 119 (2), Page 1149-69 DOI 10.1007/s11205-013-0531-4.

Viswanathan, B. (2014b). Prevalence of Undernutrition and Evidence on Interventions:

Challenges for India, Research Monograph No.49/2014, Madras School of Economics, Chennai

Von Grebmer, K., Saltzman, A., Birol, E., Wiesman, D., Prasai, N., Yin, S & Sonntag, A. (2014). Synopsis: 2014 Global Hunger Index: The challenge of hidden hunger (Vol. 83). Intl Food Policy Res Inst.

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[i] Z-score is commonly used to define stunting, underweight and wasting rates as per WHO standards. A child is said to be moderately stunted or wasted or underweight if the z - score value is less than -2 or below and severely stunted if the z- score value is less than -3 or below.