Regional Differences of Child Under-Nutrition in Bangladesh

BYOMKESH TALUKDER, Wilfrid Laurier University, Canada

Abstract

Despite recent progress shown by some of the indicators of Millennium Development Goals in Bangladesh, the nutritional status among all children of the country is not so satisfactory. Growing evidence suggest that there exist regional differences in child under-nutrition in Bangladesh. The present article is an attempt to identify the regional differences of child under-nutrition across six divisions of Bangladesh and to understand some of the determinants of under-nutrition using DHS-2007 Bangladesh dat. This data focus on under-nutrition and some of the determinants related to household, child and mother. A multivariate model was employed to study the regional differences of under-nutrition status among children. Across the divisions, a variation of under-nutrition is observed among the children. The prevalence of under-nutrition is statistically significant in poor households. Economics status, mothers' education, children's age, number of family members and duration of breastfeeding are important determinants of under-nutrition across divisions. Child under-nutrition in Bangladesh is still a concern for the household with poor economic status. The article calls for improvement of the economic status of the households across divisions keeping in view the nature of inequality in childhood under-nutrition in the country and its differential characteristics across the divisions.

Key words: Bangladesh, division, under-nutrition, regional differences

Introduction

Bangladesh is the seventh most populous country in the world, and one of the poorest (USAID 2009; World Bank 2010). Over the last few decades, Bangladesh has attained notable successes in the following areas of Millennium Development Goals: reducing the incidence of poverty, reducing the total fertility rate, reducing under-five and infant mortality rates, increasing immunization coverage against measles, and lowering the prevalence of underweight children aged below five (Barkat et al. 2009). However, over 40% of the population in Bangladesh still live below the food poverty line, of whom 28 million are "ultra poor" – consuming less than 1,800 calories a day, lacking productive assets and adequate food to provide for their sustenance (WFP 2011).

Under-nutrition rates in Bangladesh are among the highest in the world (WFP 2011). In case of the child nutrition indicator, it ranks among the highest in the world with 20–40% of babies weighing less than 2500 g at birth (Faruque et al. 2008). About 46% of children under five years old are stunted and 40% are underweight. Prevalence of

stunting is higher among children in rural areas (49%) than among their urban counterparts (36%). Prevalence of underweight is also 10 percentage points higher among rural (42%) than that among urban children (32%). Among children aged 0–4 years, about 57% of both boys and girls are undernourished (stunting, wasting, or underweight) (Barkat et al. 2009).

Under-nourished children are at an increased risk of death from a variety of infectious diseases (Kielmann and McCord 1978). The prevalence of inadequate growth or under-nutrition among children is a significant health policy concern in the developing world because it is a precise indicator of nutritional status, is associated with mental development and learning ability and is also associated with body size as well as work capacity in adult life (Rahman et al. 2008). Hence, reducing under-nutrition among children has long been a goal of population policy in Bangladesh.

Regional analysis indicates that child nutritional status is not similar all over the country (Barkat et al. 2009). The nutritional status in Bangladesh is controlled by various factors and there is a regional difference in under-nutrition. Bangladesh is divided into six divisions: Barisal, Chittagong, Dhaka, Khulna, Rajshahi and Sylhet and under-nutrition varies in these divisions (BBS and WFP 2004). Therefore, it is important to understand the regional differences of under-nutrition among children of Bangladesh for better policy making. Some work has already been done in this area, yet more work is needed, which can help for better planning to improve the nutritional status among children of all over the country. This article attempts to understand the regional differences of under-nutrition in Bangladesh and identify some of the determinants of under-nutrition.

Previous research

To identify the factors of under-nutrition among children around the world a literature survey was carried out. It was found that various factors are responsible for under-nutrition. The causes of under-nutrition are multispectral and interrelated. They often operate at many levels, from the individual child to the household and community (Nyovani et al. in 1999). Under-nutrition in children is the consequence of a range of factors that are often related to poor food quality, insufficient food intake and severe and repeated infectious diseases, or frequently combinations of the three (de Onis and Blossner 1997). Urban-rural differentials may be attributed to differential child health care services, including higher coverage with immunization, safe delivery of births and access to health care services (Haddad et al. in 1999). However, Kabir and Chowdhury (1993) pointed out that evidence from developing countries indicates that the locus of poverty and under-nourishment is gradually shifting from rural to urban areas, as the number of urban poor and undernourished is increasing more quickly than the rural number. Schiff and Valdes (1990) stressed that under-nutrition is a function of poverty. Peter et al. (2002) found that family income influences a child's nutritional status and its

effect on health status through the purchase of goods and services. The UNICEF 1990 report said that the economic status of a household is an indicator of access to adequate food supplies, use of health services, availability of improved water sources, sanitation facilities and nutrient intake, which are prime determinants of child nutritional status.

Women's education is an important determinant of children's growth and development as good education may enable women to make independent decisions, to be accepted by other household members, and to have greater access to household resources that are important to nutritional status. Studies in the Philippines, Libya and Ethiopia show a decreased incidence of under-nutrition among young children with an increase in the level of mothers' education. (Engle and Menon 1996; Aguillion et al. 1982; Yimer et al. 2000; Caldwell and Smith 1979; Haddad 2000.) Educated mothers are also likely to be better nourished and more willing to ignore harmful food taboos during pregnancy than their less educated counterparts (Ware 1984).

Breastfeeding has an impact on both the child and the mother (Hobcraft et al. 1984; Benefo and Parnell 1991). This practice is an important determinant of children's nutritional status and has effects on morbidity and mortality of infants. NGOs involvement of mother may open necessary health care information and may be useful in improving nutritional status of children (Rayhan and Khan 2006).

Yimer (2000) and Samson and Lakech (2000) in their studies in Ethiopia pointed out that under-nutrition increases with the increase in age of the child. The sex of the children is an important determinant of under-nutrition (Bairagi and Chowdhury 1994). The study by Chen et al. (1981) revealed that girls were fed less and suffered more from under-nutrition in Bangladesh. Measles infection can also adversely affect the nutritional status by reducing food intake and by causing malabsorption and metabolic losses. Measles, especially with complications such as diarrhea, often results in failure to thrive. Children are underweight at the time that they get measles. Therefore, it is more severe in malnourished children and may make the existing under-nutrition worse. (Vinodini et al. in 1986.) Finally, Brakat et al. (2009) in their report on "Child Poverty and Disparities in Bangladesh" pointed out that in Bangladesh among non-Muslim households (with children) the incidences of poverty and/or deprivation is more pronounced compared to the same types of Muslim households.

Data and methods

The Bangladesh Children Record-2007 of the Demographic and Health Surveys (DHS) was utilized for this study. In this survey "all children under five years of age were weighed and measured to determine their nutritional status" (NIPORT 2009, p. 146). The DHS programme helps developing countries conduct national surveys on population characteristics, and maternal and child health. The DHS are nationally representative surveys with large sample sizes, supported by the United States Agency

for International Development (USAID). The surveys are based on household inter-views of women of childbearing age, and they record standardized anthropometric measurements and some biochemical measurements (DHS 2011).

For children, there are three indicators of under-nutrition: Stunting-(low height-for-age), Wasting-(low weight-for-height), Underweight–(low weight-for-age) (WFP 2005). Nutritional status, especially in children, has been widely and successfully assessed by anthropometric measures in both developing and developed countries (WHO 1995). The Z-score system expresses anthropometric values as several standard deviations (SDs) below or above the reference mean or median value (Meia et al. 2007). Z-scores were calculated using the new child growth standards of World Health Organization (WHO) (de Onis M et al. 2006). The computation of Z-scores involves comparison with an international reference population as recommended by the World Health Organization (Dibley et al. 1987a and Dibley et al. 1987b). To measure under-weight and wasting, weight-for-age and weight-for-height Z-scores are used as indicators respectively (Nyovani 1999). A wasted child is one who is underweight (with a weight less than 2 standard deviations from the median of the reference population) for his or her height.

To assess the regional differences of under-nutrition in Bangladesh only the Z-score of wasting (Weight-for-Height) of six divisions is considered as dependent variable. Wasting is a measure of acute or short-term exposure to a negative environment. Height- and weight-based anthropometric measurement is an excellent tool to gauge general nutritional status in a population (WHO 1995). It is sensitive to changes in calorie intake or the effects of disease. Wasting can be calculated without knowing the age of a child. Weight-for-height (WFH) is a measure of current body mass. It is the best index to use to reflect wasting under-nutrition, when it is difficult to determine the exact ages of the children being measured (Setboonsarng 2005). McMurray in 1996 argued that for cross-sectional data, weight-for-height is the best indicator of current under-nutrition. Whereas measures of stunting indicate long-term nutritional deficiencies whereas wasting scores represent a more acute form of under-nutrition (Nyovani, 1999).

In this study to understand the regional differences of under-nutrition independent variables on household, children and mother were selected. The variables related to household's characteristics include economic status (wealth index), number of house-hold members, number of children 5 and under and religion of household. The child's characteristics include age, sex, duration of breastfeeding, received measles vaccina-tion (this also indicates parental awareness about child health) and residence place. The mother's characteristics include education and mother's association with NGOs.

In this paper, multivariate modelling is used to analyse the anthropometric survey data. The study calculated the Z-scores of weight-for-height for each child to assess the regional differences of under-nutrition and associations between the under-nutrition status and other selected variables. The dependent variable was considered as binary

where the child was either under-nourished (children with Z scores below or equal -2 standard deviation, z<–2.00) or not under-nourished (children with Z-scores between above or equal -2 standard deviation, Z≥–2.0). The multivariate logistics regression modeling of weight-for-height was executed in four stages in order to examine the changing nature of the explanatory potential of background characteristics. These four stages were designated as Model-I based on only the regional-level characteristics, Model-II based on both regional and household background level, Model-III which incorporated regional, economic and child background and Model-IV which also took into consideration regional, economic, child and mother characteristics. The odds ratio, which is determined from the logistic regression coefficients, tells us the increased or decreased chance of under-nutrition given a set level of the independent variable while controlling for the effects of the other variables in the model. Estimates of odds greater than 1.0 indicate that the risk of under-nutrition is greater than that for the reference category. Estimates less than 1.0 indicate that the risk of under-nutrition is less than that for the reference category of each variable.

Results

The ranges of under-nourished and nourished children (<6–59 months old) of the survey data based on wasting (anthropometric index weight-for-height) in the six divisions are shown in Figure 1. According to the survey data the percentage of under-nourished children is 13.28%, 20.80%, 20.38%, 11.84%, 16.51%, and 17.20% in Barisal, Chittagong, Dhaka, Khulna, Rajshahi and Sylhet respectively.
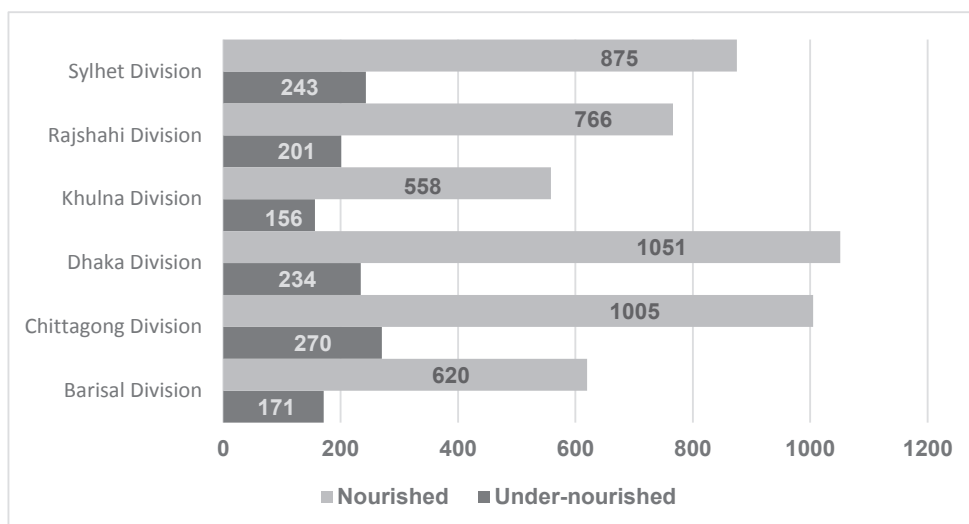

Figure 1. Number of nourished and under-nourished children in surveyed data

In Table 1 the summary statistics of independent variables of regional, household, children and mother level characteristics are shown. Among 6150 respondents the percentage of children in Barisal, Chittagong, Dhaka, Khulna, Rajshahi and Sylhet division is 12.9%, 20.7%, 20.9%, 11.6%, 15.7% and 18.2% respectively. The percentage of poorest, poorer, middle, richer and richest household among respondent is 19.8% 20.8%, 18.8%, 18.6% and 21.9%. The mean and standard deviation of number of household member is 6.44 and 3.22, the mean and standard deviation of number of children 5 and under is 1.44 and 0.86. Among respondents the Islam, Hinduism, Buddhism and Christianity is 91.2%, 8.1%, 0.3% and 0.2%. The mean and standard deviation of children's age is 29.70 and 17.07, the percentage of male and female children is 50.7% and 49.3%, the percentage of urban residence children is 34.3% and rural residence children is 65.7%. Among mothers 27.25% have no education, 31.3% have primary education, 34.05% have secondary education and 7.3% have collage and higher education. 26.9% mothers are associated with NGOs and 73.1% do not have any NGOs association.

Table 2 shows the results of the multivariate logistics regression models of weight-for-height Z-scores for the above-mentioned six divisions of Bangladesh. The inclusion of these six divisions as categorical variables in Model 1 facilitated the comparative regional assessment of the under-nutrition status of children in the aforesaid six divisions. The estimates of Model 1 revealed that under-nutrition varies in the six divisions. The under-nutrition status in Barisal, Chittagong, Dhaka, Khulna and Rajshahi divisions are 1.37, 1.23, 1.11, 1.30, and 1.47 time higher than the reference category Sylhet Division. Although the Dhaka division has more under-nutrition than Sylhet division the difference is not statistically significant.

Model 2 incorporated household characteristics such as economic status (wealth index), number of household members, number of children 5 and under and household religion. The magnitude, direction and significance of under-nutrition status in six divisions of Model 1 remain almost unchanged in Model 2 even after the incorporation of these household characteristics. After incorporating household characteristics the under-nutrition status of Dhaka division became statistically significant. The household economic status (wealth index) is an important indicator of child under-nutrition status. This study elucidates that children from the poorest households are 1.38 times malnourished than the reference category of richest households. Controlling other factors this study unveils that the children of poorer, middle and richer class household are 1.30, 1.50 and 1.47 times more likely malnourished than the reference category; in each case the difference is statistically significant. Children living in households with fewer assets have a lower nutritional status, significant at $p<0.05$. It shows that household economic status largely influenced child under-nutrition status. In households which have less family members their children are 0.98 times less likely undernourished and statistically significant. Households with more children of age 5 and under are 1.17 times more likely under-nourished and statistically significant. Children belonging to Hinduism, Buddhism and Christianity in the six divisions have a poorer nutritional

status compared to those of Muslim households, but the relative difference of the religions is not statistically significant. Braket et al. (2009) showed that in Bangladesh children of other religions rather than Islam are suffering from more under-nutrition.

Table 1. Summary statistics of the independent variables.

Name of the independent variables	Mean (M)	SD	Frequency (F)	%
Regional characteristics				
Barisal Division			791	12.86
Chittagong Division			1,275	20.73
Dhaka Division			1,285	20.89
Khulna Division			714	11.61
Rajshahi Division			967	15.72
Sylhet Division			1118	18.18
Household's characteristics				
Economic status (Wealth Index)				
Poorest			1222 (Un=325)	19.87
Poorer			1282(Un=264)	20.85
Middle			1153(Un=225)	18.75
Richer			1146(Un=257)	18.63
Richest			1347(Un=205)	21.90
Number of household member	6.436	3.225		
Number of children 5 and under	1.441	0.859		
Religion				
Islam			5,609	91.20
Hinduism			496	8.07
Buddhism			21	0.34
Christianity			15	0.24
Child's characteristics				
Children's age	29.691	17.074		
Sex of children				
Male			3,118 (Un=677)	50.70
Female			3,032(Un=598)	49.30
Duration of breastfeeding	62.702	37.000		
Received measles vaccination				
Yes			4,495	73.09
No			1,696	27.58
Residence				
Urban			2,107(Un=360)	34.26
Rural			4,043(Un=915)	65.74
Mother's characteristics				
Mother highest educational level				
No education			1,676(Un=401)	27.25
Primary			1,927(Un=428)	31.33
Secondary			2,094(Un=373)	34.05
College and higher			450(Un=74)	7.32
Mother membership of NGOs (BRAC, ASHA, PROSHIKA)				
Yes			1,655	26.91
No			4,495	73.09

Note: Number of observation (n) =6150, Nnmber of under-nourished children=Un

Model 3 included child's characteristics along with variables of Model 2. Here all divisions have a greater incidence of under-nutrition in comparison with the reference category. It should be mentioned here that when child's characteristics are incorporated,

then under-nutrition has no relationship with regional differences but the economic status remains almost the same and statistically significant. Considering the male child as the reference category, female children are 0.92 times less likely under-nourished but it is not statistically significant. Children with less age are 1.004 times more likely under-nourished and it is statistically significant. This is confirmed by the present study that the duration of breastfeeding is an important determinate of undernourishment. Children who have with encountered less duration of breastfeeding are 1.01 times more likely under-nourished then their counterparts. Breastfeeding had a significant (p<0.01) positive relationship with the nutrition of children. The children who did not receive measles vaccine have 1.050 times more likely under-nutrition than reference category but it is not statistically significant. This study also indicates that the location of residence (rural or urban) of children do not have any impacts on under-nutrition status.

Table 2. Results of multivariate models of weight-for-height Z-scores for children.

Name of the independent variables	Model 1	Model 2	Model 3	Model 4
Regional characteristics				
Barisal Division	1.373**	1.396**	1.072	1.108
Chittagong Division	1.227*	1.259**	1.022	1.164
Dhaka Division	1.108	1.191*	0.913	0.907
Khulna Division	1.305**	1.378**	0.992	1.043
Rajshahi Division	1.472***	1.526***	1.190	1.247*
Sylhet Division (Reference)				
Household's characteristics				
Economic status (Wealth Index)				
Poorest		1.384***	1.604***	1.333**
Poorer		1.304**	1.517***	1.288**
Middle		1.505***	1.775***	1.535***
Richer		1.472***	1.618***	1.484***
Richest (Reference)				
Number of household member		0.977**	0.980*	0.982*
Number of children 5 and under		1.173***	0.963	0.948
Religion				
Islam(Reference)				
Hinduism		1.058	0.942	0.959
Buddhism		1.059	1.170	1.127
Christianity		1.432	0.987	1.030
Child's characteristics				
Children's age			1.004**	1.013***
Sex of children				
Male(Reference)				
Female			0.919	0.930
Duration of breastfeeding			1.006***	1.006***
Received measles				
Yes(Reference)				
No			1.050	1.050
Residence				
Urban(Reference)				
Rural			0.902	0.919
Mother's characteristics				
Mother highest educational level				
No education				1.409**
Primary				1.596***
Secondary				1.215
College and higher(Reference)				
Mother membership of NGOs (BRAC, ASHA, PROSHIKA)				
Yes(Reference)				
No				1.079

The magnitude, direction and significance of regional location, economic status and children's background characteristics in Model 3 remain almost unchanged in Model 4 even after the incorporation of the mother's characteristics. Here it is observed that mother's education had a significantly positive impact on the under-nutrition status of children. The relative odds ratio corresponding to no education, primary and secondary educated mothers are 1.41, 1.60 and 1.21 which indicates that, no education, primary and secondary educated mothers have 1.41,1.60 and 1.21 times respectively higher probability of having under-nourished children as compared to the mothers of the next level of higher education. However, no education and primary education are statistically significant but secondary education is not. Less educated mothers have more under-nourished children because it is expected that less educated mothers will be more unexposed to knowledge and practices of proper childcare.

Discussion

It is believed that mother's involvement with NGOs may provide necessary health care information that would be useful in improving nutritional status. This study shows that a mother who has no association with NGOs is 1.08 times more likely to have under-nourished children in comparison with one who has association with NGOs but the difference is not statistically significant.

In each of Model 1, Model 2I and Model 4, household economic status was significant suggesting an unobserved heterogeneity in nutritional status between children and households. The division level variance is only significant for Model 1 and 2 and is not significant for Model 3 and 4 except Dhaka division in Model 5. This study demonstrates a very interesting finding that although there are regional differences of under-nutrition in Bangladesh, they are mostly determined by economic status of the household. When the household, children and mother's characteristics is incorporated in Model 4, it shows that there is no association of the regional variable and under-nutrition except Dhaka division. In Model-III we also observed a similar type of result. Therefore, it can be concluded that household economic status along with children's age, duration of breastfeeding, and mother's education are important determinants of under-nutrition across divisions.

Conclusion

The recent DHS dataset provides much needed data to carry out the study on regional differences of under-nutrition (weight-for-height) in Bangladesh. These data demonstrate that there is a regional difference of weight-for-height related under-nutrition among children across divisions in Bangladesh, and this is a severe public health problem. The Government of Bangladesh wants to ensure equal development of under-nutrition status all over the country. The Poverty Reduction Strategy Papers (PRSPI)

of Bangladesh aims to reduce the proportion of malnourished under-five children by 50 percent and eliminate gender disparity in child under-nutrition (PRSP 2008).

The study findings have some important and relevant policy messages. The level of under-nutrition among children in the six divisions of Bangladesh varies. The most significant determinate factors of under-nutrition were economic status, mother's education, number of family members, children's age and duration of breastfeeding. Because household income and mother's education are the most important determinant of her child's under-nutrition status, we can say that the poverty and lack of education in mothers are the main reasons for the prevalence of undernourished children. Therefore, a comprehensive intervention programme should be introduced across divisions to improve household income, since this seem to be the most important factors for child under-nutrition across Bangladesh. Under-nourishment is related with many issues. In order to face this problem properly there is need for poverty reduction, education, health education, health facilities, awareness on nutritious diets and food security.

Acknowledgements

References

Aguillion, D.B., M.M. Caedo, J.C. Arnold and R.W. Engel 1982. The relationship of family characteristics to the nutritional status of preschool children. *Food & Nutrition Bulletin* 4(4): 5–12.

Bairagi, R. and M.K. Chowdhury 1994. Socio-economic and anthropometric status and mortality of young children in rural Bangladesh. *International Journal of Epidemiology* 23: 1197–1281.

BBS (Bangladesh Bureau of Statistics) and WFP (The United Nations World Food Programme). 2004. Local Estimation of poverty and under-nutrition in Bangladesh: Bangladesh 2004. Government of Bangladesh and WFP. Available from: http://documents.wfp.org/stellent/groups/public/documents/vam/wfp033309.pdf

Barkat, A., A. Poddar, M. Rahman, G. Mahiyuddin, S. Halim, A. Karim, M. Badiuzzaman, K. M. Shahnewaz and A.A. Hussain. 2009. *Child Poverty and Disparities in Bangladesh. A research study towards Global Study on Child Poverty and Disparities.* Human Research Development Centre. UNICEF.

Caldwell, J.C. (1979). Education as a factor in mortality decline: an examination of Nigerian data. Population Studies 33(3): 395–413.

Chen, L.C., E. Huq, and S. D'Souza. 1981. Sex bias in the family allocation of food and health care in rural Bangladesh. *Population and Development Review* 7(1): 55–70.

de Onis, M. and M. Blössner. 1997. WHO Global Database on Child Growth and Under-nutrition. World Health Organization. Geneva. Available from: http://whqlibdoc.who.int/hq/1997/WHO_NUT_97.4.pdf

de Onis, M., A.W. Onyango, E. Borghi, G. Cuberto and H. Yang. 2006. WHO Multicentre Growth Reference Study Group. Comparison of the World Health Organization (WHO) child growth standards and the National Center for Health Statistics/WHO international growth reference: implications for child health programmes. *Journal of Public Health and Nutrition* 9: 942–7.

NIPORT. 2009. Bangladesh Demographic and Health Survey. 2007. USAID and National Institute of Population Research and Training (NIPORT), Dhaka, Bangladesh. P.145. Available from: http://www.measuredhs.com/pubs/pdf/FR207/FR207[April-10-2009].pdf

DHS. 2011. Details of the DHS survey design and methodology can be accessed in http://www.measuredhs.com/.

Dibley, M.J., J.B. Goldsby, N. W. Staehling and F.L. Trowbridge. 1987a. Development of normalized curves for the international growth reference: Historical and technical considerations. *American Journal of Clinical Nutrition* 46(5), 736–748.

Dibley, M.J., J.B. Goldsby, N.W. Staehling and F.L. Trowbridge. 1987b. Interpretation of Z-score anthropometric indicators derived from the International Growth Reference. *American Journal of Clinical Nutrition* 46(5), 749–762.

Engle, P.L. and P. Menon. 1996. *Urbanization and Care Giving: Evidence from South and Eastern Africa.* San Luis, California: Department of Psychology and Human Development, California Polytechnic, Stat. University, pp 4–24.

Faruque, A. S. G. et al. 2008. Nutrition: Basis for Healthy Children and Mothers in Bangladesh. ICCDRB *Health, Population and Nutrition* 26(3): 325–339.

Genebo, T., W. Girma, J. Hadir and T. Demmissie. 1999. The association of children's nutritional status to maternal education in Ziggbaboto, Guragie Zone South Ethiopia. *Ethiopian Journal of Health Development* 13(1): 55–61.

Haddad, L., M.T. Ruel and J.L. Garrett. 1992. Are urban poverty and under nutrition growing? Some newly assembled evidence. *World Development* 27: 1891–1904.

Hobcraft, J.N., J.W. McDonald and S.O. Rutstein. 1984. Socio-economic factors in infant and child mortality: a cross national comparison. *Population Studies* 38(2): 193–223.

Kabir, M. and I.R. Chowdhury. 1993. Infant and child mortality levels and trends in Bangladesh: secondary analysis of the Bangladesh Fertility Survey, 1989. National Institute of Population Research and Training (NIPORT). Dhaka.

Kielmann, A.A. and C. Mccord. 1978. Weight-for-age as an index of risk of death in children.lancet.1:1247–1250

Meia, Z., M. Laurence and G. Grummer-Strawn. 2007. Standard deviation of anthropometric Z-scores as a data quality assessment tool using the 2006 WHO growth standards: a cross-country analysis. *Bulletin of the World Health Organization* 85: 421–500.

McMurray, C. 1996. Cross-sectional anthropometry: what can it tell us about the health of young children? *Health Transition Review* 6: 147–168.

Nyovani, J.M., Z. Matthews and B. Margetts. 1999. Heterogeneity of Child Nutritional Status between Households: A Comparison of Six Sub-Saharan African Countries. *Population Studies* 53 (3): 331–343.

Peter, S.H. and D.D. William. 2002. Under-nutrition, child morbidity and the family decision process. Journal of Development Economics. *Science Direct* 6(2), 203–235.

PRSP. 2008. Unlocking the Potential: National Strategy for Accelerated Poverty Reduction (PRSP I), General Economic Division, Planning Commission, Government of the People's Republic of Bangladesh, October 16 2005.

Rahman, A., S. Chaudhury, A. Karim, and S. Ahmed. 2008. Factors associated with nutritional status of children in Bangladesh: A multivariate analysis. *Demography India* 37: 1.

Rayhan, I.M and H.S.M. Khan. 2006. Factors causing under-nutrition among under five children in Bangladesh. Asian Network for Scientific Information. *Pakistan Journal of Nutrition* 5(6): 558–562.

Samson, T. and G. Lakech. 2000. Under-nutrition and enteric parasites among under five children in Aynalem village, Tigray. *Ethiopian Journal of Health Development* 14(1): 67–75.

Setboonsarng, S. 2005. *Child under-nutrition as a poverty indicator: An evaluation in the context of different development interventions in Indonesia.* ADB Institute Discussion Paper No. 21. Asian Development Bank. Available from: http://www.adbi.org/files/2005.01.14.dp21.Under-nutrition.poverty.indonesia.pdf

Smith, L.C. and L., Haddad. 2000. *Explaining child under-nutrition in developing countries: A cross-country Analysis.* Research report 111, International Food policy Research institute, Washington D.C.

Schiff, M. and A. Valdes. 1990. The link between poverty and Under-nutrition: a household theoretic approach, Volume 1. Policy, Research, and External Affairs working papers; no. WPS 536. Trade policy. World Bank. Available from: http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/1990/11/01/000009265_3960930051623/Rendered/PDF/multi0page.pdf

USAID (United States Agency for International Development).2009. USAID Office of Food for Peace Bangladesh Food Security Country Framework FY 2010 –2014. USAID. Washington, D.C. P.2. Available from: <http://www.usaid.gov/our_work/humanitarian_assistance/ffp/bangladeshfscf.pdf>

UNICEF (United Nations Children's Fund). 1990. Strategies of improving nutrition of children and women in developing countries. New York: UNICEF.

Vinodini R., P. Bhaskaram, N. Raghuramulu, C.R. Milton, V. Rao, J. Madhusudan and K.V. R. Krishna 1986. Relationship between measles, under-nutrition, and blindness: a prospective study in Indian children. *The American Journal of Clinical Nutrition.*

WFP (World Food Programme). 2011. Food Security Atlas for Bangladesh.Rome. WFP. Available from: http://foodsecurityatlas.org/bgd/country

WFP (World Food Programme). 2005. Guidelines for the Use of Nutritional Information in vulnerability analysis and mapping. Thematic Guidelines on Nutrition and Health.

Rome: WFP.

World Bank. 2010. *Migration and Remittances Fact book 2011*, second edition, World Bank. Available from: http://siteresources.worldbank.org/INTLAC/Resources/Factbook2011-Ebook.pdf

WHO (World Health Organization). 1995. Physical status: the use and interpretation of anthropometry. WHO technical report series. WHO Geneva.

Ware H. 1984. Effects of maternal education, women's roles and child care on child mortality, in W.H. Mosley and L.C. Chen (eds.) Child Survival: Strategies for Research, *Population and Development Review 10*, Supplement.

Yimer G. 2000. Under-nutrition among children in southern Ethiopia: Levels and risk factors. *Ethiopian Journal of Health Development* 14(3): 283–292.