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# Nutritional Status of Children in Bangladesh: Measuring Composite Index of Anthropometric Failure (CIAF) and its Determinants

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**Abstract**

The objective of the current analysis is to see the factors responsible for malnutrition in children (under-5 years) in urban and rural areas of Bangladesh. In this study binary logistic model is applied to 1831 observations of urban and 3427 observations of rural areas. The Composite Index of Anthropometric Failure (CIAF) is constructed and used as an indicator of malnutrition. It is estimated that malnutrition in rural children is much higher than in urban children. The results have shown that probability of CIAF is negatively associated with birth-interval of child (in urban areas only), mother's education, wealth index of the household, mother's BMI and number of children (5-15 years) in the household (in urban areas only). However, birth-order of the child (in urban areas only), child's age (in rural areas only), breastfeeding, incidence of diarrhea and household size (in urban areas only) positively affect the probability of malnutrition in children. For the policy formulation mother's education, duration of breastfeeding and nutritional status (BMI) of the mother is recommended to eliminate malnutrition. The rural areas need special focus in the policy making.

**Keywords**: anthropometry, rural-urban disparity, child health, child growth, household economics.

## 1. Introduction

Nutritional status of children is an indicator of a number of phenomena, they are access to food, availability of medical services and their use, care given to the children, and allocation of food within the household members. Malnutrition among children have lifelong implications, its outcomes not only cover the whole life but are transferred from one generation to another. The phenomenon of malnourished girl child is more important in the context of her role as a mother, who being a stunted mother give birth to a stunted child and the circle rotates.

Malnutrition is associated with more than half of all child deaths worldwide. Malnourished children are more likely to die from common childhood ailments, and those who survive, have recurring sicknesses and faltering growth. Three-quarters of the children who die from causes related to malnutrition are only mildly or moderately malnourished. The Millennium Development target 5: to reduce by two third, between 1990 and 2015, the under-5 mortality rate, is relevant with malnutrition in under-5 children. A reduction in the prevalence of malnutrition will also assist in the goal to reduce child mortality.

In developing countries, children and adults are vulnerable to malnutrition because of low dietary intakes, infectious diseases, lack of appropriate care, and inequitable distribution of food within the household. Children's nutritional status is a reflection of their overall health. When children have access to an adequate food supply, are not exposed to repeated illness, and are well cared for, they reach their growth potential and are considered well nourished.

In the current study we will attempt to see the determinants of malnutrition in children taking a case study of Bangladesh. A number of studies have analyzed the determinants of malnutrition in Bangladeshi children (Choudhury, et. al. 2000; Muzumder, et. al. 2000; Rahman and Chowdhury 2007; Das and Rahman 2011; Khan and Raza 2013). The novelty of the current study is that we are going to use the Composite Index of Anthropometric Failure (CIAF) for measuring the nutritional status of children.

### *1.1 Situation Analysis of Child's Malnutrition in Bangladesh*

Bangladesh is most populated country of the world. It has 150 million population with density of 920 persons per square kilometer. The 63 percent of population is of 15 to 64 years and this young age structure is the main cause of population momentum. The per-capita income of the country is 848 US Dollars. Bangladesh ranked 140$^{th}$ position in HDI (Human Development Index) and 93rd in HPI (Human Poverty Index).

The stunting, wasting and under-weight children are alarmingly high in Bangladesh. According to BDHS (Bangladesh Demographic and Health Survey) 2007, 43 percent of children in under-5 age group are stunted and 16 percent are severely stunted. Seventeen percent of children under-5 wasted, and 3 percent are severely wasted. Weight-for-age results show that 41 percent of children under-5 are underweight, with 12 percent are severely underweight.

### *1.2 Programs and Policies of Nutritional Status of Children in Bangladesh*

To overcome the multidimensional problem of malnutrition in children and to meet the challenge in the spirit of the 1994 International Conference on Population and Development (ICPD) in Cairo, the Government of Bangladesh launched the Health, Nutrition and Population Sector Program (HNPSP) in 2003. This program aims to reform the health and population sector. It entails providing a package of essential and good quality health care services that are responsive to the needs of the people, especially children, women, the elderly, and the poor.

Recently, the government adopted the Bangladesh Population Policy. Its goals are to improve the status of family planning and maternal and child health, including reproductive health services, and to improve the living standard of the people of Bangladesh by striking a desired balance between population and development in the

context of the Millennium Development Goals (MDGs) and a Poverty Reduction Strategy Paper (PRSP). The objectives of the population policy are to:

- Ensure adequate availability of and access to reproductive health services, especially family planning services, for all—including information, counseling, and services for adolescents
- Improve maternal health, with an emphasis on reducing maternal mortality
- Reduce infant and under-5 mortality rates
- Reduce maternal and child malnutrition
- Promote and actively support programs to eliminate gender disparity in education, health, and nutrition
- Ensure early childhood development programs
- Ensure and support gender equity, and empower women
- Actively support measures to provide food, social security, and shelter for the disadvantaged, including the elderly, destitute, and physically and mentally retarded persons, and
- Support poverty alleviating strategies, and create an environment conducive to improved quality of life.

**2. Existing Literature and Current Study**

A variety of literature exists on malnutrition in Bangladeshi children. The studies have used various measures of malnutrition. For instance, Mozumder, et. al. (2000) has estimated the effect of length of birth-interval on nutritional status of children (6-39 months) by taking weight-for-age (modest to severe malnutrition) as nutritional status. The results revealed that malnutrition declines with rise in the length of subsequent birth-interval, maternal education and housing area while it rises with number of older surviving children. Choudhury, et. al. (2000) have analyzed the gender inequality in nutritional status of children in rural and urban areas of Bangladesh. Mid-upper-arm circumference was taken as the nutritional status. The characteristics of child, household and mother were the categories of explanatory variables.

Hong, et. al. (2006) have used the BDHS data and analyzed the impact of wealth on chronic childhood malnutrition (stunting). The study concluded that stunting is strongly associated with household wealth inequality. The controlled variables included in the analysis were child's multiple birth status, age, gender, prenatal-care, delivery assistance, birth-order, breastfeeding, mother's age at child birth, mother's education, household access to safe drinking water, arsenic in drinking water, access to hygienic toilet and residence of the household.

Rahman and Chowdhury (2007) have also used BDHS data to analyze the chronic malnutrition (severe and moderate) in under-5 year children. Employing multinomial logistic regression, the study found that demographic characteristics were more significant for chronic malnutrition.

Das and Rahman (2011) again used the BDHS data and estimated the child malnutrition taking the weight-for-age anthropometric index (Z-score) for three categories of severely under-nourished, under-nourished and nourished. The study used ordinal logistic regression instead of binary logistic regression. The age of the child, birth-interval,

mother education, maternal nutrition, household wealth, child feeding index and incidence of fever, ARI and diarrhea were found significant predictors of child malnutrition.

Khan, et. al. (2011) have evaluated the impact of prenatal food and micronutrients supplementation on nutritional status (stunting) of children (up to 54 months) in Bangladesh. They found that food supplementation reduce the occurrence of stunting in boys only however, prenatal micronutrients supplementation increases the proportion of stunting also in boys only. Srinivasan, et. al. (2013) have estimated the rural-urban disparity in nutrition in Bangladeshi and Nepali children using DHS data of both countries. The study concluded that differences in maternal education, spouse education and wealth index contribute a major share of rural-urban disparity in the lowest quantile of child's nutritional status measured as height-for-age z-score.

Using BDHS data and taking the number of under-5 malnourished children (weight-for-age) in a household, Islam, et. al. (2013) has applied generalized poisson regression model to explain the factors responsible for number of malnourished children in a household. The factors identified were of the same kind used by the studies based on BDHS data, like mother's education, father's education, wealth index, sanitation status, source of drinking water and total number of children ever born to a woman. Khan and Raza (2013) have also analyzed the socioeconomic determinants of malnutrition in children (under-5 years) using BDHS. The study has probed the stunting and wasting separately for urban and rural areas. The explanatory variables were child's age, sex, birth-order, birth-interval, mother's education, mother's BMI, duration of breastfeeding, incidence of diarrhea, fever and cough, wealth index, household size and number of children in the household. From the policy perspective mother's education and birth-interval and socioeconomic status of the household expressed by wealth index were suggested for good nutritional status of children.

All the studies about child malnutrition in Bangladesh reviewed above have used different measures of malnutrition. Such types of measures are questioned by Svedberg (2000) and more appropriate measure proposed is CIAF (see Khan and Azid 2011 for details). Svedberg (2000) argued that anthropometric indices like the stunting, wasting and under-weight are necessary for determining their relevant interventions. However, they overlap and none is able to provide a comprehensive estimate of number of malnourished children in an economy. Some children who are stunted may also be wasting and/or be underweight. Some children who are under-weight may also be wasting and/or be stunted and some children who have wasting may also be stunted and/or under-weight. Estimates of the prevalence of malnutrition depend on the index used. The use of three indices to show the prevalence of malnutrition raises a number of questions; just how many malnourished children are there in a particular population? Do the three indices provide a true picture of the scale of the malnutrition? Is under-weight the most appropriate indicator that is being used for MDG targets? To answer these questions Svedberg (2000) proposed Composite Index of Anthropometric Failure (CIAF) that incorporates all malnourished children. Though Garza and de Onis (2004) have proposed Multicenter Growth Reference (MRG) which includes functional capabilities of children in growth reference (growth represented by anthropometric measurement), but the reference of MRG is still not available. We will use CIAF measure for Bangladesh, which makes the current study different from the previous ones. According to our knowledge, still no study has used this measure for Bangladesh.

## 3. Methodology

Two models are run separately for rural and urban areas separately. The data source, methodology, model estimation and definitions of explanatory and independent variables are discussed below.

The 2007 BDHS (Bangladesh Demographic and Health Survey) is the 5th DHS of Bangladesh. It is nationally representative survey and covers the entire population. The 5,258 observations have been included in the current analysis (1,831 for urban and 3,427 for rural areas).

The main estimation equation used in the present study is expressed as:

$$MSC = f\ (BORD_{ij},\ SEX_{ij},\ AGE_{ij},\ BIRINT_{ij},\ MEDU_{ij},\ WELINX_{ij},\ BFEED_{ij},\ MBMI_{ij},\ DIAR_{ij},\ FEVER_{ij},\ COUGH_{ij},\ HHSIZE_{ij},\ NCHILD_{ij}) \quad \ldots\ldots\ldots (1)$$

Where

MSC = Malnutritional Status of Child, BORD = Birth-order of child, SEX = Sex of child, AGE = Age of child, BIRINT = Birth-interval, MEDU = Mother's education, WELINX = Wealth index, BFEED = Breast-feeding, MBMI = Mother's Body Mass Index, DIAR = Diarrhea, FEVER = Fever, COUGH = Cough, HHSIZE = Household size, NCHILD = Number of children in household

Equation (1) is the general form of series of functions (for urban and rural areas separately), to be used for CIAF (Composite Index of Anthropometric Failure) as general indicator of child malnutrition. The Binary Logistic Model is used for both functions. The operational definitions of the variables have been shown in Table 1.

**Table 1: Operational Definitions of Variables for Bangladesh**

| VARIABLES | DEFINITIONS |
|---|---|
| **Dependent Variable** | |
| MSC (Malnutritional Status of Child) | 1 if the child is malnourished (falls in CIAF), 0 otherwise |
| **Explanatory Variables** | |
| BORD (Birth-order of Child) | Child's birth-order |
| SEX (Sex of Child) | 0 for female, 1 for male |
| AGE (Age of Child) | Child's age in completed months |
| BIRINT (Birth-interval) | 0 for ≤ 24 months, 1 for > 24 months |
| MEDU (Mother's Education) | 0 for not educated, 1 for primary, 2 for secondary, 3 for collage and higher |
| WEALTH (Wealth Index) | 0 for poorest, 1 for poorer, 2 for middle, 3 for richer, and 4 for richest. |
| BFEED (Breastfeeding) | Months of breast-feeding to child |
| MBMI (Mother's BMI) | 0 for < 18.5, 1 for ≥ 18.5 |
| DIAR (Incidence of Diarrhea in last 2 weeks) | 0 for no, 1 otherwise |
| FEVER (Incidence of Fever in last 2 weeks) | 0 for no, 1 otherwise |
| COUGH (Incidence of Cough in last 2 weeks) | 0 for no, 1 otherwise |
| HHSIZE (Household Size-Number of Household Members) | 0 for > 4, 1 for ≤ 4 |
| NCHILD (Number of Children under-5 years) | 0 for > 2, 1 for ≤ 2 |

## 4. Results and Discussion

The results of non-econometrical analysis of urban and rural areas and Binary Logistic Model are presented in Table 2 and 3 respectively.

**Table 2: Percentage Estimates of Malnutrition in Children for Bangladesh**

| Background Characteristics | Fall in CIAF (Urban areas) | Fall in CIAF (Rural areas) |
|---|---|---|
| **Birth-order of Child** | | |
| **1** | 43.3 | 54.1 |
| **2-3** | 45.6 | 58.5 |
| **4-5** | 61.8 | 62.0 |
| **6+** | 64.4 | 68.4 |
| **Sex of Child** | | |
| **Male** | 49.4 | 58.7 |
| **Female** | 46.3 | 58.6 |
| **Age of Child (in months)** | | |
| **<6** | 34.9 | 41.0 |
| **6-9** | 32.8 | 42.9 |
| **10-11** | 38.5 | 44.8 |
| **12-17** | 40.1 | 53.2 |
| **18-23** | 53.2 | 62.4 |
| **24-35** | 53.2 | 66.0 |
| **36-47** | 55.5 | 64.6 |
| **48-59** | 49.1 | 52.2 |
| **Birth-interval (in Months)** | | |
| **≥ 24** | 47.5 | 60.0 |
| **< 24** | 48.5 | 57.0 |
| **Mother's Education** | | |
| **No Education** | 63.0 | 65.9 |
| **Primary** | 59.4 | 62.0 |
| **Secondary** | 40.2 | 51.0 |
| **Collage and Higher** | 21.9 | 42.4 |
| **Wealth Index** | | |
| **Poorest** | 65.6 | 68.2 |
| **Poorer** | 62.2 | 62.8 |
| **Middle** | 57.7 | 56.4 |
| **Richer** | 52.2 | 50.8 |
| **Richest** | 37.3 | 38.3 |
| **Breastfeeding (in Months)** | | |
| **≤ 6** | 34.4 | 43.8 |
| **7-12** | 41.0 | 49.0 |
| **13-36** | 51.6 | 62.6 |
| **37 +** | 60.0 | 69.2 |
| **Mother's BMI** | | |
| **< 18.5** | 62.8 | 65.2 |
| **≥ 18.5** | 43.1 | 55.1 |
| **Incidence of Diarrhea** | | |

| | | |
|---|---|---|
| **No** | 47.0 | 57.9 |
| **Yes** | 56.4 | 65.5 |
| **Incidence of Fever** | | |
| **No** | 46.1 | 57.5 |
| **Yes** | 51.3 | 60.5 |
| **Incidence of Cough** | | |
| **No** | 47.4 | 57.7 |
| **Yes** | 49.2 | 60.2 |
| **Number of Household Members** | | |
| **≤ 4** | 49.9 | 57.4 |
| **> 4** | 47.9 | 59.1 |
| **Number of Children Under-5 Years** | | |
| **≤ 2** | 47.2 | 58.9 |
| **> 2** | 57.7 | 55.8 |
| **Total** | **47.9** | **58.7** |

**Table 3: Results of Binary Logistic Regression for Rural and Urban Bangladesh**

| **Co-Variables** | **Coefficient (S.E., p-value)** | |
|---|---|---|
| | **CIAF (Urban Areas)** | **CIAF (Rural Areas)** |
| **Birth-order of child (Child's Birth-order)** | | |
| | .141 (.044, .001)* | .034 (.026, .187) |
| **Sex of child [Female as reference]** | | |
| **Male** | .144 (.101, .154) | -.025 (.072, .733) |
| **Age of child (in Months)** | | |
| | .001 (.004, .823) | .010 (.003, .001)* |
| **Birth-interval (months) [< 24 months as reference]** | | |
| **≥ 24 months** | -.386 (.122, .002)* | -.100 (.083, .230) |
| **Mother's Education [No Education as reference]** | | |
| **Primary** | -.035 (.149, .815) | -.010 (.096, .917) |
| **Secondary** | -.540 (.157, .001)* | -.213 (.107, .047)* |
| **Collage and Higher** | -1.191 (.213, .000)* | -.278 (.204, .174) |
| **Wealth Index [Poorest as reference]** | | |
| **Poorer** | .023 (.246, .926) | -.154 (.103, .135) |
| **Middle** | -.151 (.238, .527) | -.404 (.107, .000)* |
| **Richer** | -.218 (.227, .337) | -.545 (.119, .000)* |
| **Richest** | -.460 (.221, .038)* | -.945 (.155, .000)* |
| **Breastfeeding (in Months)** | | |
| | .025 (.006, .000)* | .015 (.004, .000)* |
| **Mother's BMI [Thinness < 18.5 as reference]** | | |
| **Normal ≥ 18.5** | -.544 (.120, .000)* | -.301 (.077, .000)* |
| **Incidence of Cough (in last 2 weeks) [no as reference]** | | |
| **Yes** | -.136 (.135, .314) | .075 (.095, .430) |
| **Incidence of diarrhea (in last 2 weeks) [no as reference]** | | |
| **Yes** | .287 (.171, .092)** | .299 (.124, .016)* |
| **Incidence of fever (in last 2 weeks) [no as reference]** | | |

| | | |
|---|---|---|
| **Yes** | .206 (.134, .124) | .120 (.094, .202) |
| **Number of Household Members [ > 4 as reference]** | | |
| **≤ 4** | .270 (.116, .020)* | -.120 (.088, .172) |
| **Number of Children under-5 years [ > 2 as reference]** | | |
| **≤ 2** | -.572 (.202, .005)* | .027 (.132, .840) |
| **Constant** | **.644 (.341, .059)**** | **.221 (.196, .261)** |

**No. of observations: 1831 for urban and 3427 for rural areas**
*** expresses 5 percent and ** expresses 10 percent level of significance.**

The results of explanatory variables are discussed below for Bangladesh. The percentage estimations shows that 47.9 percent children are malnourished in urban areas as compared to 58.7 in rural areas. It reflects poor nutritional status of children in rural areas of Bangladesh.

*4.1 Child's Age*

A child at different ages needs specific food and care. Our results have shown that by increase in child's age the probability to fall in CIAF (risk of being malnourished) increases in rural areas of Bangladesh only, as the variable is insignificant in urban areas (see also, Garcia and Alderman 1988; Mozumder, et. al. 2000; Mian, et. al. 2002; Wamani, et. al. 2004; Rahman and Chowdhury 2007; Giroux 2008; Hien and Hoa 2009; Das, et. al. 2011). It reflects the lack of child health facilities, poor education and lower level of income in rural area of Bangladesh. The results are supported by the urban and rural status of malnourished children in Bangladesh. It revealed that most of parents in rural areas are failing to fulfill optimal food requirements of their children by increase in child's age. The other reason may be that these children do not recover soon due to poor health facilities in rural areas. It also represents the low educational status of mother in rural areas of Bangladesh (see for same results Khan and Raza 2013).

*4.2 Child's Birth-order and Birth-interval*

In our analysis the birth-order is positively related with risk of being malnutrition in urban areas only (see also Ukwuani, et. al. 2003). The result reflects the betterment in the knowledge of mother about child health and feeding practices as the birth-order increases in urban areas (see also Mukuria, et. al. 2005). Our estimation has shown that the risk of being malnutrition in urban areas decreases by birth-interval of more than 24 months (see also, Ibrahim 1999; Mozumder, et. al. 2000). The results are supported by percentage estimates where 48.5 percent children with less than 24 months birth-interval are malnourished as compared to 47.5 percent with more than 24 months birth-interval for urban areas[1]. The explanation may be that larger birth-interval between two births allows the batter use of resources towards child, which ultimately improves the child's nutritional status. Biologically, the larger birth-interval enhance the productive strength of the mother. For the new-born the larger birth-interval results into better care and more time allocation for the nutrition and health. The larger birth-interval enhance the breast-feeding duration of the new-born. The resource may also be the factor as more resources are required by the household for caring the mother and new-born during pregnancy as well as in infancy. The smaller birth-interval requires new resources within small span of

[1] For rural areas the econometric estimates are insignificant but it is surprized to note that the ratio of malnourished children in this area with birth-interval of 24 or more months is higher than those with birth-interval of less than 24 months. They are 60 and 57 percent respectively.

time as compared to larger birth-interval. For the poor families it become difficult to bear expenditure related with diet, birth and child bearing within small span of time. Generally larger number of children and smaller birth-interval in poor families generate the problems. The results clearly support the proposal of larger birth-interval for good nutritional status of children.

*4.3 Mother's Education*

Our analysis explained that in urban as well as rural areas of Bangladesh the secondary levels of education of mother negatively influence the risk of being malnourished (see also Das and Rahman 2011). However the primary and the higher level of education has no significant effect on nutritional status of children. The effect of education is more elastic in urban as compared to rural areas of Bangladesh There are important policy implications of mother's education regarding child's nutritional status. Generally the policy makers stress on compulsory primary education as well as adult literacy programs focusing on primary education. In the context of child's nutritional status secondary education for females is required. Bangladesh should focus on compulsory secondary level of education for all. In the long-run it will result into increasing the nutritional status of children.

The positive impact of mother's education on nutritional status of children may be through the employment status of the woman. It may also be through the knowledge and awareness of mother regarding child's health-care. The educated women are generally empowered at household level. The mothers with higher education significantly contribute in household income and are actively involved in domestic life and their knowledge from education about child health and feeding practice cause reduction in risk of child's malnutrition. The findings by Mukherjee, et. al. (2008) supported the results by explaining that educated females marry late than illiterates. Early child birth affects both child and mother's health. Educated women have higher child interval and fewer children and can do better child health-care and medical attention.

*4.4 Wealth Index*

The wealth index constructed by BDHS has two main principles regarding to measure economic status (i) the distribution of health services among the poor and (ii) the ability to pay for health services. So the wealth index quintiles provide the information about ability to pay health expenditures. The distribution of health services to the poor can be better represented by wealth index as compared to income or expenditure index (Rutstein, et. al. 2004). We have used wealth index as a proxy of socioeconomic status of the household. In urban areas it negatively influence the malnutrition (see Mbuya, et. al. 2010; Das and Rehman 2011) but the result is significant in richest category only. In rural areas wealth index affects the malnutrition in middle, richer and richest classes. Moreover wealth index is more effective in urban areas as compared to urban areas of Bangladesh. It reflects poor socioeconomic status of households in rural areas.

*4.5 Duration of Breastfeeding*

Nutrition intake from birth to two years of age is a key determinant of the future growth, health, and development of the child. However, this period is often marked by growth faltering, micronutrient deficiencies, and common childhood illnesses. Proper breastfeeding practices, including exclusive breastfeeding during the first six months of life, are crucial to the health and well-being of a child. Continued breastfeeding not only

improves the nutritional status of the child but also prevents the mother's exposure to another pregnancy too soon. Breastfeeding protects babies and infants from infectious and chronic diseases including diarrhea and acute respiratory diseases. It helps the children to recover more quickly from illness. Complementary foods introduced initially around six months of age contribute to the nutritional needs of the child. Our estimation has shown that longer duration of breastfeeding positively influence the risk of malnutrition in urban and rural areas of Bangladesh. It is corroborated by the percentage estimates. The 34.4 and 43.8 percent of children are malnourished with having $\leq 6$ months of breast-feeding and 60.0 and 69.9 percent with having more than 37 months of breast-feeding in urban and rural areas of Bangladesh respectively. It reflects that mothers breastfeed for long duration to fulfill the nutritional requirement of the children as a substitute of food supplements (see also Ukwuani, et. al. 2003). It may be concluded that breast-milk is good for health of infants but for older children supplement food is required because they need additional food for growth. It is proposed that supplementary food through the mother and child-care programs should be given to the children for their proper growth.

*4.6 Mother's BMI*

A woman's nutritional status has important implications for her health as well as the health of her children. A woman with poor nutritional status, as indicated by a low body mass index (BMI) produces a baby with a low birth-weight, which has higher probability of malnutrition in the infancy days.Our results have shown that mother's BMI negatively influence the risk of malnutrition in both urban and rural areas of Bangladesh. The effect is more elastic in urban areas than rural ones showing mother's better health and health-care facilities in urban areas as compared to rural areas. It is corroborated with percentage estimates. The children from mothers with below 18.5 BMI are 62.8 (65.2) percent and those from mothers with $\geq 18.5$ BMI are 43.1 (55.1) in rural (urban) areas. It illuminates the intergenerational cycle of malnutrition in Bangladesh (see also, Victora, et. al. 2008; Mbuya, et. al. 2010; Das and Rahman 2011). The results may be explained as mother's good nutritional status is needed for breastfeeding, recovery from the stress of pregnancy and labor, coping with child rearing and care. Her compromised nutritional status affects the nutrition of her children. The problem of mother's nutrition is a complex one with several underlying causes. Undernourished mothers are nutritionally deprived during childhood and adolescence, and they do not improve after marriage. Social causes like early marriage, frequent child birth, lack of proper birth-spacing and discrimination of intrahousehold food distribution all exacerbate the poor state of maternal nutrition. The preferential treatment of males increases the prevalence of nutritionally poor mothers. The undernourished mothers usually have no or lesser education. As a long-run policy all these aspects need particular attention in the policy formation.

*4.7 Diarrhea, Fever and Cough*

Our estimates have shown that incidence of Diarrhea within last two weeks positively influence the risk of malnutrition in urban and rural areas of Bangladesh (see also Das and Rahman 2011). The results are corroborated with the percentage estimates. The explanation may be that diarrhea may cause the loss of weight and it affects nutritional status. The effect is more elastic in rural areas and it reflects poor health and sanitation facilities in rural areas. The incidence of fever and cough in the last two weeks are not related to the risk of being malnutrition in urban and rural areas of Bangladesh. So the

urgent policy formulation and implementation is proposed to decrease the incidence of diarrhea to reduce the malnutrition in children.

*4.8 Number of Household Members and Children*

Our results have shown that the children from smaller households (having less than or equal to four members) are more likely to be malnourished in urban areas. It is supported by the percentage estimates where 49.9 percent of children are malnourished in smaller households against the 47.9 percent in the larger households in urban areas. It represents that the risk of malnutrition is higher in smaller families in urban areas (see Mozumder, et. al. 2000). The explanation may be that in large families a household member course to increase the income of the household. Our results have further shown that the risk of being malnourished reduces in the families having less and equal to two children below 5 years of age in urban areas. According to the average estimates 47.2 percent of the children are malnourished in the households where the under-5 children are less than or equal to 2 against 57.7 percent of those in the households where under-5 children are greater than 2. The explanation is that fewer resources are left for each child in large families as compared to small families (see Garcia and Alderman 1988; Mukherjee, et. al. 2008; Hien and Hoa 2009).

Resource effect is clear from the results. The larger families enhance the nutritional status of children but the larger number under-5 children reduce the nutritional status of children. The effect of under-5 children is supported by the effect of birth-interval on nutritional status of children as more than two under-5 children is conceptually related with lesser birth-interval.

## 5. Conclusion and Policy Recommendations

The study concluded that there exists an rural-urban disparity in the incidence of malnutrition in children. Malnutrition is much higher in rural areas against the urban ones, i.e. 47.9 percent in urban areas and 58.7 percent in rural areas. Rural areas should be focused in the policy formulation and child malnutrition elimination programs. Health, Nutrition and Population Sector Program by Government of Bangladesh should be expanded to rural areas specifically for decreasing the malnutrition in the country. The mother's education, mother's BMI (thinness) and wealth index decrease the probability of child malnutrition in urban as well as rural areas. The duration of breast-feeding and incidence of diarrhea enhance the probability of malnutrition in both areas. The effect of wealth Index is greater in rural areas as compared to urban areas reflecting the wealth is an ultimate determinant of malnutrition among children in rural areas. The effect of mother's education is a core determinant of child's nutritional status in Bangladesh. The mother's education should be stressed for improved nutritional status of children. The policy is proposed to increase female education up to secondary level. Two factors, i.e. duration of breast-feeding and BMI of mothers need further stress. The children need supplement food instead of breast-feeding at a specific age. In the absence of supplement food or its substitution with breast-milk results into malnutrition. As a policy program the supplement food may be provided to the children at subsidized rate. Second factor that is low BMI of mothers requires attention for policy making in the long-run. For presently female children in the childhood and adolescent good nutrition is recommended for their better BMI in their motherhood to break the inter-generational cycle of malnutrition in children.

It is further concluded that mother's characteristics determine the nutritional status of children. It may be in the form of breastfeeding, mother's education, mother's nutritional status (represented here by BMI), fertility behavior (represented here with birth-interval and number of under-5 children) or incidence of diarrhea. So all the programs related with women's health, education and family planning are ultimately concerned with child's nutritional status.

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