Food Insecurity and Child Undernutrition: Evidence from BDHS 2011

Md. Mehedi Hasan[1,*], Sayem Ahmed[2], Md. Atiqul Hoque Chowdhury[3]

[1]Food Security Nutritional Surveillance Project, Helen Keller International, Dhaka, Bangladesh
[2]Health Economics & financing Research Group, icddr,b Dhaka, Bangladesh
[3]Department of Public Health, University of South Asia, Dhaka, Bangladesh
*Corresponding author: mehedi.sbi.du@gmail.com

Abstract Food insecurity has prejudicial impact in protecting child undernutrition. To explore this, using nationally representative two-stage stratified sample from Bangladesh demographic and health survey 2011 data collected from mothers about their household and child born during their last delivery, a total of 5904 children having valid information of all variables selected for this study were analyzed. Following the WHO guidelines and cut-off points, the prevalence of nutritional status- stunting (40.2%), underweight (35.7%) and wasting (16.3%) were accessed by the Z-scores approach of anthropometric criterion height-for-age, weight-for-age and weight-for-height respectively. The Household Food Insecurity Access Scale (HFIAS) measure was used to measure household food insecurity in this study. Food insecurity of household was discovered to have significant impact on child undernutrition in the form of stunting (OR = 1.62, 95% confidence interval: 1.42, 1.85, p< 0.01), underweight (OR = 1.80, 95% confidence interval: 1.58, 2.06, p < 0.01) and wasting (OR = 1. 28, 95% confidence interval: 1.09, 1.51, p < 0.01). These findings persisted even after adjusted for some significant socioeconomic characteristics. It indicates that a sufficient reduction of food insecurity is obvious for protecting child from undernutrition.

Cite This Article: Md. Mehedi Hasan, Sayem Ahmed, and Md. Atiqul Hoque Chowdhury, "Food Insecurity and Child Undernutrition: Evidence from BDHS 2011." *Journal of Food Security* 1, no. 2 (2013): 52-57. doi: 10.12691/jfs-1-2-7.

1. Background

Child malnutrition is one of the major public health problems in developing countries and is a vital direct or indirect cause of death of children under 5 years of age [1]. Globally, 26% (roughly 165 million) of under five child were found low in height (stunting) for their age where as prevalence of underweight and wasting were 16% (roughly 101 million) and 8% (roughly 52 million) respectively. In Asia (except Japan), about 26.8%, 19.3% and 10.1% were stunting, underweight and wasting respectively [2]. In Bangladesh according to BDHS 2011, undernutrition was highly prevalent with rates of stunting, underweight and wasting were 41%, 36% and 16% respectively [3]. Children who are suffering from stunting, underweight and wasting are at increased risk of deficient and delayed mental development and they are also prone to develop different types of infectious disease which sometimes fatal to them. If child malnutrition continues to long term then it may lead to poor school performance, decreased intellectual development, reduced adult size and decreased work capacities. A number of studies reveal the biomedical and socioeconomic risk factors of child malnutrition in Bangladesh [4-11]. In addition, it is estimated that more than one-third of under-five deaths are attributable to undernutrition [1,12].

Food insecurity refers to limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire food in socially acceptable ways [13]. Three core domains comprising the access component of food insecurity are, namely, anxiety and uncertainty about household food supply, insufficient quality of food, and insufficient food intake by household members [14,15,16]. According to the recent estimates provided by the Food and Agriculture Organization that 842 million people, 12% of the global population, have no ability to meet their dietary energy requirements in 2011-2013. Thus, around one in eight people in the world are likely to have suffered from chronic hunger e.g. food insecurity. In line, the projected 552 million people (about 13.5%) were food insecure in Asia [17].

In spite of several constraints including the country's ever-increasing population density, climate change, scarcity of natural resources with nearly no enough agricultural land left untilled, vulnerability to price shocks and persistent poverty, Bangladesh has already met the Millennium development goal (MDG) hunger target [17] due to the achievement of rapid economic growth in the 1990s spurred by significant growth in agricultural productivity [18].

However, 25 million people remain hunger, and the prevalence of hunger has been rising slowly since the mid 2000 in Bangladesh [17]. Food security therefore remains

high on the agenda of the government, and is being mainstreamed in policies. A comprehensive National Food Policy developed in 2008 was followed in 2011 by the Country Investment Plan, which provides stakeholders with a clear roadmap for investment in agriculture, food security and nutrition.

Though there were cases facing food insecurity yet, the impact of food insecurity of households on child undernutrition has remained emphasis to find out. This study was designed to search for this association along with the magnitude of food insecurity of households as well as the differential patterns of child undernutrition by major socioeconomic characteristics.

2. Materials and Methods

2.1. Data

This paper exploits the data extracted from a nationally representative cross sectional survey BDHS 2011. A two-stage stratified sample was collected from selected mother of households from 600 clusters (enumeration areas), 207 in urban and 393 in rural areas, throughout Bangladesh. Child aged 0-59 months of eligible mother who were last born in 5 years preceding the survey were selected for this study. A total of 5904 cases, having valid information about selected socioeconomic variables included in this study, were analyzed. Children who have died before the interview or have missing information in any of the study variables were omitted from this study.

2.2. Outcome Measures

The BDHS 2011 collected data on height and weight of child to focus nutritional status by measuring anthropometry. Three anthropometric measures of nutritional status, namely height-for-age Z-score (HAZ), weight-for-age Z-score (WAZ) and weight-for-height Z-score (WHZ), were calculated based on the WHO growth standards and were used to determine nutritional status among the children [19]. Height-for-age is a measure of linear growth of a child whereas weight-for-height describes the current nutritional status and weight-for-age is a composite index of weight-for-height and height-for-age. Stunting, underweight and wasting were defined as being less than 2 SD below the median value for HAZ, WAZ and WHZ, respectively.

2.3. Exposure

Food security, a household socioeconomic indicator closely related to undernutrition, refers to the availability of food and a person's access to it. A household is considered food secure when its occupants do not live in hunger or fear or starvation [20]. In 1996, the World Food Summit defined food security as "the situation when all people at all times have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" [21]. The BDHS 2011 included a food insecurity module. The Household Food Insecurity Access Scale (HFIAS) measure, a valid measure of food insecurity in several settings [22], was used to measure household food insecurity in this study. Food and Nutrition Technical

Assistance (FANTA) project developed Household Food Insecurity Access Scale (HFIAS) indicators and the standard questions of food insecurity were systematically reviewed and modified by the technical working group of the 2011 BDHS for Bangladesh. Allowing the seasonal variation, 12 months preceding the interview was considered as reference period to keep the food insecurity assessment.

Based on the responses to the questions on the women's perception and experience of food vulnerability, four categories of food insecurity were created to form a composite indicator. A quantitative score ranging from 0 to 3 was assigned to each food security indicator question category, with zero being the most food-secure response. After assigning the individual food frequency scores, all the frequency responses were summed in a single food security score. The range of the composite score varied from a minimum of "0" to a maximum of "15" which was then classified into four categories as food secure if score is 0, mild insecure if score ranges from 1-5, moderate insecure if score ranges from 6-10 and severe insecure if score ranges from 11-15, as suggested in Household Food Insecurity Access Scale indicator calculations [23]. For study purpose, these four categories were further turned into two by treating mild, moderate and severe insecurity as food insecurity.

2.4. Covariates

Studies have shown that education is one of the major socioeconomic factors that influence a person's behaviors and attitudes. In general, the greater a person's educational attainment, the more knowledgeable he or she is about the use of health services, family planning methods, and the health care of children. Parent's educational status was considered and categorized as having no education, primary, secondary or higher.

All the mother were classified as financial contributor by working currently or not and father were classified on the basis of their occupation as unemployed/other, farm based worker, day labor, semi-skilled worker, service and business.

Piped into dwelling, piped to yard/plot, public tap/standpipe, tubewell/borehole, protected well, protected spring, rainwater, tanker truck, cart with small tank, bottle water were considered as improved source of drinking water where as unprotected well, unprotected spring and river/dam/lake/ponds/stream/canal/irrigation channel as non-improved source of drinking water of the household.

Flush to piped sewer system, to septic tank, to pit latrine, ventilated improved pit latrine (vip), pit latrine with slab, composting toilet were considered as improved toilet where as flush to somewhere else or not known, pit latrine without slab/open pit, no facility/bush/field, hanging toilet were considered as non-improved toilet facility of household.

Household having electricity facility or not was also considered as important covariate for this study and a composite variable- mother's exposure to mass media was created indirectly by using information of whether the respondent usually "read a newspaper", "listen to radio", or "watch television" at least once a week and categorized as: 'yes' if she either watching TV or listening radio or reading newspaper, and 'no' if otherwise.

2.5. Statistical Analysis

A description of the study population followed by univariate and bivariate analysis were included in data analysis to examine the pattern and differentials in the level of anthropometric measures of nutritional status by selected socioeconomic characteristics. In bivariate analysis the Chi-square test for independence was used to detect statistical association between nutritional status and socioeconomic characteristics. Finally, binary logistic regression analysis was carried out to determine the association and net effects of these indicators with/on the binary outcomes of stunting, underweight and wasting. Notably, variables found significant with nutritional status in bivariate analysis were only included in logistic regression analysis. All the analyses were performed after adjusted for cluster effect using the 'svy' command in STATA to ensure that standard errors were adjusted for cluster effects. The STATA statistical software package version 11.1 (StataCorp LP, College Station, TX, USA) was used for all analyses.

2.6. Human Subjects

Data used in this study was de-identified data obtained from MEASURE DHS. Ethical approval was not necessary, as the study was conducted on anonymous public use data having no identifiable information on the survey respondents.

3. Results

3.1. Descriptive Findings

Table 1. Descriptive statistics of the study

Characteristics	Univariate results	Stunting		Underweight		Wasting	
	n (%)	n (%)	p-value	n (%)	p-value	n (%)	p-value
Food security status							
Secure	3823 (64.05)	1327 (36.04)	0.000	1157 (30.72)	0.000	577 (15.08)	0.003
Insecure	2081 (35.95)	1016 (47.73)		929 (44.45)		382 (18.51)	
Mother's education							
No education	1109 (20.05)	565 (50.34)	0.000	534 (49.08)	0.000	208 (18.64)	0.000
Primary	1789 (30.41)	808 (45.13)		741 (41.29)		346 (19.74)	
Secondary	2527 (42.31)	872 (35.03)		728 (28.34)		349 (13.73)	
Higher	479 (7.23)	98 (22.19)		83 (17.6)		56 (10.57)	
Mother's currently working status							
No	5283 (89.9)	2081 (40.14)	0.683	1861 (35.81)	0.496	857 (16.4)	0.648
Yes	621 (10.1)	262 (41.15)		225 (34.29)		102 (15.57)	
Father's education							
No education	1634 (29.5)	797 (47.86)	0.000	734 (45.0)	0.000	298 (18.05)	0.002
Primary	1739 (29.49)	783 (45.12)		680 (38.67)		308 (17.64)	
Secondary	1714 (28.24)	587 (34.37)		508 (29.64)		248 (15.27)	
Higher	817 (12.77)	176 (24.37)		164 (20.43)		105 (11.57)	
Father's occupation							
Unemployed/Others	124 (2.08)	53 (41.47)	0.000	48 (41.69)	0.000	21 (21.85)	0.017
Farm based worker	1598 (28.85)	731 (45.62)		677 (43.05)		298 (18.89)	
Day labor	1339 (22.88)	598 (43.83)		547 (39.29)		231 (16.32)	
Semi-skilled worker	1142 (18.85)	415 (37.33)		335 (29.42)		161 (14.14)	
Service	345 (5.08)	68 (23.08)		73 (21.88)		52 (12.99)	
Business	1356 (22.27)	478 (35.86)		406 (30.19)		196 (15.03)	
Source of drinking water							
Improved	5798 (98.68)	2297 (40.21)	0.587	2036 (35.47)	0.002	933 (16.18)	0.007
Non-improved	106 (1.32)	46 (42.89)		50 (49.53)		26 (26.51)	
Type of toilet facility							
Improved	3131 (50.53)	1074 (35.71)	0.000	934 (30.33)	0.000	476 (15.43)	0.105
Non-improved	2773 (49.47)	1269 (44.87)		1152 (41.1)		483 (17.22)	
Has electricity							
No	2286 (40.2)	1080 (45.93)	0.000	1022 (44.51)	0.000	435 (19.28)	0.000
Yes	3618 (59.8)	1263 (36.42)		1064 (29.71)		524 (14.32)	
Media exposure							
No	2077 (36.28)	1004 (47.58)	0.000	920 (44.66)	0.000	390 (19.24)	0.000
Yes	3827 (63.72)	1339 (36.06)		1166 (30.53)		569 (14.65)	
Total	5904 (100%)	2343 (40.24)		2086 (35.66)		959 (16.31)	

As depicted in Table 1 that more than 40% of the study children aged under five years were stunted where as 35.7% and 16.3% of the study children were found as underweight and wasted, respectively. Likewise, food insecurity was highly prevalent (36%) among households where child live in. Besides, 48% and 44% of the child in food insecure household were respectively stunted and underweight. One of five mothers were illiterate (20%) and among them, almost one of two child were found undernourished in the form of stunting (50%) and underweight (49%). Although most of the household get water from improved source (99%), about half of the households have no improved facility of toilet (49%) with 45% and 41% children of these households were stunted and underweight respectively. More than one third (36%) of the children's mothers had not been exposed to mass media and childhood undernutrition, especially stunting and underweight, were highly prevalent among children of these non-media exposed mother. Currently working status of mother was investigated to have independent association with child undernutrition.

3.2. Multivariate Findings

Results of logistic regression analysis, applied for exploring the potential factors of child undernutrition, were displayed in Table 2. In unadjusted models, the odds ratio of undernutrition in the aspect of stunting (OR = 1.62, 95% CI: 1.42-1.85, p < 0.01), underweight (OR = 1.80, 95% CI: 1.58-2.06, p < 0.01) and wasting (OR= 1.28, 95% CI: 1.09-1.51, p < 0.01) were significantly higher for the children living in food insecure environment compared to the children living in food secure environment. The odds ratio of undernutrition of under five child decreases with the increase of educational status of their parents from illiterate to higher. Moreover, children of households having electricity and media exposed mother were found to have significant lower odds of being undernourished than that of having no electricity facility and media unexposed mother respectively. After adjusting for socioeconomic variables (like educational status of parents, father's occupation, source of drinking water, type of toilet facility, has electricity and media exposure) food insecurity of households was also showed significant association with child undernutrition. Although, adjustment for socioeconomic variables eroded the effect of food insecurity on child undernutrition, the strength of association between food insecurity and child undernutrition remain strong (stunting: AOR = 1.25, 95% CI: 1.07-1.45, p < 0.01; underweight: AOR = 1.29, 95% CI: 1.12-1.50, p < 0.01), except for wasting (AOR = 1.09, 95% CI: 0.91-1.29, p > 0.10). Thereafter, educational status of parents, especially of mother, was discovered to have significant contribution in the reduction of child undernutrition.

Table 2. Results of logistic regression analysis

Characteristics	Stunting		Underweight		Wasting	
	OR (95% CI)	AOR (95% CI)	OR (95% CI)	AOR (95% CI)	OR (95% CI)	AOR (95% CI)
Food security status						
Secure	1	1	1	1	1	1
Insecure	1.62 (1.42-1.85)***	1.25 (1.07-1.45)***	1.80 (1.58-2.06)***	1.29 (1.12-1.50)***	1.28 (1.09-1.51)***	1.09 (0.91-1.29)
Mother's education						
No education	1	1	1	1	1	1
Primary	0.81 (0.68-0.97)**	0.90 (0.74-1.09)	0.73 (0.62-0.86)***	0.83 (0.69-1.0)*	1.07 (0.87-1.32)	1.11 (0.89-1.39)
Secondary	0.53 (0.45-0.63)***	0.76 (0.62-0.93)***	0.41 (0.35-0.49)***	0.60 (0.49-0.75)***	0.69 (0.56-0.86)***	0.78 (0.60-1.03)*
Higher	0.28 (0.21-0.39)***	0.58 (0.39-0.87)***	0.22 (0.16-0.31)***	0.44 (0.29-0.66)***	0.52 (0.35-0.75)***	0.65 (0.40-1.05)*
Father's education						
No education	1	1	1	1	1	1
Primary	0.90 (0.77-1.04)	1.05 (0.89-1.25)	0.77 (0.65-0.91)***	1.0 (0.83-1.19)	0.97 (0.80-1.19)	1.09 (0.88-1.35)
Secondary	0.57 (0.49-0.66)***	0.79 (0.65-0.96)**	0.52 (0.44-0.60)***	0.87 (0.72-1.04)	0.82 (0.66-1.01)*	1.08 (0.84-1.38)
Higher	0.35 (0.28-0.44)***	0.64 (0.47-0.86)***	0.31 (0.25-0.39)***	0.71 (0.52-0.96)**	0.59 (0.44-0.80)***	0.90 (0.60-1.36)
Father's occupation						
Unemployed/ Others	1	1	1	1	1	1
Farm based worker	1.18 (0.74-1.89)	0.90 (0.55-1.47)	1.06 (0.68-1.64)	0.75 (0.47-1.22)	0.83 (0.48-1.45)	0.71 (0.41-1.26)
Day labor	1.10 (0.71-1.71)	0.88 (0.55-1.39)	0.91 (0.59-1.39)	0.70 (0.44-1.11)	0.70 (0.39-1.23)	0.62 (0.35-1.12)
Semi-skilled worker	0.84 (0.53-1.33)	0.85 (0.53-1.38)	0.58 (0.38-0.90)**	0.61 (0.38-0.98)**	0.59 (0.33-1.07)*	0.61 (0.33-1.13)
Service	0.42 (0.25-0.71)***	0.74 (0.42-1.31)	0.39 (0.23-0.66)***	0.75 (0.42-1.34)	0.53 (0.28-1.03)*	0.79 (0.38-1.64)
Business	0.79 (0.49-1.27)	0.83 (0.51-1.35)	0.60 (0.39-0.93)**	0.66 (0.42-1.04)*	0.63 (0.35-1.13)	0.67 (0.37-1.22)
Source of drinking water						
Improved	-	-	1	1	1	1
Non-improved	-	-	1.79 (1.24-2.58)***	1.67 (1.05-2.65)**	1.87 (1.18-2.96)***	1.75 (1.10-2.77)**
Type of toilet facility						
Improved	1	1	1	1	-	-
Non-improved	1.47 (1.30-1.65)***	1.12 (0.99-1.27)*	1.60 (1.41-1.82)***	1.14 (1.0-1.30)*	-	-
Has electricity						
No	1	1	1	1	1	1
Yes	0.67 (0.60-0.76)***	0.98 (0.85-1.14)	0.53 (0.47-0.60)***	0.80 (0.68-0.93)***	0.70 (0.59-0.83)***	0.84 (0.70-1.02)*
Media exposure						
No	1	1	1	1	1	1
Yes	0.62 (0.55-0.71)***	0.82 (0.71-0.96)**	0.54 (0.48-0.62)***	0.85 (0.73-1.0)*	0.72 (0.60-0.86)***	0.90 (0.73-1.10)

4. Discussion

The purpose of this study was to investigate the magnitude of food insecurity of households and its impact on child nutrition. Almost one third of the study children were still passing their lives in food insecure environment. The prevalence of undernutrition in the form of anthropometric measurements of stunting, underweight and wasting were significantly higher among children of food insecure households compared to that of food secure households. Study results showed that food insecurity has impact on nutritional outcomes of children. This result also supported by Holben (2006) [24]. In addition, food insecurity is negatively associated with health status [25-31]. Children of food insecure households were 62% more likely to become stunted compared to children of food

secure households. This finding met with the results of several studies including a multi-country study [32,33,34,35]. Additionally, food insecurity significantly contributes in increasing the risk of underweight as well as wasting among under five children in Bangladesh. This higher risk of undernutrition among under 5 children holds even after adjusting some major significant socioeconomic characteristics possessed by mass Bangladeshi people.

On the other hand, mothers' education status has prominent effect on nutritional status of children. Children born to educated women suffer less from undernutrition which manifests as underweight, wasting and stunting in children. The risk from suffering undernutrition decreases gradually with the sequential improvement of educational status of mother. This finding is also similar to the findings from other studies such as NMIS from Nepal and NFHS from India [36,37]. Maternal education has been associated with nutrition outcomes among children in studies in various settings including Jamaica [38]; Bolivia [39]; and Kenya [40,41]. This relationship would probably be due to the fact that literate mothers adopt many improved behaviors related to maternal and child health care, feeding and eating practices which ultimately affect to the nutritional status of children.

Similar with mother's education, children of educated father's were also less likely to become undernourished as well. These finding focuses children's education, especially girls' education, to overcome the problem of child malnutrition in the long run whereas to combine specific nutrition interventions to overcome the undernutrition problem since high proportion of children from families with literate parents are also stunted, underweight and wasted. Although father's occupation had significant contribution in reducing child undernutrition, mostly underweight, currently working status of mother revealed independent association with child undernutrition as prevalence of undernutrition of all forms were distributed as equally likely with currently working status of mother. However, non-improved source of drinking water causes underweight and wasting reflecting greater risk for under five children of suffering from undernutrition.

Wamani, *et al.* [42] reported that children without hygienic toilet facilities were significantly related with under-two stunting. The present study was not contradicted with the finding of Wamani. Both stunting, underweight and wasting were highly prevalent among children without having improved sanitation/toilet facility according to this study. As expected, they are more likely of suffering from undernutrition.

Children having electricity facility in their households were less likely of being undernourished relative to children having no electricity facility of households. This might happen due to the fact that household with high income are intended to get electricity facility and there may be a linkage either direct or indirect with media exposure.

Media is a vital source of information about child health and nutrition. Mother gain knowledge through media and its reflection was found in this study. Results of current study indicate that media exposed mothers had a significant reduction in the likelihood that their children were stunted, underweight and wasted. This might be due to the awareness of mother about facility services, washing and sanitation practices, feeding practices and some other important information needed for the betterment for child nutrition through media.

5. Conclusion

Drawing results from analyzing Bangladesh demographic and health survey 2011 data, food insecurity of households affects nutritional status of under five children. The effect of food insecurity still remains strong after controlling common and significant socioeconomic characteristics like educational status of parents, their working status, source of drinking water, type of toilet facility, possession of electricity and exposure to mass media. Therefore, intervention should be taken to eradicate food insecurity. Further research is highly appreciated to find out the significant determinants of child undernutrition. Policy makers and program managers should play a vital role in reducing childhood undernutrition by implementing necessary intervention focusing the underlying causes including food insecurity in order to develop a healthy nation as well as the overall progress and development of Bangladesh.

Acknowledgements

Statement of Competing Interests

We declare that we have no competing interest.

List of Abbreviations

AOR- Adjusted Odds Ratio
BDHS- Bangladesh Demographic and Health Survey
FANTA - Food and Nutrition Technical Assistance
HAZ-Height-for-Age Z-score
HFIAS- Household Food Insecurity Access Scale
MDG- Millennium Development Goal
NFHS – National Family Health Survey
NMIS – Nepal Multiple Indicator Surveillance
OR- Odds Ratio
WAZ- Weight-for-Age Z-score
WHO- World Health Organization
WHZ- Weight-for-Height Z-score

References

[1]   R. E. Black, L. H. Allen, Z. A. Bhutta, L. E. Caulfield, M. de Onis, M. Ezzati, C. Mathers, and J. Rivera, "Maternal and child undernutrition: global and regional exposures and health consequences.," *Lancet*, vol. 371, no. 9608, pp. 243-60, Jan. 2008.

[2]   United Nations Children's Fund; World Health Organization; The World Bank., "UNICEF-WHO-World Bank Joint Child Malnutrition Estimates," New York, 2012.

[3] N. I. of P. R. and T. (NIPORT); M. and A. M. International, "Bangladesh Demographic and Health Survey 2011," Dhaka, Bangladesh and Calverton, Maryland, USA, 2013.

[4] J. A. Ricci and S. Becker, "Risk factors for wasting and stunting among children in Metro Cebu, Philippines.," *Am. J. Clin. Nutr.*, vol. 63, no. 6, pp. 966-75, Jun. 1996.

[5] A. Rahman and S. Chowdhury, "Determinants of chronic malnutrition among preschool children in Bangladesh.," *J. Biosoc. Sci.*, vol. 39, no. 2, pp. 161-73, Mar. 2007.

[6] C. Nazneen, M. Ataharul, and C. Nitai, "Infant and child feeding practices in Bangladesh: Evidence from BDHS 1993-94," *Dem India*, pp. 26-27, 1997.

[7] A. Bhuiya, S. Zimicki, and S. D'Souza, "Socioeconomic Differentials in Child Nutrition and Morbidity in a Rural Area of Bangladesh," *J. Trop. Pediatr.*, vol. 32, no. 1, pp. 17-23, Feb. 1986.

[8] N. J. Binkin, R. Yip, L. Fleshood, and F. L. Trowbridge, "Birth Weight and Childhood Growth," *Pediatrics*, vol. 82, no. 6, pp. 828-834, Dec. 1988.

[9] N. Alam, B. Wojtyniak, and M. M. Rahaman, "Anthropometric indicators and risk of death.," *Am. J. Clin. Nutr.*, vol. 49, no. 5, pp. 884-8, May 1989.

[10] L. Raman, "Influence of maternal nutritional factors affecting birthweight," *Am J Clin Nutr*, vol. 34, no. 4, pp. 775-783, Apr. 1981.

[11] R. Bairagi and M. K. Chowdhury, "Socioeconomic and anthropometric status, and mortality of young children in rural Bangladesh.," *Int. J. Epidemiol.*, vol. 23, no. 6, pp. 1179-84, Dec. 1994.

[12] L. Liu, H. L. Johnson, S. Cousens, J. Perin, S. Scott, J. E. Lawn, I. Rudan, H. Campbell, R. Cibulskis, M. Li, C. Mathers, and R. E. Black, "Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000.," *Lancet*, vol. 379, no. 9832, pp. 2151-61, Jun. 2012.

[13] S. A. Anderson, "Core indicators of nutritional state for difficult-to-sample populations," *J. Nutr.*, 1990.

[14] W. S. Wolfe and E. A. Frongillo, "Building household food-security measurement tools from the ground up," *Food Nutr. Bull.*, vol. 22, no. 1, pp. 5-12, 2001.

[15] J. Coates, E. A. Frongillo, B. L. Rogers, P. Webb, P. E. Wilde, and R. Houser, "Commonalities in the Experience of Household Food Insecurity across Cultures: What Are Measures Missing?," *J. Nutr.*, vol. 136, no. 5, p. 1438S–1448, May 2006.

[16] J. Coates, A. Swindale, and P. Bilinksy, "Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. Food and Nutrition Technical Assistance (FANTA), Version 2," Washington DC, 2006.

[17] FAO IFAD and WFP., "The State of Food Insecurity in the World 2013: The multiple dimensions of food security.," Rome, 2013.

[18] A. Yousuf and J. Rahman, "Economic growth in Bangladesh: experience and policyu priorities," 2010.

[19] WHO, "The World Health Growth Standards," Geneva, 2010.

[20] P. Hunt, "World Food Crisis Worsens," *Irish Independent*, 12-Oct-2009.

[21] FAO, "The State of Food Insecurity in the World 2001," Rome, 2002.

[22] A. Bilinsky, P. Swindale, "Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide Version 2," Washington DC, 2006.

[23] J. Coates, A. Swindale, and P. Bilinsky, "Household Food Insecurity Scale (HFIAS) for Measurement of Food Access: Indicator Guide. Food and Nutrition Technical Assistance (FANTA), Version 3," Washington DC, 2007.

[24] D. H. Holben, "Position of the American Dietetic Association: food insecurity and hunger in the United States.," *J. Am. Diet. Assoc.*, vol. 106, no. 3, pp. 446–58, Mar. 2006.

[25] A. M. Pheley, D. H. Holben, A. S. Graham, and C. Simpson, "Food security and perceptions of health status: a preliminary study in rural Appalachia.," *J. Rural Health*, vol. 18, no. 3, pp. 447-54, Jan. 2002.

[26] K. Alaimo, C. M. Olson, and E. A. Frongillo, "Family food insufficiency, but not low family income, is positively associated with dysthymia and suicide symptoms in adolescents.," *J. Nutr.*, vol. 132, no. 4, pp. 719-25, Apr. 2002.

[27] K. Alaimo, C. M. Olson, E. A. Frongillo, and R. R. Briefel, "Food insufficiency, family income, and health in US preschool and school-aged children.," *Am. J. Public Health*, vol. 91, no. 5, pp. 781-6, May 2001.

[28] P. H. Casey, K. Szeto, S. Lensing, M. Bogle, and J. Weber, "Children in food-insufficient, low-income families: prevalence, health, and nutrition status.," *Arch. Pediatr. Adolesc. Med.*, vol. 155, no. 4, pp. 508-14, Apr. 2001.

[29] J. M. Murphy, C. A. Wehler, M. E. Pagano, M. Little, R. E. Kleinman, and M. S. Jellinek, "Relationship between hunger and psychosocial functioning in low-income American children.," *J. Am. Acad. Child Adolesc. Psychiatry*, vol. 37, no. 2, pp. 163-70, Feb. 1998.

[30] K. Siefert, C. M. Heflin, M. E. Corcoran, and D. R. Williams, "Food insufficiency and the physical and mental health of low-income women.," *Women Health*, vol. 32, no. 1-2, pp. 159-77, Jan. 2001.

[31] J. E. Stuff, P. H. Casey, K. L. Szeto, J. M. Gossett, J. M. Robbins, P. M. Simpson, C. Connell, and M. L. Bogle, "Household Food Insecurity Is Associated with Adult Health Status," *J. Nutr.*, vol. 134, no. 9, pp. 2330-2335, Sep. 2004.

[32] S. Psaki, Z. A. Bhutta, T. Ahmed, S. Ahmed, P. Bessong, M. Islam, S. John, M. Kosek, A. Lima, C. Nesamvuni, P. Shrestha, E. Svensen, M. McGrath, S. Richard, J. Seidman, L. Caulfield, M. Miller, and W. Checkley, "Household food access and child malnutrition: results from the eight-country MAL-ED study," *Popul. Health Metr.*, vol. 10, no. 1, p. 24, Jan. 2012.

[33] D. M. Matheson, J. Varady, A. Varady, and J. D. Killen, "Household food security and nutritional status of Hispanic children in the fifth grade," *Am J Clin Nutr*, vol. 76, no. 1, pp. 210-217, Jul. 2002.

[34] M. Hackett, H. Melgar-Quiñonez, and M. C. Álvarez, "Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia," *Rev. Panam. Salud Pública*, vol. 25, no. 6, pp. 506-510, Jun. 2009.

[35] H. C. Gooding, C. E. Walls, and T. K. Richmond, "Food Insecurity and Increased BMI in Young Adult Women," *Obesity*, vol. 20, no. 9, pp. 1896-1901, 2009.

[36] National Planning Commission Secretariate of Nepal and UNICEF, "Nepal Multiple Indicator Surveillance (NMIS), Early Childhood Feeding, Nutrition and Development, Fourth Cycle," 1996.

[37] V. Mishra and R. Ratherford, "Women's Education Can Improve Child Nutrition in India.In Bulletin National Family Health Survey," Mumbai, 2000.

[38] S. Handa, "Maternal Education and Child Height," *Econ. Dev. Cult. Change*, vol. 47, no. 2, pp. 421-439, 1999.

[39] M. B. Frost, R. Forste, and D. W. Haas, "Maternal education and child nutritional status in Bolivia: finding the links," *Soc. Sci. Med.*, vol. 60, no. 2, pp. 395-407, 2005.

[40] J. Kabubo-Mariara, G. K. Ndenge, and D. K. Mwabu, "Determinants of Children's Nutritional Status in Kenya: Evidence from Demographic and Health Surveys," *J. Afr. Econ.*, vol. 18, no. 3, pp. 363-387, Dec. 2008.

[41] B. A. Abuya, E. O. Onsomu, J. K. Kimani, and D. Moore, "Influence of maternal education on child immunization and stunting in Kenya.," *Matern. Child Health J.*, vol. 15, no. 8, pp. 1389-99, Nov. 2011.

[42] H. Wamani, A. N. Astrøm, S. Peterson, J. K. Tumwine, and T. Tylleskär, "Predictors of poor anthropometric status among children under 2 years of age in rural Uganda.," *Public Health Nutr.*, vol. 9, no. 3, pp. 320-6, May 2006.