Journal of Science and Technology, 6(1 & 2): 125-136, December 2016

A META-ANALYSIS OF GENDER AND SOCIO ECONOMIC FACTORS ASSOCIATED WITH STUNTING IN PRE-SCHOOL CHILDREN

AFRINA AKTER MISHU[1*], MOHAMMAD AHSAN UDDIN[2], DHANESWAR CHANDRO SARKAR[3] and MD. BELAL HOSSAIN[2]

[1]Department of Statistics, Commilla University, Commilla, Bangladesh; [2]Department of Statistics, Biostatistics and Informatics, University of Dhaka, Bangladesh; [3]Department of Statistics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh.

Abstract

Stunting is one of the three major indices of measuring malnutrition of a child. It is one of the most prime problems of the world's public health and more serious case of developing countries. A general objective of this study is to identify the factors that are responsible for stunting among children of the developing countries. The main objective of the study is to explore the potential socio-economic factors that affect child's growth utilizing the most recent MEASURE Demographic and Health Survey (DHS) data from 18 different countries. Eight influencing socio-economic factors related to stunting are chosen, namely gender, residence, mother's education, water and sanitation facilities on households, number of child on household, wealth index and vaccination. The study shows that 48.15% children ages between 0-59 months, are stunted in South & South East Asia, 22.35% in Latin America & Caribbean and 39.11% in Sub-Saharan Africa. All the variables considered showed highly significant association to stunting prevalence. It is found that male children are more vulnerable to stunting than their female counterparts (OR=1.10, CI 1.05-1.16, p<.0001). As urban children have access to better health care facilities and services than rural children, children from urban places are less stunted (OR=1.71, CI 1.47-1.99, p<.0001). Most important factor found in the study is mother's education which has great influence on children's proper growth status. Children of uneducated mothers are more than two times likely to be stunted than educated mothers' (OR=2.05, CI 1.75-2.41, p<.0001). Water and sanitation facilities have direct influence on stunting of pre-school children. Children from poor families are more stunted than the rich families (OR=1.99, CI 1.69-2.34, p<.0001). This study also reveals that child of a household having more than three children is more at risk to be stunted than those families having less than three children (OR=1.20, CI 1.06-1.37, p<.0001). Vaccination is found to be insignificantly associated with stunting (OR=1.10, CI .96-1.27, p=.13).

Keywords: Stunting, socio-economic factors, odds ratio, meta-analysis

---

[*] Corresponding author: bjoardar2003@yahoo.com

Introduction

Stunted growth or low height-for-age, commonly known as stunting is a reduced growth rate in human development. It is a primary manifestation of malnutrition in early childhood, including malnutrition during fetal development brought on by the malnourished mother. It is one of the most important issues in developing countries. It is a useful anthropometric measure for children in terms of its positive correlation with social and economic deprivation. Stunting is now acknowledged as the best proxy measure for child health inequalities (Pradhan *et al.* 2003). This is because stunting captures the multiple dimensions of children's health, development and the environment where they live. Stunting is attributable to a wide range of factors (Cheung *et al.* 2007) including low birth weight (Kulmala *et al.* 2009), inadequate care and stimulation (Gin *et al.* 1998), insufficient nutrition and recurrent infections, and other environmental determinants.

Stunting is conveniently used because empirical evidence suggests that the distribution of healthy children's height is not affected by ethnicity and race for the first five years of life (Habicht *et al.* 1974). Any variation between populations or ethnic groups below five years of age is due to varying degree of the growth faltering caused by factors other than genetic predisposition. A number of previous studies have already shown that different socio-economic factors, such as gender, household wealth, mother’s education, sanitation, water sources, immunization etc have positive effects on stunting. Gender has become an important factor for stunted children. Stunting is found to be higher among male child compared to female child. Type of residence may have significant impact on stunting (Fotso 2007 and Shannon *et al.* 2013). Over the developing countries it is found that mother’s education is more influential than father’s education. Mother’s education is inversely related to malnutrition (Wamani *et al.* 2004).

This study, used data sets of 18 Demographic Health Survey (DHS) derived from three regions. The aim was to use meta-analysis and to draw overall effects of stunting over the developing countries. It combined data sets on developing countries from three different regions, and tried to figure out the overall picture of stunting and then compare and contrast among these three regional results of stunting or height-for-age, a proxy for long-run malnutrition. The specific objectives explored in the study are to find the significant evidence of the key role of the factors, namely gender, residence, mother’s education, water facilities, sanitation facilities, number of child on household, wealth index and vaccination for stunting. We also obtain the pooled effects using fixed effects and random effects model in meta–analysis.

Materials and Methods

The 2011 Demographic and Health Survey program provides data on child anthropometric status and household level information on gender, type of residence, education of mother, water and sanitation facilities on households, number of child on households, wealth index and vaccination for about 60 low-and middle-income countries. Population sampling frames are used for data collection, which makes the data sets nationally representative. In most countries, 15000 to 25000 children below age of 60 months are assessed for their growth status using anthropometric measures. These data sets are in the public domain and are available from the MACRO international web-site [http://www.measuredhs.com/start.cfm]. We obtain data sets across South & South-East Asia, Latin America & Caribbean and Sub-Saharan Africa fulfilling the following criteria: containing information on height-for-age measurements; English-speaking country, for ease of review of DHS reports; country with experience of more than one DHS study; and recent surveys (conducted between 2006 and 2012). A total of 18 countries were included from three subcontinent including Bangladesh, Bolivia, Cameroon, Colombia, Cambodia, Ethiopia, Ghana, Guyana, Haiti, India, Kenya, Malawi, Mozambique, Namibia, Nepal, Nigeria, Peru and Uganda.

Creation of Socio-economic indices: Eight variables from DHS data sets related to socio-economic status of household were selected for the study. Among them three variables were considered as main factors, which were gender, mother's education and wealth index. Five more variables, type of residence, water facilities, sanitation facilities, number of child on households and vaccination were considered as auxiliary factors. In the DHS data sets, data are available on the following domains of household wealth: characteristics of the dwelling (floor, walls, and roof material), availability of electricity, water and sanitation services, ownership of household durable goods, and parental education. Other domains that one might expect such as income or occupation are not contained in the DHS data sets. Statistical analyses were performed with SPSS 20 and R-2.14.1. The child recode file from DHS data sets were used for analytical purpose as the data sets has one record for every child of eligible women, born in the last five years. Anthropometric data were missing on approximately 25% of children. This was because children whose months and year of birth were not known for certain reason or parents who refused to have their children measured were excluded from anthropometric analysis in the DHS data sets. Children with incomplete data on stunting plus the flagged cases were therefore excluded from our analysis. Pearson Chi-square test were performed for the significance of associations. Odds ratios were used to compare the outcomes between the exposed and unexposed group. Both fixed and random effects models were used to combine the effects measures. The test of homogeneity between studies was conducted and the Cochran's statistic was also reported. The level of statistical significance for all analyses was set up at $p < 0.05$ with two tailed comparison.

Results and Discussion

Among the studies, the highest stunting frequency was found in Ghana 2011 (71.2%) and the lowest was in Colombia 2010 (15.6 %). Stunting frequencies were above 40%-50% in eight studies (Bangladesh 2011,India 2006, Nepal 2011, Cambodia 2010, Ethiopia 2011, Mozambique 2011, Malawi 2012, Nigeria 2010) (Fig. 1).

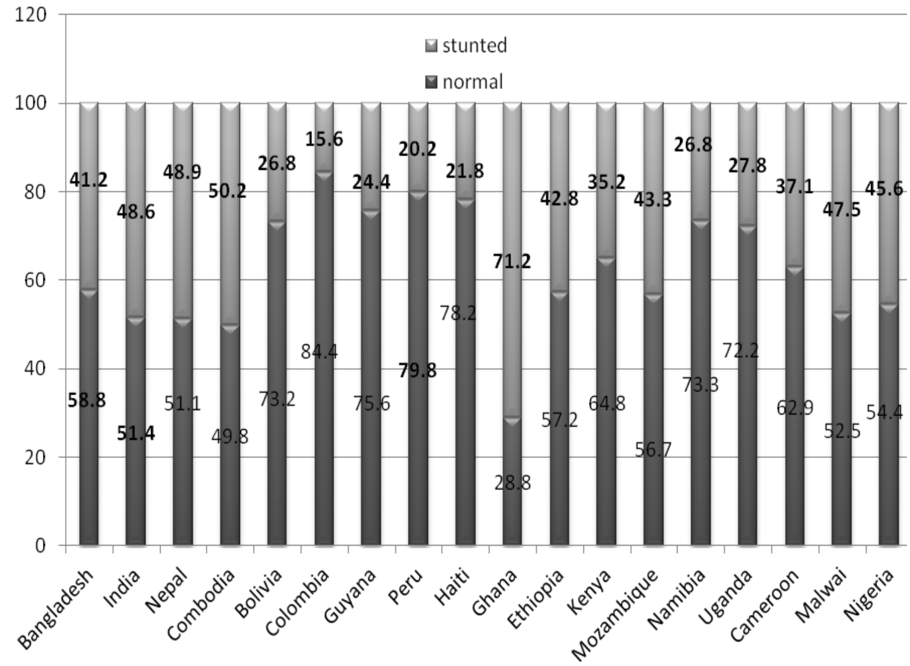


Fig. 1. Bar Chart for the Distribution of stunting in eighteen countries

The evolutions of the interaction using Pearson χ^2 between stunting and socio-economic factors (Gender, Mother's education and Wealth index) were significant for most of the individual studies except for Guyana 2000, and, Ghana 2000 in all cases, for Haiti 2000 and Kenya 2000 in case of Gender (Table 1). Among the male children the highest prevalence of stunting was observed for Ghana 2011 (70.6 %), but in otherwise below 30% were in Bolivia 2008 (28%), Colombia 2010 (15.7%), Guyana 2009 (29.2%), Peru 2012 (21.5%), Haiti 2012 (23 %). Among uneducated mother the highest prevalence of stunting was observed again for Ghana 2011 (70 %), and in otherwise below 30% were in Colombia 2010 (22.8%), Guyana 2009 (27.1%) and Uganda 2011 (28.1%) and above 50% were in three studies India 2006 (55.1%), Nepal 2011 (53.7%), Cambodia 2010 (53.5%). Again among the children belong to poor families, the highest prevalence of stunting was observed for Ghana 2011 (68.4 %), but in otherwise below 30% were in Colombia 2010 (20.2%), Guyana 2009 (27.6%) and Haiti 2012 (27.9%) and above 50% in four studies Bangladesh 2011 (51.5), India 2006 (57.7%), Nepal 2011 (57.9%), Cambodia 2010 (57.4%) (Table 2).

Table 1. Pearson χ^2 test for stunting and socio-economic factors (Gender, Mother's education and Wealth index) for each country along with p-value

Country (year of study)	x^2 for Stunting & Gender	p-value	x^2 for Stunting & mother's education	p-value	x^2 for Stunting & wealth index	p-value
Bangladesh 2011	4.91	.027	45.31	.001	72.20	.001
India (2006)	6.54	.043	66.30	.001	69.79	.001
Nepal (2011)	28.1	.011	34.41	.001	62.75	.001
Cambodia (2010)	4.10	.022	21.73	.001	29.24	.001
Bolivia (2008)	5.26	.022	86.20	.001	45.15	.001
Colombia 2010	31.2	.001	50.73	.001	59.01	.001
Guyana (2009)	0.94**	.331**	0.29**	.585**	3.38*	.066*
Peru (2012)	8.50	.004	20.90	.001	38.39	.001
Haiti (2012)	0.51**	.473**	16.16	.001	6.64	.010
Ghana (2011)	0.08**	.784**	0.58**	.443**	2.93*	.087*
Ethiopia (2011)	25.05	.003	28.36	.001	47.32	.001
Kenya (2010)	3.23*	.072*	18.44	.001	14.43	.001
Mozambique 2011	15.38	.005	29.12	.001	33.22	.001
Namibia (2009)	5.26	.022	86.20	.001	45.15	.001
Uganda (2011)	4.94	.026	9.60	.006	3.93	.048
Cameroon(2011)	8.95	.003	51.62	.001	77.13	.001
Malawi (2012)	8.05	.007	17.10	.008	10.98	.001
Nigeria(2010)	28.38	.001	35.97	.001	27.47	.001

**= insignificant at 5% level of significance, *= insignificant at 5% level of significance but significant at 10% level of significance.

Table 2. Prevalence of stunting for socio-economic factors in each country (in percentage)

Socio-economic factors	**Bangladesh (11)**	**India (2006)**	**Nepal (2011)**	**Cambodia (2010)**	**Bolivia (2008)**	**Colombia (2010)**	**Guyana (2009)**	**Peru (2012)**	**Haiti (2012)**
Gender									
Male	39.9	48.9	49.4	49.2	28.0	15.7	29.2	21.5	23.0
Female	44.4	48.4	48.2	51.1	25.6	15.4	21.5	18.8	20.6
Mother's Education									
Uneducated	48.1	55.1	53.7	53.5	35.3	22.8	27.1	34.6	34.6
Educated	34.4	37.1	37.8	35.5	14.8	11.9	22.8	12.3	18.1
Wealth index									
Poor	51.5	57.7	57.9	57.4	37.8	20.2	27.6	30.2	27.9
Rich	34.2	41.6	37.6	41.7	16.1	8.9	9.1	8.5	18.6
	Ethiopia (2011)	Ghana (2011)	Kenya (2010)	Mozambique (2011)	Namibia (2009)	Uganda (2011)	Cameroon (2011)	Malawi (2012)	Nigeria (2010)
Gender									
Male	43.9	70.6	37.4	44.7	39.3	49.6	40.7	48.9	47.9
Female	41.6	71.7	32.9	41.9	20.2	26.0	33.8	46.2	43.3
Mother's education									
Uneducated	43.5	70.0	38.1	45.4	37.1	28.1	42.3	48.3	49.7
Educated	22.6	73.4	25.3	24.7	21.4	27.6	23.5	42.1	30.2
Wealth index									
Poor	47.2	68.4	40.2	49.8	43.5	35.6	47.0	53.1	52.1
Rich	37.1	35.7	30.7	36.5	32.2	26.3	26.6	42.9	37.6

The average prevalence of stunting was higher in male than in female in all the studies. The corresponding odds ratios (OR) for the prevalence of stunting among males compared to females were statistically significant in 15 of the 18 studies (Figure 2). In the pooled analysis of stunting among males remained significantly greater than for females (p<.002), OR 1.10 and 95 % confidence interval (CI) 1.05-1.16. Odds ratios (OR) for the prevalence of stunting among rural children were significantly higher than for urban children (p<.001), OR 1.71 and CI 1.47-1.99. The prevalence of stunting among uneducated mother is significantly greater than for educated mother (p<.001), OR 2.05, CI 1.75-2.41. Stunting prevalence is also significantly greater among poor families than among rich families (p<.007), OR 1.99, CI 1.69-2.34. Water facilities, sanitation facilities and no. of child on households were also considered as separate variable as some studies found direct relations between stunting and these interventions. Significant results were also found in this study. Higher prevalence for stunting among the children using unsafe water facilities were found than among the children using safe water facilities (p<.001) OR 1.52, CI 1.38-1.67. Stunting was also higher among the children using poor sanitation facilities and the children whose families have more than three children in the house (p<.0001, P<.005), OR 1.81 and 1.20, CI 1.45-2.26 and 1.06-1.37 respectively. Vaccination was also considered as an intervention for the prevalence of stunting, but no significant result was found (p=.17), OR=1.10, CI .96-1.27 (Table 3).

Table 3. Random effects models for combining the outcomes of effects measures

Factors	Exposed group	Unexposed Group	OR	CI
Gender	Male	Female	1.10 (p <.002)	[1.05; 1.16]
Residence	Rural	Urban	1.71 (p <.0001)	[1.47; 1.99]
Mother’s education	Uneducated	Educated	2.05 (p <.0001)	[1.76; 2.41]
Water facilities	Unsafe facilities	Safe facilities	1.52 (p <.0001)	[1.38; 1.67]
Sanitation	Poor	Good	1.81 (p <.0001)	[1.45; 2.26]
No of child	>= 3	< 3	1.20 (p <.005)	[1.06; 1.37]
Wealth Index	Poor	Rich	1.99 (p <.007)	[1.69; 2.34]
Vaccination	Non vaccine	Vaccine	1.10* (p =0 .17)	[0.96; 1.27]

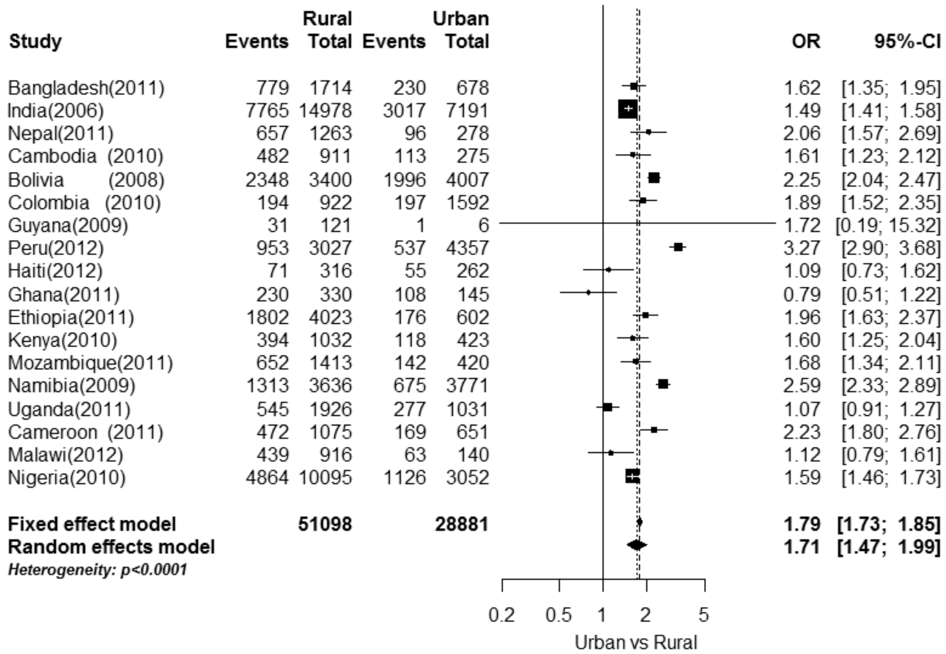
*= insignificant at 5% level of significance

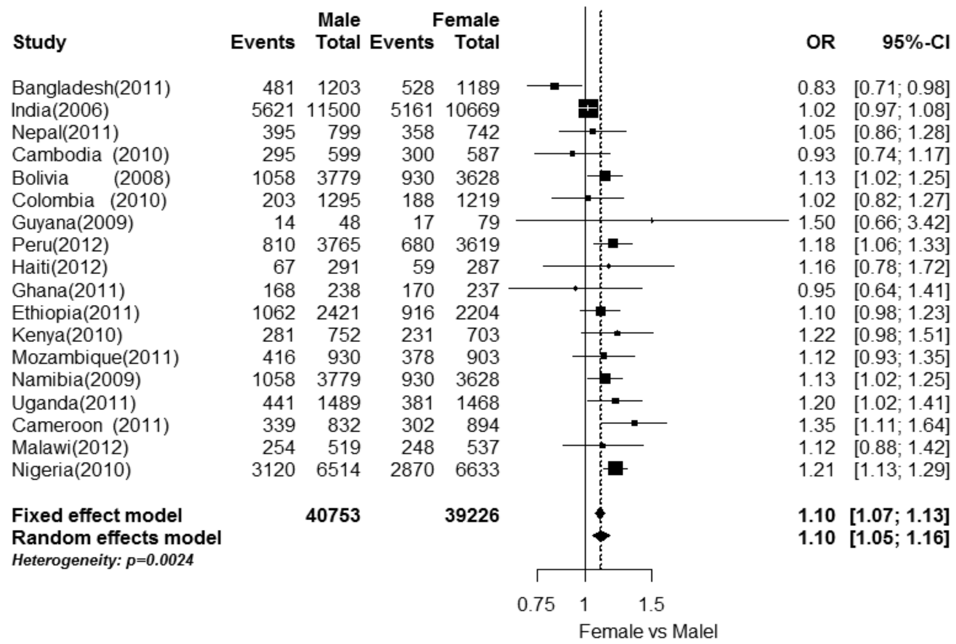
The test of homogeneity for different studies were significant for all the studies as the studies were taken from different region and different years, implying that random effects and fixed effects model are distinguishable. Here results from random effects models were considered as it is more precise in presence of heterogeneity. However, both fixed effects and random effects model were displayed in forest plot for comparison purpose (Figure 2). This systematic analysis of nationally representative data sets included 18 countries from three different regions with a total of 64,000 children. This study examined how socio-economic indicators namely Gender, mothers' education, residence, household asset index, water and sanitation facilities, number of child in household relate with inequalities in child health and nutrition using growth stunting as the proxy for the inequalities.

In meta-analysis, two main assumptions could be employed in interpreting the effect size or the systematic difference in stunting between sexes. First, studies were drawn from a common population, and therefore share a common effect size (fixed effects model). Second, studies were drawn from populations that differ from each other in ways that could impact on effect sizes (random effects model) (Cochran 1954). In the former scenario, effect size varies from one study to the next due to random error inherent in each study. In the latter scenario it varies due to both random error and true variation in effect size from one study to the next. If studies are homogeneous (significant p-value implies no homogeneity), it implies that fixed effects and random effects models are similar and not statistically different. This further implies that similar studies done in similar set-ups would yield statistically similar results with any study-to-study dispersion attributable to random error. Turning to our findings the studies were heterogeneous ($p<.0001$), thus random effects models were used to find out the results.

Findings showed that male children were more stunted than their female counterparts over the eighteen countries, but most of them in Sub-Saharan Africa (Wamani *et al.* 2007). In an extensive analysis of gender bias in under nutrition in sub- Saharan Africa, Svedberg proposed that the slight anthropometric advantage shown by girls, women, or both in many countries may suggest a historical pattern of preferential treatment of females due to the high value placed on women's agricultural labor (Svedberg 1990). But studies in Asian region showed different pictures than this. In South & South-East Asia the prevalence of stunting is higher among female children than among male children (Khatun *et al.* 2004). This might be because of inheritance of family wealth by male children, female children are ill-treated in their families. According to the study the stunting status of children is significant between rural and urban areas. This finding is consistent. Some possible causes according to this study are lack of economic, socio-cultural, healthcare and intuitional facilities in rural areas (Hien and Kam 2008). Like in Vietnam, rural areas of low and middle income countries in Asia, Latin America and Sub-Saharan Africa also suffer from limited infrastructure and facilities in terms of modern healthcare services, sanitation, education, electricity and economic facilities. Particularly health services are concentrated in urban areas than rural areas. On the other hand mothers' education was a robust predictor for inequalities of child health and nutrition. Our study finds a significant positive relationship between mother’s education and child growth rate. This result is consistent with many other studies (Frongillo *et al.* 1997 and Ojiako *et al.* 2009). Such a relationship could exist because maternal schooling is strongly associated with good child care and good health. Women with higher as compared to lower educational or no education level are more likely to raise their family income, which helps the families to provide more quality diets and better healthcare to their children. Additionally, educated mothers can efficiently use limited household resources and available healthcare facilities, limit their family size, maintain better health promoting behaviors and provide healthcare to their children (Frost *et al.* 2005). All these factors inversely contribute to the child stunting prevalence.

In all eighteen countries it was found that those children from poor households are more likely to be stunted than children from rich households. The combined effects also showed the same results in this study. This can be attributed to the fact that rich families have more ability to allocate necessary resources for their children than poor families. Understandably allocation of more resources to their children improves their health conditions by reducing multiple health risks. As one moves up the income ladder, a remarkable drop in the rate of stunting is observed. Improved household income levels are associated with a dramatic drop in the probability of stunting of children. Our finding reveals a strong positive association between number of children under age five in the households and stunting status. These results were consistent with the findings of other study. Generally families with more children experience more economic strain for food consumption and hence they are more likely to suffer from poor nutritional status. In other words, inadequate allocation of household resources among many children may lead to the low height for age. Particularly poor families cannot fulfill the nutritional requirements of the children. Families with more children generally devote less time to take care of their children (Hien and kam 2008).





In Figure 2: Forest plot of 18 studies indicating the excess of stunting prevalence in (i) Rural compared to Urban (ii) Male compared to Female. In the forest plot, squares indicate the estimated treatment effects with the size of the squares representing the weight attributed to each study. The pooled estimated OR is obtained by combining all the ORs of the studies using the inverse variance weighted method, represented by the diamond and the width of the diamond depicts the 95% confidence interval.

In our study factors namely source of drinking water and type of toilet also show significant association with stunting prevalence. Similar results are reported by (Pongou *et al.* 2006). These are plausible because access to safe drinking water and hygienic toilet are the pre-conditions for maintaining good hygiene and nutrition among children.

The incidence of various water-borne illnesses can be reduced with the improved supply of drinking water. Therefore increasing access to the safe drinking water and hygienic sanitation are important to improve the nutritional status among under-five children. The effect of water and sanitation on height was independent of the effect of diarrheal prevalence. One interpretation of these data is that some of the effect of water and sanitation might have been confounded by socioeconomics. In our analysis, however, neither household income per head nor maternal education confounded the effects of water and sanitation on height. An alternative interpretation is that inadequate water and sanitation is a source of asymptomatic gastrointestinal infections, which are known to affect adversely nutrient absorption and linear growth.

The study considered vaccination as an intervention to see the link between low height for age and immunization (Bloom *et al* 2011). But no significant results were found in the data sets being used. That is, according to the study there is no direct relation of stunting inequalities with vaccination. Childhood vaccination has previously been linked to reduced morbidity and reductions in stunting and wasting in young children. That result suggests that childhood vaccination has positive health effects that persist and are demonstrated in young teenagers in the form of increased cognitive ability.

This study has several strengths. The use of nationally representative data is one of the important strengths. Our findings could be reliable because of the large sample. However, this study is not free from limitation. Firstly, all inherent limitations associated with the cross-sectional data are also true here. Another limitation of the study is that the study did not include regional and cultural variables, which are also reported as significant predictors. Sex of the children is also not included in the model. Finally some socioeconomic variables are strongly correlated with each other (e.g. wealth index and education), which may produce biased estimates. Exclusion of important predictors due to non-availability may also alter our findings. On average 25% of data on stunting was missing in all the studies. Another possibility is misclassification of SES in some surveys leading to a dilution of the associations. Theoretically, there could be other sources of bias in the study. First, systematic errors with the measure could lead to the observed systematic sex differences. The NCHS/ WHO growth reference (Wamani *et al*. 2007) has separate references for males and females, thus observed sex difference might be related in some way to the reference itself.

Our study demonstrates that the random effects model is an appropriate model to identify and combine predictors affecting the stunting status of children in developing countries. Gender, residence, mother's education, wealth index, source of drinking water of the household, toilet facility, and total number of children in a household are significantly associated with child malnutrition in the regions (South & South-East Asia, Latin America & Caribbean). Various strategies are reported by many studies. This study revealed that in 18 countries male children below five years of age are more likely to become stunted than their female counterparts. Researches for biological explanation as to why male children should be worse off compared to female children are needed. Better healthcare facilities for rural children can better scenario of stunting conditions. Increasing educational facilities for mothers can improve the child nutrition. Facilitating access to safe drinking water and sanitation for poor families is also necessary to improve the child nutrition. Since higher fertility (i.e. number of children ever born to a woman) has a negative impact on child nutrition, government should implement policies to limit family size by increasing birth space. Comprehensive and concerted nutritional interventions such as exclusive breastfeeding, complementary feeding, supplementation of micronutrients to children and mother, hygiene interventions, and management of severe malnutrition are also needed to improve child nutrition. Other strategies such as public transportation to carry food and relief programmes for the disadvantaged groups are important to reduce child malnutrition. Addressing inequity and general deprivation and implementation of other health programmes are also necessary to reduce malnutrition among children. We should keep in mind that adequate nutrition of children is a prerequisite to build a healthy and productive nation. The study also indirectly reaffirms that stunting, a proxy for child health inequalities, is as well a proxy for socio-economic inequalities. Even though the study advances knowledge on the understanding of early childhood health inequalities, it raises interesting issues that mandate further research.

References

Bloom, D.E., Canning, D. and E. Seiguer, (2011). The effect of vaccination on children's physical and cognitive development in the philippines. *PGDA Working Paper No.* 69.

Checkley, W., Gilman, R.H., Black R.E., Epstein L.D., Cabrera L., Sterling C.R. and Moulton L.H., (2004). Effect of water and sanitation on childhood health in a poor Peruvian peri-urban community**.** *Lancet*; **363**: 112-18

Cochran, W.G., (1954). The combination of estimates from different experiments. *Biometrics* **10**: 101-29.

Cheung, Y.B., Grantham-McGregor, S., Cueto, S., Glewwe, P., Richter, L., and Strupp, B., (2007). Developmental potential in the first 5 years for children in developing countries.

Espo, M., Kulmala, T, Maleta, K, Cullinan, T, Salin. M.L., and Ashorn, P., (2009). Determinents of linear growth and predictors of severe stunting during infancy in rural Malwai. *Acta paediatr*, **91**: 1364-1370.

Filmer, D and Pritchett, L. (2001). Estimating wealth effects without expenditure --or tears: an application to educational enrollments in states of India. *Demography*, **38*:*** 115-132.

Fotso, J-C., (2007). Urban–rural differentials in child malnutrition: trends and socioeconomic correlates in sub-Saharan Africa. *Health Place*, **13**: 205-223.

Frongillo, E.A., De, O.M. and Hanson, K.M.P., (1997). Socioeconomic and demographic factors are associated with worldwide patterns of stunting and wasting of children. *J. Nutr*, **127(12)**: 2302-2309.

Frost, M.B., Forste, R., Haas, D.W., (2005). Maternal education and child nutritional status in Bolivia: finding the links. *Soc Sci Med*, **60(2)**: 395-407.

Gin, F.B., Frongillo, E.A., and Delisle, H.L.N., (1998). Caregiver Behaviors and Resources Influence Child Height-for-Age in Rural Chad. *The journal of nutrition.*

Habicht, J.P., Martorell, R., Yarbrough, C., Malina, R.M., and Klein, R., (1974). Height and weight standards for preschool children: how relevant are ethnic differences in growth potential? *Lancet*, **1**: 611-614.

Hien, N.N. and Kam, S., (2008). Nutritional status and the characteristics related to malnutrition in children under five years of age in Nghean, Vietnam. *J. Prev. Med. Publ. Health.*, **41(4)**: 232-240.

Khatun, M., Stenlund, H. and Hornell, A., (2004). BRAC initiative towards promoting gender and social equity in health: a longitudinal study of child growth in Matlab, Bangladesh. *Public Health Nutrition*, **7(8)**: 1071-1079.

Ojiako, I.A., Manyong, V.M. and Ikpi, A.E., (2009). Determinants of nutritional status of preschool children from rural households in Kaduna and Kano states, Nigeria. *Pakistan J. Nutr*, **8(9)**: 1497-1505.

Pradhan, M., Sahn, D.E. and Younger, S.D., (2003). Decomposing world health inequality. *Journal of Health Economics,* **22**: 271-293.

Pongou, R, Ezzati, M and Salomon, J.A., (2006). Household and community socioeconomic and environmental determinants of child nutritional status in Cameroon. *BMC Publ Health*, **6**: 98.

Svedberg, P., 1990. Undernutrition in sub-Saharan Africa: is there a gender bias? *J Dev Stud*, **26**: 469-486.

Shannon, H.S., Kyu, H.H., Georgiades, K. and. Boyle, M.H., (2013). Association of Urban Slum Residency with Infant Mortality and Child Stunting in Low and Middle Income Countries. *BioMed Research International*, 12 pp.

Wamani, H., Astrom, A.N., Peterson, S., Tumwine, J.K. and Tylleskär, T., (2007). Boys are more stunted than girls in Sub-Saharan Africa: a meta-analysis of 16 demographic and health survey. *BMC Pediatrics*,**7**: 17

Wamani, H., Tylleskar, T., Astrom, A.N., Tumwine, J.K. and Peterson, S., (2004). Mothers' education but not fathers' education, household assets or land ownership is the best predictor of child health inequalities in rural Uganda. *International Journal for Equity in Health*, **3**: 9.