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## ARTICLE REVIEW

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# Food Insecurity and Nutritional Outcome in Children and Mothers of Bangladesh and Some Perceptions to Overcome Malnutrition

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### ABSTRACT

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<b>Accepted</b>	1 March 2012
<b>Introduction</b>	To understand the extent of food insecurity in Bangladesh emphasizing on the non cereal food availability and maternal and child nutritional outcome.
<b>Methods</b>	We conducted systematic review in between 1985 to 2010 by using PubMed and Google Scholar databases as well as archives of relevant journals by hand. Contacting with the author was also performed in the case where original data needed.
<b>Results &amp; Conclusions</b>	Results from the evidence it may be sated that despite the growth of cereal production and its availability Bangladesh is still problems with accessing of non cereal foods (e.g., vegetable, fruits, fish, milk, meat, egg etc) as well as the incidence of acute malnutrition in children and mothers were hardnosed in the rural area of Bangladesh.
<b>Keywords</b>	Food insecurity - BMI - MUAC - malnutrition - child - and mother.

### INTRODUCTION

Food security is an important factor contributing to socio-economic stabilization and development. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. To discuss food security, three important aspects must be considered: (a) the availability of adequate food, (b) the stability in food supplies, and (c) the access to food. Recently, nutrition security (e.g., intake of micronutrients, percentage of goiter, cretinism, urinary iodine, serum thyroglobulin etc) is also added as an important aspect of food insecurity<sup>1</sup>. Bangladesh has made a steady progress in the expansion of food production. Despite the growth in food production and its availability, food insecurity is still a major problem in the country mainly because of the lack of purchasing power i.e. access to food, seasonal unavailability i.e. availability of adequate food. Besides, due to the seasonal variation in agricultural production and employment and limited employment opportunities in the nonfarm sector, millions of people are suffering from chronic and transitory food insecurity in the rural area of the country. However, in Bangladesh there is about 15 % energy deficit in the average diet<sup>2</sup>. It is also remarkable that the diet of Bangladeshi people is seriously unbalanced with an inadequate intake of fat, oil, fish/animal protein, fruit and vegetable which mainly comes from non staple food<sup>3</sup>.

From nutritional prospective the calorie consumption from different sources of food plays an important role for food security. Household food security is an important measure of well-being. An appropriate measure of food security is necessary to identify the food insecurity, assessing the severity of food shortfall, characterizing the nature of their insecurity (for example, seasonal versus chronic), predicting who is most at risk of future hunger, monitoring changes in circumstances, and assessing the impact of interventions. There exist different approaches to measure household food insecurity like based on some socio-economical

characteristics as for example, income, expenditure, expenditure for purchasing food etc. <sup>(4-6,7)</sup>. But, recently the dietary diversity has shown as a potential mean of measuring food security and monitoring changes and impact<sup>8</sup>. Hence, in this review we attempt to focus on the present status of food insecurity in Bangladesh emphasizing on the existing extent of non-staple food availability as well as maternal and children nutritional outcome of the country.

### METHODOLOGY

We conducted a literature search between 1985 to 2010, PubMed and Google Scholar databases using the suitable words. Last electronic search was performed in June 2011. We also searched the archives of relevant journals by hand to identify additional studies that could meet our inclusion criteria. Additional studies from the bibliographies of reviews or reports were also identified. Authors of original reports were contacted for original data if needed. However, first, this review illustrates the total production and availability of both cereal and non cereal food in Bangladesh. Special attention has been given to the importance of accessing food insecurity from the determinants of non cereal food consumption for the people of Bangladesh. Second, this review also demonstrates the nutritional outcome of children and mothers in the overall Bangladesh.

### A Review of Agricultural Production and Availability of Food in Bangladesh

#### Cereal and vegetable

Bangladesh is an agro-based country and agriculture is the major source of livelihood. More than 65% of the populations of the country are engaged in this sector as well as approximately one-third of the GDP come from agriculture and about 65% of total land area is cultivable<sup>9</sup>. The Major crop grown in the country is rice followed by some vegetable and pulse<sup>10</sup> (Figure 1).

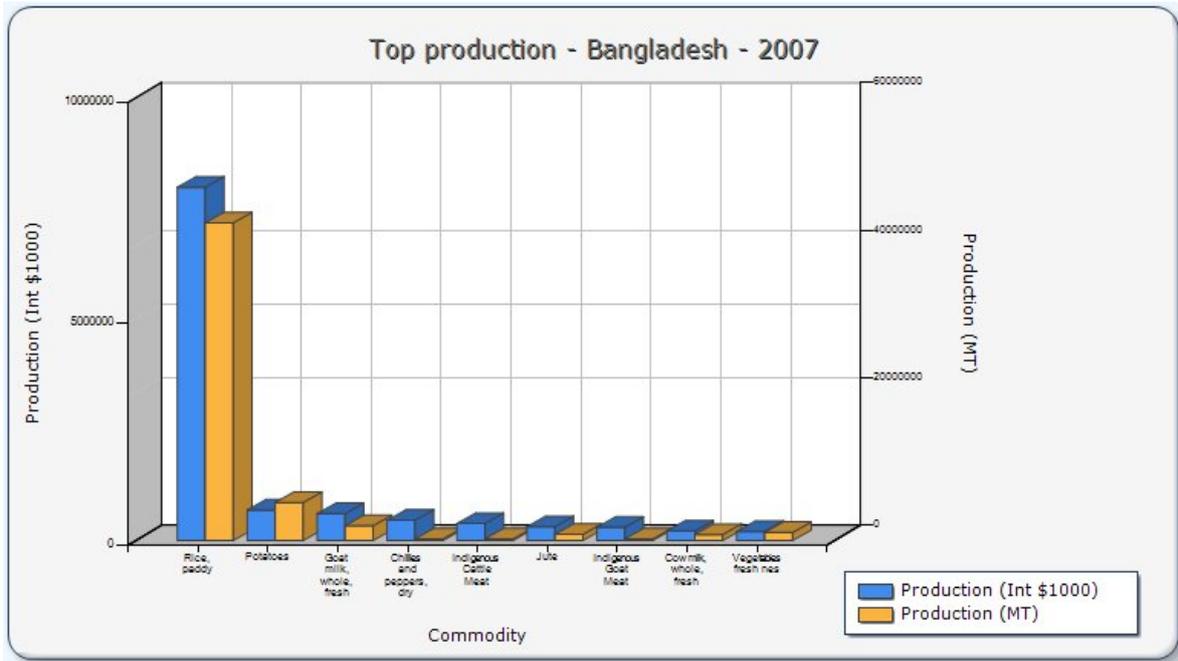
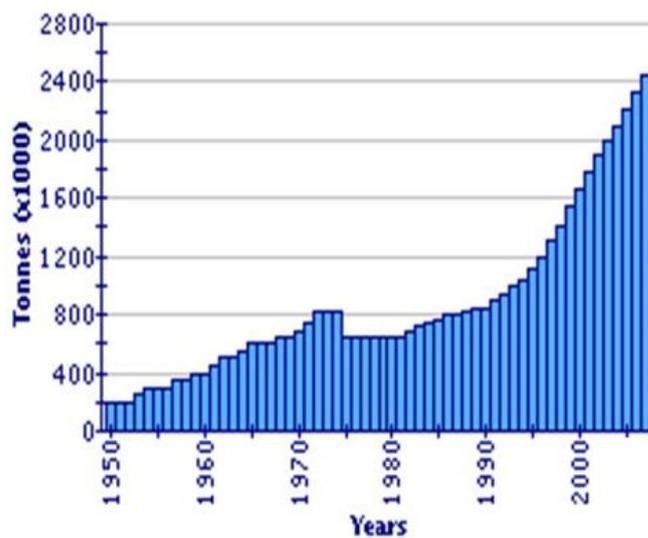


Figure 1 Agricultural production in Bangladesh<sup>10</sup>

According to FAO (2007) from 2000 to 2005 the total cereals production of the country has increased from 28 to 32 million tonnes mainly because of increasing rice production which contribute almost 90% of total cereals production but in the same period the production of fruit has remained the same 1.6 million<sup>10</sup>. Vegetable production within the same period increased from 60 thousand tonnes to 70.6 thousand tones with an average annual growth rate of 2.30 %. Most of this growth can be attributed about 2% area expansion and only a small share to yield increases about 0.15%<sup>10</sup>.

**Fisheries**

Bangladesh is one of the world's leading inland fisheries producers with a production of fresh water fish and marine fish 646 819 tonnes and 455601 tonnes respectively during 2003–4<sup>11</sup>. However, FAO ranked Bangladesh as sixth largest aquaculture producing country in the year of 2005<sup>10</sup>. The fish production has been dramatically increased in the country after 1990 mainly due to the adoption of polyculture<sup>10, 11</sup> (Figure 2).



Source: FAO, 2007<sup>10</sup>

Figure 2 Fish production in Bangladesh: 1990-2007.

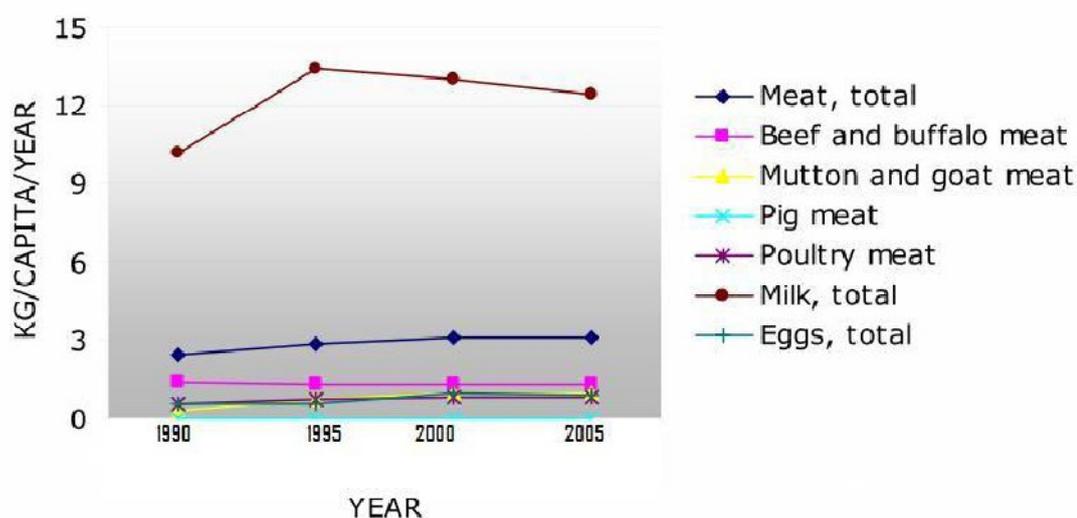
## Food security in Bangladesh

However, at present per capita annual fish consumption in Bangladesh is about 14 kg/year against recommended minimum requirement of 18 kg/year<sup>13</sup>. Hence, there is still needed to improve per capita fish consumption of the country<sup>11</sup>.

### Meat, egg and milk

Bangladesh has produced 593200 tonnes of meats in the year of 2008<sup>12</sup>. The per capita meat consumption in Bangladesh is 3.1 kg per annum (Figure 3), which is much less than the per capita

average recommended meet consumption (41.2 kg per year) for healthy adults<sup>13</sup>. In 2008, Bangladesh has produced 3059830 tonnes of milk and the per capita milk availability is about 11.56 kg per year (Figure 3) against the recommended requirement of 91.5 kg/year<sup>12, 13</sup>. The annual per capita consumption of egg in Bangladesh is only 19 which is much lower in comparison to the to the recommend level for healthy adult (at list 180 eggs/year)<sup>12, 13</sup>.

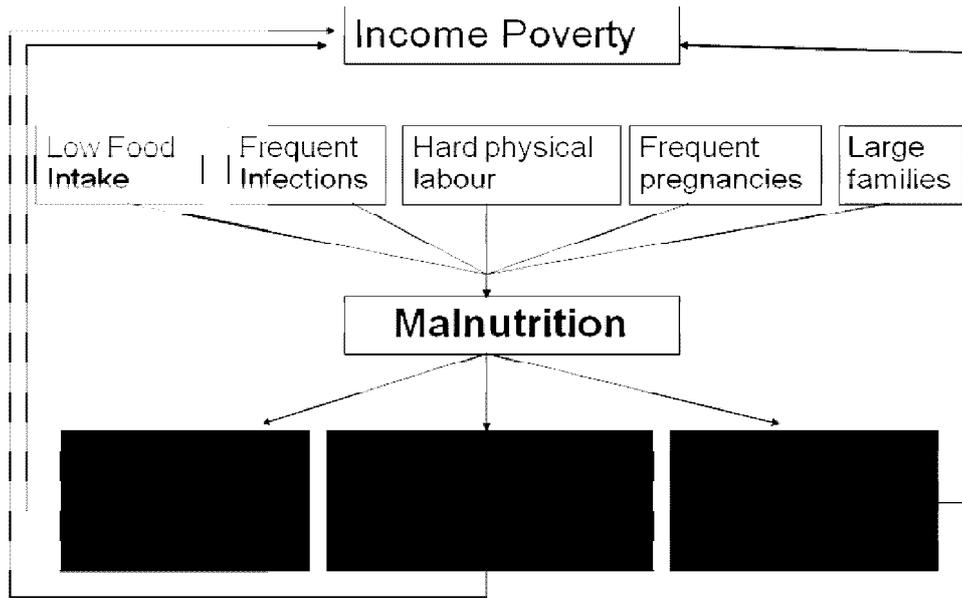


**Figure 3** Trend in annual per capita consumption of meats milk and eggs<sup>12</sup>

### Malnutrition in Bangladesh

Malnutrition can be defined as insufficient or imbalanced consumption of nutrients. The cause of malnutrition is related to several dimensions of socio demographic factors (Figure 4). Malnutrition in Bangladesh is mainly due to food insecurity, low diet diversity, poor health and water & sanitation status as well as poverty which is underlying each of these factors. Hence, a number of different

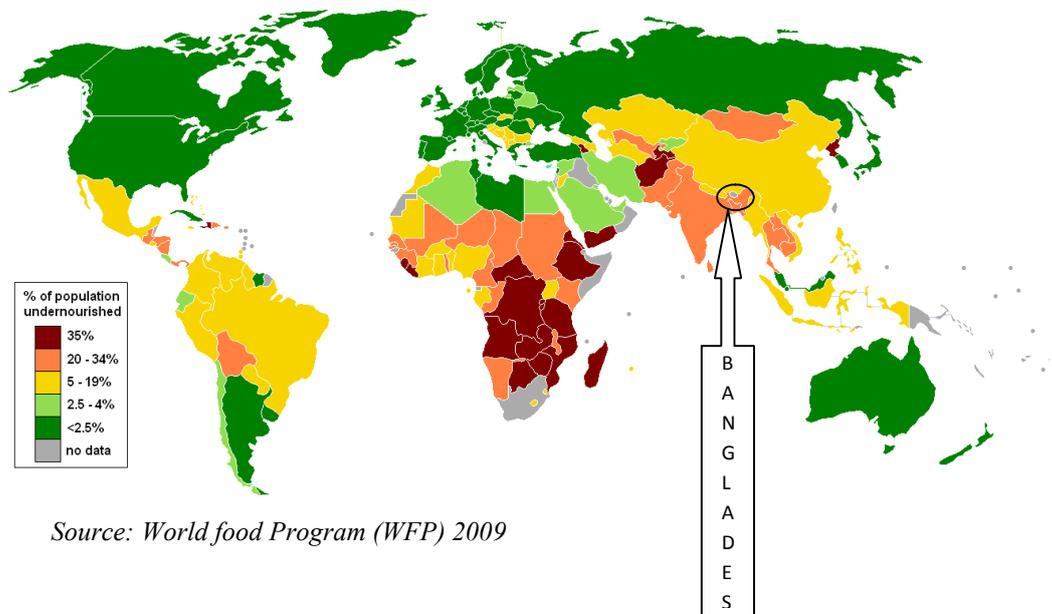
nutrition disorders may arise, depending on which nutrients are under or overabundant in the diet like wasting, stunting, underweight other physiological disorders as well as infectious diseases. According to World Food Program (WFP) based on the per capita calorie availability in Bangladesh about 20-34 % peoples were malnourished<sup>14</sup> (Figure 5).



**Figure 4** Relationship of malnutrition with socio demographic factors<sup>15</sup>

The per capita calorie consumption in Bangladesh between 1990-1992 and 2003-2005 has been shown in figure 6. However, the calorie consumption differs between the hardcore poor and absolute poor from 1,805 kcal/day to 2,122 kcal/day respectively<sup>9</sup>. Cereal, mainly rice, is the main food in Bangladesh. Nearly two-thirds of the daily diet of Bangladeshi people consists of rice complemented with some vegetables, a little amount of pulses and small quantities of fish when available. Milk, dairy products and meat are

consumed only occasionally and in a very small amount<sup>16</sup>. Cereals make up the staple food (62 %) of the diet, followed by non-leafy vegetables, roots and tubers, which together comprise more than four-fifths of the rural people's total diet<sup>13</sup>. The consumption of protein and micronutrient-rich foods like fish, meat, eggs, milk, dairy products, fats and oil is also low in rural poor areas in Bangladesh<sup>3</sup>.



Source: World food Program (WFP) 2009

**Figure 5** World view of malnutrition<sup>14</sup>

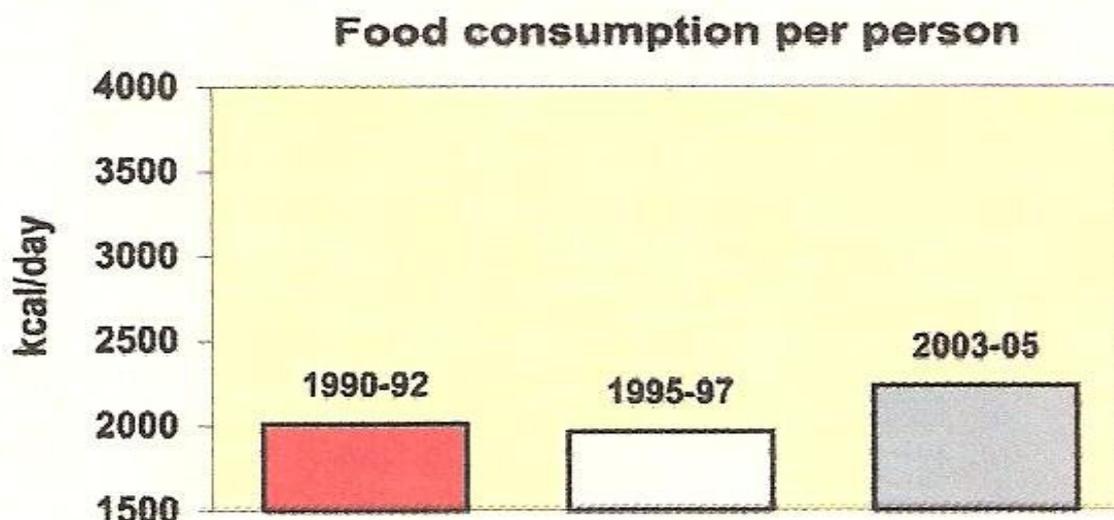


Figure 6 Food consumption per person in Bangladesh <sup>2</sup>: 1990-2005

### Measurement of Food Insecurity

Food insecurity may be defined as limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire foods in socially acceptable ways. Reliable and adequate detailed information about the food security of a population is important for the development of policies and implementation of the intervention to reduce food insecurity and hunger<sup>1</sup>. It is not possible to capture the full range of food insecurity and hunger by any single indicator. Instead, it is desirable a household's level of food insecurity or hunger must be determined by obtaining information on a variety of specific conditions, experiences, and behaviours that serve as indicators of the varying degrees of severity of the condition. The ideal direct measure of household food insecurity is one that captures the core behaviours and experiences that characterize household food insecurity and recognizes stages of severity<sup>17</sup>. Further, Frongillo, 1999 has indicated that the screening out tools should have known and acceptable levels of validity and reliability<sup>4</sup>. However, there are many methods of measuring food insecurity. Most familiar and used methods are discussed below:

### Household-level surveys

This system compares the household food security extent with expenditure styles on food and other goods and services. It permits a broader analysis of the experience of household food insecurity in the context of financial resource constraints and competing financial demands<sup>18</sup>. But the disadvantage in this system is the difficulty to express the facts or observations on the intake of nutritionally adequate and safe foods which is the most important information from nutritional perspectives as well.

### Longitudinal versus cross-sectional surveys

This system emphasizes on the understanding of the socio-demographic factors of household food insecurity and of the sensitivity of this phenomenon to macro-level changes in social and economic conditions. But such analyses are seriously limited by sample size and information constraints in a general population survey as it depends on the proportion of the sample that (a) reports food insecurity and (b) exhibit changes in food security status over time<sup>18</sup>.

### Dietary surveys

Dietary surveys derive the information from the recall of amount of foods or food groups has been consumed over a given time period<sup>19, 20</sup>. The measurement of household food security status in conjunction with individual-level measures of dietary intake will provide important contextual information. It also provides an opportunity to further examine the relationship between household food security and individuals' dietary intakes<sup>21</sup>. Dietary diversity indicators become popular because data are fairly easy to collect, and associated with dietary quality, energy intake, and food security<sup>22, 23</sup>. Thus the use of dietary diversity indicators holds promise as a powerful tool for effective needs assessments and targeting, as well as effective program monitoring and evaluation.

### Nutritional Outcome

It is difficult to define precisely the nutritional status of a person, and more so of a population. Now, it is a global concern which can only be grasped through a set of clinical, physical or functional characteristics<sup>1</sup>. However, in this review we have mainly discussed about child and adult malnutrition where anthropometric tools are used. As anthropometric tools are easy to use and cost

effective, they are used in most of the cases in developing country to screen out malnutrition<sup>1</sup>.

Black *et al.*, (2008) in their review indicated that inadequate nutrition of mothers has effects on child health. Other studies have showed that short stature of the mother and poor maternal nutrition are associated with increased risk of child growth retardation<sup>24-28</sup>. Human body structure is

affected by genetic and environmental factors throughout the growth period. In general, growth is affected by inadequate diet and frequent infection in the first few years of life<sup>29</sup>. The relation between food insecurity and its risk factors is presented in figure 7.

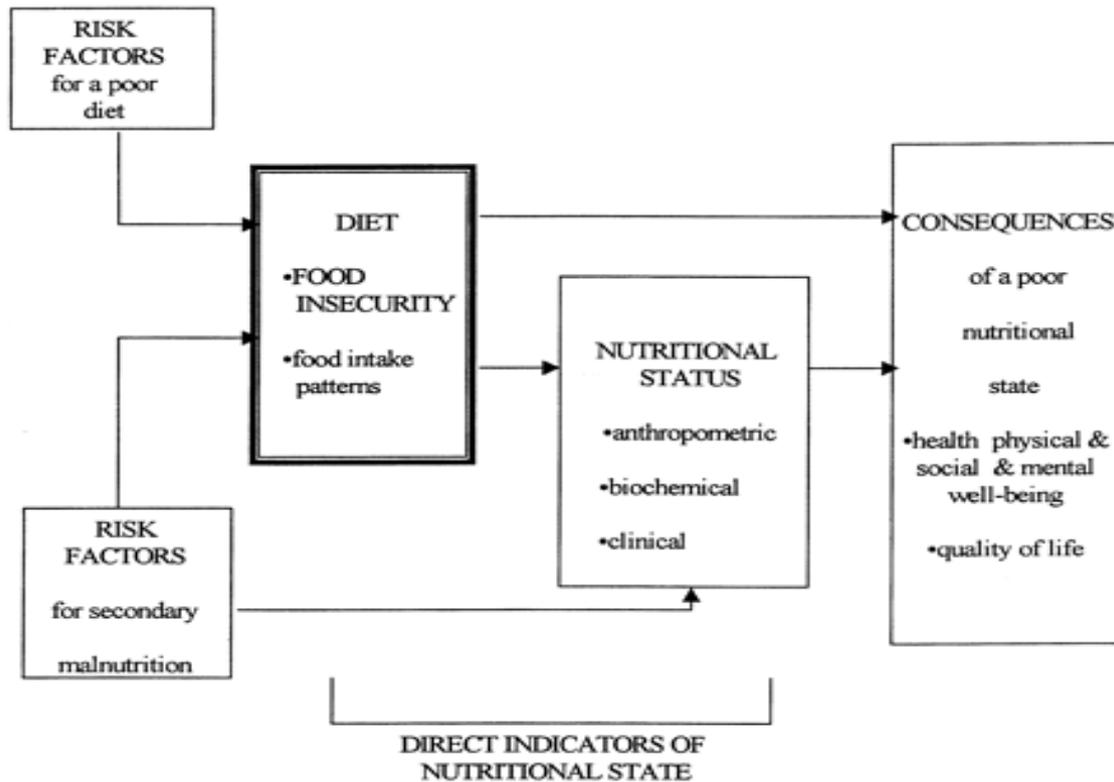


Figure 7 Campbell's conceptual framework for food insecurity, its risk factors, and consequences<sup>30</sup>

**Nutritional Outcome in Mothers' in Bangladesh**

For adult Body Mass Index (BMI) and Mid Upper Arm Circumference (MUAC) are generally used to screening out who are malnourished. BMI compares a person's weight and height (weight in kg/ height in m<sup>2</sup>). For screening out the malnutrition several cut off points are proposed and the cut-off points differ from country to country as well as region to region due to variation of physical structure of the people.

Ferro-Luzzi and James, (1996) and WHO (1995) proposed to dichotomize under nutrition and normal as (a) in case of BMI: less than 18.50 kg/m<sup>2</sup> as 'undernourished'; more than or equal 18.50 kg/m<sup>2</sup> as considered as 'normal' (b) and in case of MUAC: less than 220 mm as 'undernourished' and

more than or equal 220 as 'normal' for Asian adult women<sup>31,32</sup>.

However, according to Child and Mother Nutritional Survey (CMNS) 2005 in Bangladesh about 35.2 % of rural women (18-45 years) were undernourished (BMI ≤ 18.50) among which 23% were mild thin (BMI: 17-18.49), 8.1% were moderate thin (BMI <16-19) and 4.1 % were severe thin (BMI <16) (Table 1). This investigation also showed that using MUAC, 96% of the respondent were suffering from some degree of malnutrition (MAUC < 257mm) and most notable observation was that about 60% of respondents were suffering from moderate to severe forms of under nutrition<sup>33</sup> (MAUC < 227mm) (Table 2).

**Table 1** BMI distribution of rural women in Bangladesh (18-45 years)

Mothers BMI (wt kg/height m <sup>2</sup> )	%
Severe thinness (<16)	4.1
Moderate thinness (16-19)	8.1
Mild thinness (17-18.49)	23
Normal (18.50-24.99)	58.9
Over weight (≥ 25)	5.9
Obese (≥ 30)	0.0

Source: CMNS, 2005<sup>33</sup>

**Table 2** MUAC distribution of rural women in Bangladesh (18-45 years)

MAUC (mm)	%
Severe malnutrition (<200)	4.9
Moderate malnutrition (200-227)	55.70
Mild (228-256)	35.5
Normal (<256)	4.1

Source: CMNS, 2005<sup>33</sup>

### Nutritional Outcome in Children’s in Bangladesh

The nutritional status of below five children is commonly assessed by using “Z” score. A “Z”

score is a standard score indicating how many standard deviations an observation is above or below the mean. Which derived by the equation:

$$z = \frac{x - \mu}{\sigma}$$

Where,

$x$  = raw score which to be standardized;

$\mu$  = mean of the population;

[In general the reference developed by National Centre for Health Statistics (NCHS) / Centre for Disease Control and Prevention (CDC)/ World Health Organization (WHO) is used];

and

$\sigma$  = standard deviation of the population.

The nutritional status of children below five is commonly assessed using three indices of Z score i.e.

- (1) weight-for-height (wasting) - which reflects acute growth disturbances,
- (2) height-for-age (stunting) - which reflects long-term growth faltering and
- (3) weight-for-age (underweight) - which is a composite indicator of both long and short term effects.

However, incidence of anthropometric deficits is usually expressed as the percentage of children below a specific cut-off point such as minus 2 standard deviations from the median value of the international reference data.

WHO (1995) proposed 3 kinds under nutrition based on Z score i.e.

- a) mild malnourished (Z score ≥ -1);
- b) moderate malnourished ( Z score < -1 to ≥ -2) and
- c) sever malnourished ( Z score <-3) (32)

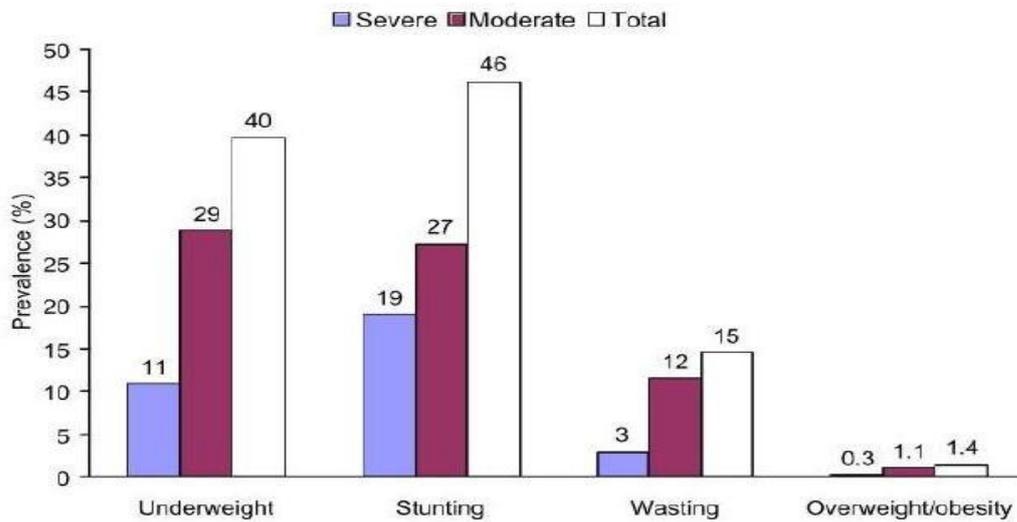
According to CMNS 2005 in Bangladesh about 15 %, 45 % and 40 % were suffering from wasting, stunting and underweight respectively mainly because of micronutrient deficiencies<sup>33</sup> (Figure 8). Hence, the incidence of acute malnutrition in the country (i.e. wasting) was low (15 %) but the chronic malnutrition (i.e., stunting and underweight) was a lot higher<sup>33</sup>. However, according to the report Helen Keller International

2005 (HKI) between 1990 to 2005, there were observed steady reducing trends in the prevalence of chronic malnutrition (both underweight and stunting) among under five children in the rural area of Bangladesh (Figure 9 and 10). During this period, the prevalence of underweight and stunting were reduced by 25.2 percentages (from 70.9% to 45.7%) and 29.1 percentages (from 68.3% to 39.2%) that contributed the average per year rates of reduction approximately 1.7 and 1.9 % respectively. In the early 1990s, severe under nutrition (<-3 Z-score) accounted for about half of total underweight and stunting; in 2005 it accounts for about a quarter. The overall reduction in stunting and underweight rates was attributed mostly to the reduction of severe under nutrition. On the other hand, the prevalence of moderate

under nutrition (<-2 to >- 3 Z-score) remained almost stagnant over the entire period<sup>15</sup>.

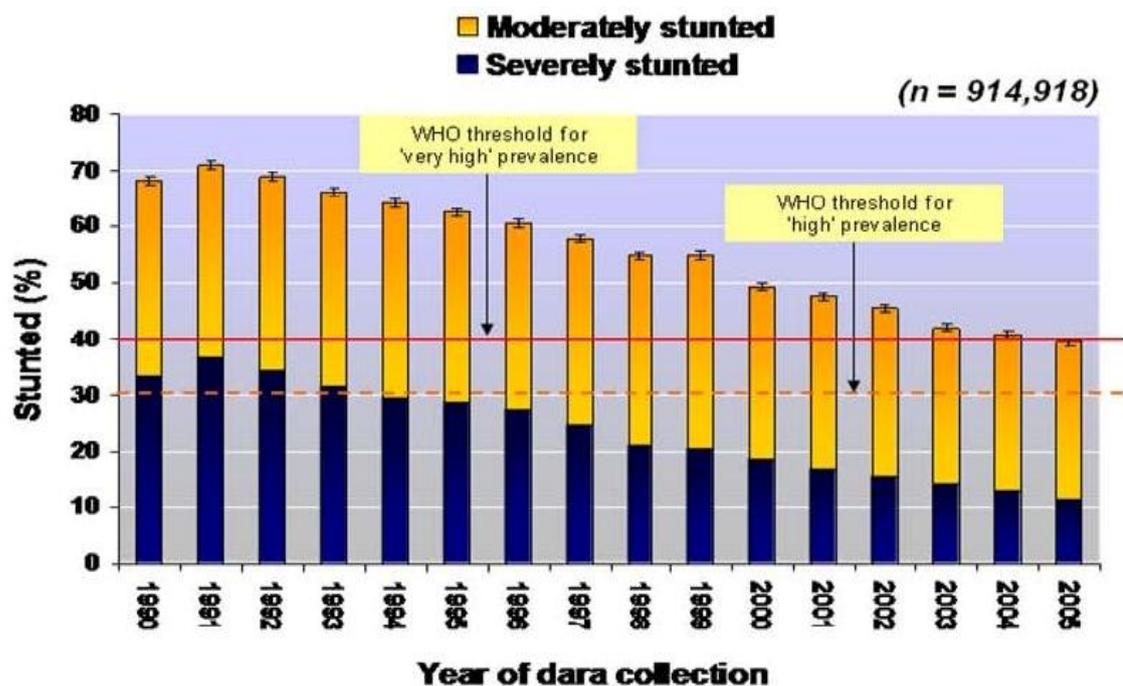
Though Bangladesh shows a significant reduction in under nutrition, the problem still needs to address to meet the Millennium Development Goal (MDG) of reducing underweight by 50% as the current prevalence of underweight in the country is still well above the threshold level for a country indicated by WHO<sup>32,34</sup> (Figure 9,10).

Figure 11 presents the incidence of acute wasting in overall Bangladesh in the year of 2005<sup>33</sup>. From the figure it evident that in 2005 about 3.3 % and 11 % people were suffering from severe and moderatewasting respectively. Although the incidence of wasting was lower than stunting, wasting were still important because of its complex relation with stunting and underweight (Figure 11).



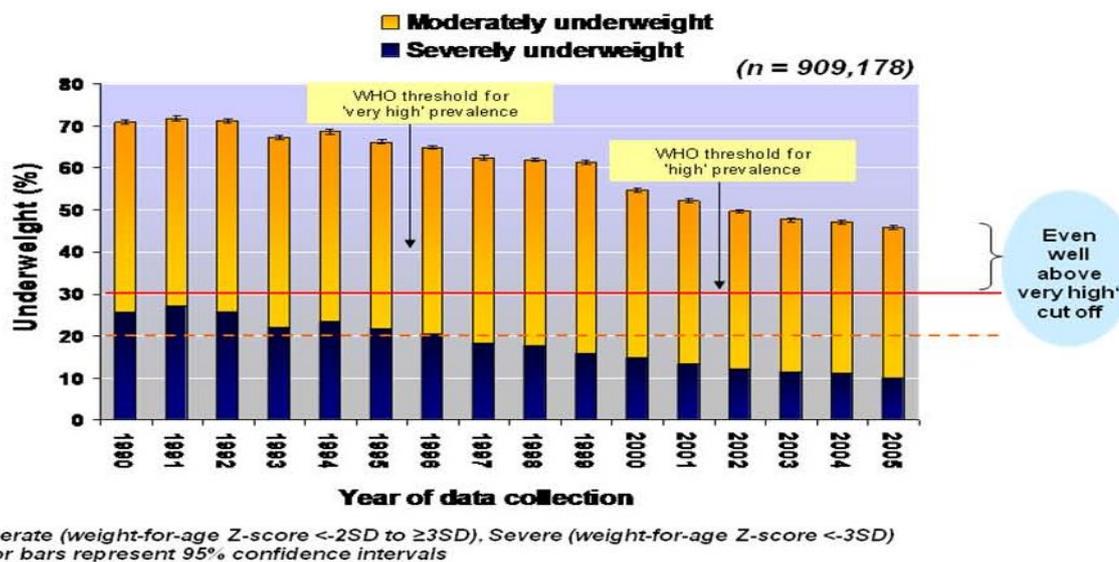
Source: Child and Mother Nutritional Survey-2005<sup>33</sup>.

**Figure 8** Prevalence of underweight, stunting, wasting and obesity under 5 year's children in Bangladesh



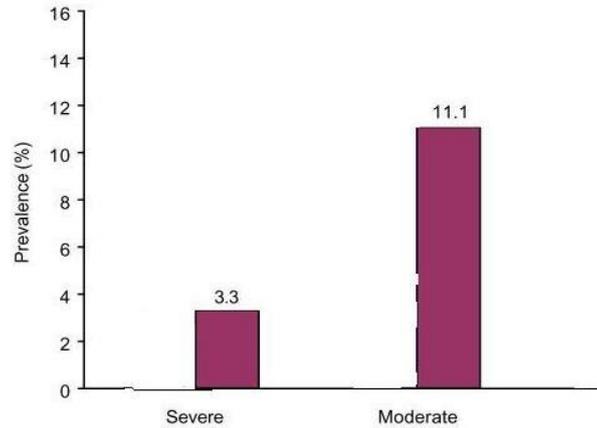
† Moderate (height-for-age Z-score <-2SD to ≥3SD), Severe (height-for-age Z-score <-3SD)  
 ‡ Error bars represent 95% confidence intervals

Figure 9 Trends of stunting among rural children of Bangladesh from 1990 to 2005<sup>15</sup>.



† Moderate (weight-for-age Z-score <-2SD to ≥3SD), Severe (weight-for-age Z-score <-3SD)  
 ‡ Error bars represent 95% confidence intervals

Figure 10 Trends of underweight among rural children of Bangladesh from 1990 to 2005<sup>15</sup>.



**Figure 11** Child wasting ( $W/H_{who} < 2$  years)<sup>33</sup>

**Strategies to Overcome Malnutrition**

Fighting against acute and chronic malnutrition in particular is needed to achieve the millennium goals because it is a vast concern those who are working in the field of nutrition all over the world. Therefore the following sections describe most reliable strategies to deal with malnutrition<sup>35</sup>.

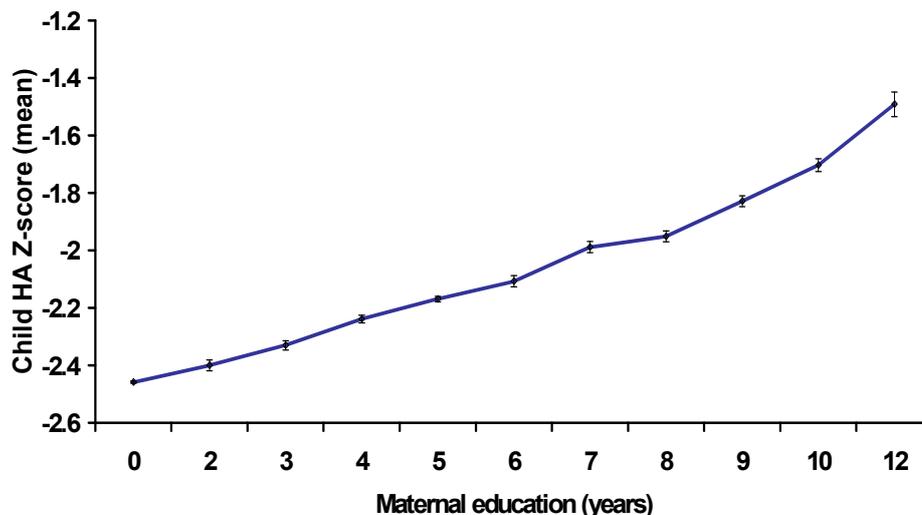
**Emergency/short term management of malnutrition**

For emergency management of malnutrition generally food fortification, supplementation of ready to use food (RTF) and micronutrient supplementation is generally performed<sup>36</sup>. But recently, there is a growing realization among aid groups that giving cash or cash vouchers instead of food is a cheaper, faster, and more efficient way to deliver help to the hungry people, particularly in areas where food is available but unaffordable<sup>37</sup>. But people living a long way from and with limited access to markets, delivering food may be the most

appropriate way to help them to cope with the problem on malnutrition<sup>37</sup>.

**Long term sustainable action**

Educational interventions involving parents and/or other family members might play a role in the care behaviour and care resources that play an important role in feeding the children energy and protein-enriched, hygienic, simple and cheap foods. Such practices could improve child growth even under conditions of poverty<sup>38</sup>. Bloem *et al.*, (2004) conducted a study on three urban slums cities in Bangladesh and found a remarkable positive effect of maternal education on child Z scores of height for age (H/A)<sup>39</sup> (Figure 12). However, According to Smith *et al.*, (2000) in the world improvements in women’s education have contributed by far the most, accounting 43 percent of the reduction in child malnutrition between 1970 and 1995, while improvements in per capita food availability contributed about only 26 percent<sup>40</sup>.



**Figure 12** Maternal education level and child Z score<sup>39</sup>

Some other initiatives have been proven to reduce malnutrition, especially hunger. A great example has been done by novel prize holder economist Dr. Muhammad Yunus who established “Grameen Bank” and is struggling against hunger and poverty. His policy is to give small loans to help very poor women generate income and those loans can lift women out of poverty and nutritional disruption. Some studies have illustrated that when a woman is provided with an income, she will spend nearly all of it on household needs, especially for food<sup>41</sup>. Therefore, by focusing on women empowerment, poverty can be reduced, and also malnutrition. The Grameen Bank Micro-credit Initiatives also focus predominantly on women because hunger disproportionately affects females more so than males<sup>41</sup>. Therefore, by targeting women, micro-credit initiatives malnutrition can strive by promoting both employment and educational opportunities.

The effort to introduce modern agricultural techniques may also reduce malnutrition. From many studies it evident that increasing use of seeds, nitrogen fertilizers and pesticides, called the Green revolution, has resulted in decreasing malnutrition<sup>37</sup>. Besides, investments in agriculture, such as subsidized fertilizers and seeds, increases food harvest and reduces food prices may help to solved the food insecurity problems<sup>37,42</sup>. As for example, in Malawi, almost five million of its 13 million people used to need emergency food aid. However, after the Malawi government changed the policy where subsidies for fertilizer and seed were introduced against World Bank strictures, farmers produced record-breaking corn harvests and production leaped to 3.4 million in 2007 from 1.2 million in 2005. As a result, Malawi has become a major food exporter<sup>42</sup>.

## CONCLUSION AND POLICY IMPLICATIONS

From the above discussion it can be stated that since food insecurity is important in Bangladesh, hence policy makers and researcher should broaden their efforts to analyze the determining factors of food insecurity to address how the problem can overcome the problem. Particular attention should be given with children and mothers as they are more vulnerable tend to have limited options in terms of social capital and safety nets. Intensive research and implementation of the intervention emphasizing on socio demographic factors which has importance with that particular situation like education, income regeneration etc is also essential to overcome the problem. Besides, a successful agriculture-based approach is as well crucial to address micronutrient deficiencies that promise longer-term changes in dietary practices and sustainable benefits over time. In summing up, substantial investments are needed immediately

both in direct and indirect interventions to address maternal and child under nutrition of Bangladesh.

### Direct interventions

- Promotion and support to age appropriate infant and young child feeding, including micronutrient interventions.
- Scaling up basic preventive health care services.
- Promotion of adolescent and women’s nutrition status (micronutrients’, Food supplements).

### Indirect intervention

- Taking appropriate social protection and economic growth polices to reduce household poverty.
- Targeted interventions to address women’s empowerment and status, including secondary education and adolescent programs.
- Social protection, agricultural and prices polices to improve supply of, and access to, high nutrient value food.

## ACKNOWLEDGEMENT

The authors would like to thank the Flemish Interuniversity Council – University Development Cooperation (VLIR-UOS) for the financial and logistic support during this study in addition to Helen Keller International (HKI) for supporting the database.

## REFERENCES

1. FAO (Food and Agriculture Organization), Nutrition indicators for development- Reference Guide. Nutrition Planning, Rome: Assessment and Evaluation Service, Food and Nutrition Division.
2. Anonymous, Monthly statistical Bulletin serial no. 55. Bangladesh Bureau of Statistics. Statistics division, Ministry of planning, Government’s of people republic of Bangladesh; 2008.
3. Lalita B, Sanjib KS, and Biplab KN, Food-Based Nutrition Strategies In Bangladesh. Experience of integrated horticulture and nutrition development. Thailand: FAO; 2007.
4. Frongillio EA, Validation of measures of food insecurity and hunger. J Nutr. 1999; 129, 506-509.
5. Saha KK, Frongillo EA, Alam, DS, Arifeen SE, Persson, LA and Rasmussen KM, Household Food Security Is Associated with Infant Feeding Practices in Rural Bangladesh. J Nur. 2008;138,1383-139.

6. Hamelin AM, Beaudry, M, Habicht, JP, Characterization of household food insecurity in Quebec: food and feelings. *Social Science & Medicine*; 2002; 54 (1), 119–132.
7. Wolfe, WS, & Frongillo EA, Building household food security measurement tools from the ground up. *Food Nutr Bull*. 2001; 22,5-12.
8. Hoddinott J, & Yohannes Y, Dietary diversity as a food security indicator, Food security and nutrition division briefs No. 136, Washington: International Food Policy Research Institute (IFPRI); 2002.
9. BBS (Bangladesh Bureau of Statistics), Statistical Yearbook of Bangladesh Ministry of planning, Government's of people republic of Bangladesh, Dhaka: Statistics division; 2005.
10. FAO (Food and Agriculture Organization), FAO statistics. Rome, Italy; 2007.
11. DoF (Directory of Fisheries), Fishery Statistical Yearbook of Bangladesh 2003–2004. Fisheries Resources Survey System, Department of Fisheries, Ministry of Fisheries and Livestock, Matshya Bhaban, Dhaka; 2005: 46.
12. FAO (Food and Agriculture Organization), FAO statistics. Rome, Italy; 2008.
13. FAO (Food and Agriculture Organization), launch expert report on diet, nutrition and prevention of chronic diseases. Nutrition Planning, Rome: Assessment and Evaluation Service, Food and Nutrition Division; 2003.
14. WFP (World Food Program), Hunger map, United Nations; WFP; 2009.
15. HKI (Helen Keller International), Trends in child malnutrition, 1990 to 2005: Declining rates at national level mask inter-regional and socioeconomic differences, Nutritional Surveillance Project Bulletin No. 19, Dhaka: HKI; 2005.
16. Jahan K, and Hossain M, Nature and extent of malnutrition in Bangladesh .National Nutrition Survey, 1995–1998. Dhaka: Institute of Nutrition and Food Science, Dhaka University, Bangladesh; 1998.
17. Frongillo EA, Rauschenback BS, Olson CM, Kendall A and Colmenares AG, 1997. Questionnaire-based measures are valid for the identification of rural households with hunger and food insecurity. *J Nutr*. 1998; 127,699–705.
18. Radimer KL, Olson CM, Greene JC, Campbell CC and Habicht JP, Understanding hunger and developing indicators to assess it in women and children. *J Nutr Educ*. 1992: 24(1), 36S-45S.
19. FNTA (Food and Nutritional Technical Assistance Project), Measuring household food insecurity workshop report, NW Washington, Academy for Educational Development; 2005.
20. Rose D and Oliveira V, Validation of a Self-Reported Measure of Household Food Insufficiency with Nutrient Intake Data. Technical Bulletin 1863. Economic Research Service, U.S. Department of Agriculture, Washington, DC; 1997a.
21. Rose D and Oliveira V, Nutrient intakes of individuals from food-insufficient households in the United States. *Am J Public Health*. 1997b; 87, 1956-1961.
22. Thorne-Lyman AL, Valpiani N, Sun K, Semba RD, Klotz CL, Kraemer K, Akhter N, de-Pee S, Moench-Pfanner R, Sari M, and Bloem MW, Household dietary diversity and food expenditures are closely linked in rural Bangladesh, increasing the risk of malnutrition due to the financial crisis. *J Nutr*. 2010; 140(1), 182S-8S.
23. Ruel M, Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. FCND Discussion Paper No. 140. Washington, DC: International Food Policy Research Institute; 2002.
24. Black RE, Allen LH, Bhutta ZA, Laura E, Caulfield LE, de Onis M, Ezzati M, Mathers C, and Rivera J, Maternal and child under nutrition: global and regional exposures and health consequences. *Lancet*. 2008; 07, 61692-4.
25. Victora GC, Adair L, Fall C, Hallal PC, Martorell R, Richter L, and Sachdev HS, Maternal and child undernutrition: consequences for adult health and human capital, maternal and child undernutrition, *Lancet*. 2008; 2371, 340–57.
26. Leary S, Fall C, Osmond C, Lovel H, Campbell D, Eriksson J, Forrester T, Godfrey K, Hill J, Jie M, Law C, Newby R, Robinson S, and Yajnik C, Geographical variation in relationships between parental body size and offspring phenotype at birth. *Acta Obstet Gynecol Scand*. 2006; 85, 1066–79.
27. Kristof ND, Raising the World's I.Q. The new works time. 2008; 12, 43-46.
28. Weinreb L, Cheryl W, Jennifer P, Scott R, Hosmer D, Sagor L, and Gundersen C, Hunger: its impact on children's health and mental health. *Pediatrics*. 2002; 110 (4), 41.

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29. Shrimpton R, Victora CG, de Onis M, Lima RC, Blossner M and Clugston G,. Worldwide timing of growth faltering: implications for nutritional interventions. *Pediatrics*. 2001; 107, E75.
30. Campbell CC, Food insecurity: a nutritional outcome or a predictor variable? *J Nutr*. 1991; 121, 408–415.
31. Ferro-Luzzi A and James WPT, Adult malnutrition: simple assessment Technique for use in emergencies. *Br J Nutr*. 1996; 75, 3-10.
32. WHO (World Health Organization), World Health Organization Physical status: The Use and Interpretation of Anthropometry: WHO Technical Report Series 854, Geneva: world Health organization; 1995.
33. CMNSB (Child and Mother Nutrition Survey of Bangladesh), Key Findings of Child and Mother Nutrition Survey of Bangladesh, Ministry of planning, Government's of people republic of Bangladesh, Dhaka: Statistics division; 2005.
34. MDCR (Millennium Development Goals Report), To the MDC and beyond: accountability and institutional innovation in Bangladesh. Bangladesh development series: paper No. 14. The world bank office: Dhaka Bangladesh; 2007.
35. Gardner G, and Halweil B, Escaping Hunger, Escaping Excess. *World Watch*. 2000; 13(4). 24.
36. Collins S, Dent N, Binns P, Bahwere P, Sadler K, and Hallam A,. Management of severe acute malnutrition in children. *Lancet*. 2006; 368, 1992–2000.
37. Cohen D, Achieving food security in vulnerable populations, *BMJ*. 2005; 331, 775-777.
38. Salehi M, Kimiagar SM, Shahbazi M, Mehrabi Y and Kolahi AA, Assessing the impact of nutrition education on growth indices of Iranian nomadic children: an application of a modified beliefs, attitudes, subjective-norms and enabling-factors model. *Br J of Nutr*. 2004; 91,779-787.
39. Bloem MW, Moench-Pfanner R, Graciano F, Stalkamp G, and de Pee S, Trends in health and nutrition indicators in the urban slums of three cities in Bangladesh, compared to its rural areas. Paper No. 83, Globalization of Food Systems in Developing Countries: Impact on Food Security and Nutrition FAO, Rome: FAO Food and Nutrition division; 2004.
40. Smith LC and Haddad LJ, "Explaining child malnutrition in developing countries: a cross-country analysis," Research reports 111, International Food Policy Research Institute (IFPRI): Washinton DC; 2000.
41. Yunus M, The Grameen Bank, *Sci Am*. 1999; 281:114–119.
42. Dugger CW, Ending Famine, Simply by Ignoring the Experts. *The new works time*, 2007.