# Multinomial Logistic Regression of Factors Influencing Malnutrition among 6 to 10 Year Old Children in Rural Area of Rajshahi District, Bangladesh

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*ABSTRACT:* Under nutrition and over nutrition both are considered as malnutrition in a particular population. Still under nutrition is a major health problem of Bangladeshi children. The aim of the study was to investigate the factors influencing malnutrition among 6 to 10 years old children in rural area of Rajshahi district, Bangladesh. Chi-square test and multinomial logistic regression model were used in this study. The prevalence of under nutrition among school going children was 6.4% and over nutrition was 14.8%. Multinomial logistic regression model demonstrated that under nutrition was the common phenomenon of children especially for girls, living in poor family. Undernourished parent's children were more likely to get under nutrition than their counterparts. On the other hands over nutrition was common for boys and living in rich family. These results suggest that there are dual burden of malnutrition among primary school children in Rajshahi district of Bangladesh that requires attention.

## INTRODUCTION

Nowadays malnutrition both under nutrition and over nutrition are major health problem of children for most of the countries in the world. Malnutrition has been shown to be a risk factor for disease, over nourished children are more likely to become over nourished adults and it is associated with a number of serious health conditions including heart disease, diabetes, and some cancers (Roger *et al.,* 2011). On the other hand, undernourished children are more likely to develop gastro esophageal reflux disease (GERD), inflammatory bowel disease, chronic vomiting or diarrhoea (Zidorio *et al.,* 2015). The study on prevalence of under nutrition and over nutrition may provide useful information about child health, and that may reflect the general living environment of a given population.

It is estimated that overweight and obesity for school-aged children in the year 2010 is 20% in urban China, 46% in the Americas, 41% in the Eastern Mediterranean region, 38% in the European region, 27% in Western Pacific region, and 22% in South-East Asia (Abstract: 38th General Internal Medicine meeting held in 2015). The prevalence of obesity has increased 54% among 6-11 years old children in India (Xiao *et al.,* 2015). In Ghana, malnutrition among primary school children had been surveyed and was found that the prevalence of overweight was 7% in urban and 1% in rural areas (Manyanga *et al.,* 2014). In Bangladesh, the prevalence of malnutrition among

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rural primary school children was as follows: 24.34% mild malnutrition, 34.20% moderate malnutrition and 24.06% were severe malnutrition (Ara *et al.*, 2012). From the other study in Bangladesh we have observed that the prevalence of malnutrition among primary school children, stunting and wasting are 38.8%, 55.9%, and 25.9% respectively (Siva Kumar *et.al*, 2016). It is noted that child obesity has been dramatically increasing throughout the world both in developed and developing countries, and also it is observed that the prevalence of undernourished children have been increasing specially in poor countries, so there are dual burden in worldwide.

This current epidemic of obesity among children is largely the result of rapid changes in the socio-economic and nutrition transition to globalization. Among children of Bangladesh, 22 million under-five year aged children are obese (Habib *et al.*, 2016). Bangladesh became one of the signatories of the UN Millennium Declaration in 2000 and has committed to achieving eight Millennium Development Goals that assert a vision for the 21st century (Lunze *et al.*, 2015). UNESCO has initiated Salamanca declaration and Salamanca framework that emphasized on accommodating all students in Bangladesh regardless of their physical, intellectual, emotional, social, linguistic or other conditions (Lowe *et al.*, 2017). At least 53,000 children die every year in Bangladesh due to complications related to malnutrition as the country is exposed to the highest rate of child and maternal malnutrition in the world (Rahman *et al.*, 2015). Moreover, 45% of deaths among the under-5 children are caused by malnutrition since millions of children suffer from one or more forms of malnutrition, including low birth weight, stunting, underweight and vitamin A and iodine deficiencies (Rahman *et al*., 2015). It is malnutrition that puts the children into a state of compulsion to usually suffer from psychological impairment and different forms of mental disorders that appear as threats to their future development. According to statistics, 41% of the under-5 children in Bangladesh are stunted, 36% of them underweight in terms of age and 16% are underweight compared to their height (Rahman *et al.*, 2015). Obviously due to their economic insolvency and, to some extents, lack of awareness malnutrition travels from generation to generation because the malnourished mothers give birth to malnourished babies. If they are girls, these children often may become malnourished mothers themselves, and this how the vicious cycle continues. Statistics revealed that 25% women under 20 year of age, 57% women at the age of 20 years and 17% women at the age of 30 become mothers in Bangladesh (Rahman *et al.*, 2015). There is a relation between child marriage and malnutrition. So, child marriage has to be prevented to address the malnutrition issue properly in the country. Lack of education and awareness are emerging as major impediments to face malnutrition challenges in Bangladesh (Raiten *et al*., 2015). Special attention should be paid to school going children considering their potential influence on the family and their contribution to the nation's workforce for future. Due to their unique role in the nation for future, it is important to investigate the prevalence and determine the risk factors for malnutrition among children. This type of study is poorly documented in Bangladeshi population and to the best of our knowledge there is no survey on prevalence and associated factors of malnutrition among primary school children in Rajshahi district of Bangladesh.

The objective of the study is to estimate the prevalence of malnutrition among children aged 6-10 years and to establish the relationship of malnutrition and socio-demographic factors using multinomial logistic regression model.

## MATERIALS AND METHODS

*Materials:* A total number of 800 children (girls 474 and boys 326) were considered as a sample in this cross sectional study. The age range of children was 6 to 10 years, we considered only school going children who were living in rural area of Rajshahi distract, Bangladesh. Six to 10 years children were generally studying in class I to V level. The cross-sectional study sample consisted of 800 (boys 474 and girls 326) at the rural primary school, kindergarten and madrasah of Rajshahi, Bangladesh. Students were interviewed from May to October 2015 using a semi-structured questionnaire containing precluded and open-ended questions. The household socioeconomic, demographic factors and also anthropometric and behavior variables were collected from the students and their parents. All information about children was

confirmed from school records and their respective parents. The date of birth of each subject has been taken from the school records and cross checked from their respective parents or guardian. Information on the whole day activities of the last seven days were collected as well as food habit of seven days has been collected from the student or from their respective parents by re-call methods. Information also was collected about distance of school from the residence and the mode of transport used to go to school. Besides this, height and weight of the children as well as their parents has been taken to see the hereditary of obesity through anthropometric rod and weighing machines.

*Sample size determination:* Sample size was determined using an appropriate statistical formula which was $n = \frac{N}{1 + Nd^2}$ where n= required sample size, N=population size (in here 354546), d=marginal error (in here 0.05), and 95% confidence level was considered. The formula provided that the significant sample size was approximately 400 but we were considered 800 for this study (Simpson, 1971).

*Sampling procedure:* However, due to obvious difficulty of identifying the children who do not go to school, we were restricted our study to only school-going children. Sample of schools has been taken from the list of all primary school (Class I-V). There are four types of primary educational institutions (Government primary school, Semi-government primary school, Private primary (Kindergarten and English Medium school) and madrasah) are available in Bangladesh. It has been assumed that students from lower to middle class family go to government or semi-government schools or madrasah, whereas children from upper middle and high income groups attend private schools/English medium schools. In our target area there is no English medium school and semi-government school. We considered all students who were studying in class I-V and three types of primary institutions; Government primary school, Kindergarten and Madrasah. First of all, the author went to District Primary Education Office of Rajshahi in Bangladesh for getting the information about the number of school going children age (6-10) in Rajshahi rural area. In the first stage, we selected one upazilla using simple random sampling among nine upazillas of Rajshahi district, and Durgapur upazilla had been selected. In the second stage two unions have been selected randomly from selected upazilla (Durgapur). In the next stage, we selected one primary school, one kindergarten and one madrasah selected randomly from one union and primary school have been selected randomly from other union, and we went to get permission from authority of selected institutions. From selected institutions, we selected 900 students randomly. We asked selected students for giving their parents hand phone number, we contacted with them and met with them for taken written consent from the selected students' parents, 100 parents did not interest to provide their children information. Finally we took data from 800 students and their parents.

*Methods:* The body mass index (BMI) percentile was used in the present study to calculate nutritional status of children. BMI was subdivided into four classes according to the most widely used categories of the BMI percentile for children, these were (i) underweight-BMI less than the 5$^{th}$ percentile (under nutrition), (ii) healthy weight (normal weight)-BMI 5$^{th}$ percentile up to the 85$^{th}$ percentile (healthy weight), (iii) overweight-BMI 85$^{th}$ to less than the 95$^{th}$ percentile, and (iv) obese-BMI greater than or equal to the 95$^{th}$ percentile (Barlow & Expert Committee, 2007). Over weight and obese was considered as over nutrition.

*Out come variable:* The catogories of nutritional status; (i) under nutrition, (ii) healthy weight and (iii) over nutrition was considered as out come variable in the present study.

*Independent variables:* The independent variables were gender, father's occupation, birth order, mother's height, number of children born, number of alive child, family monthly income, father's body size, mothers body size and parent vs. children discuss about advertisement of meals and health of society.

*Statistical analysis:* Descriptive analysis has been done for the health, nutritional status, socio-economic, demographic and student activates factors. Contingency chi-square test has been used to understand association between health and nutritional parameters and socio-economic, demographic and cultural variables. Multinomial logistic regressions have been performed to identify the significant factors

associated with underweight and overweight/obesity. Age has been adjusted as and when necessary. The data was analyzed with 'Statistical Package for Social Sciences (SPSS)' version 20.0. A value of $p<0.05$ was regarded as statistically significant in the analysis.

## RESULTS

In this study, 800 (boys 474 and girls 326) primary school students were considered as participants for investigating their nutritional status, and it was measured by the percentile of their body mass index (BMI). The prevalence of under-nutrition (underweight) in our sample population was 6.4%, the value was higher among girls (9.8%) compared to boys (4.2%). The prevalence of healthy weight (normal weight) of children was 78.8% with 79.3% for boys and 77.9% for girls. The prevalence of over nourished children was 14.8% among them 16.5% were boys and 12.3% were girls respectively (Table 1).

TABLE 1

*Prevalence of body mass index (BMI) percentile among primary school children aged 6-10 years in Rajshahi district of Bangladesh*

| | Children BMI group | | | |
|---|---|---|---|---|
| Gender | Underweight | Normal weight | Overweight and obese | Over all |
| Boys | 20(4.2%) | 376(79.3%) | 78(16.5%) | 474(59.2%) |
| Girls | 32(9.8%) | 254(77.9%) | 40(12.3%) | 326(40.8%) |
| Over all | 52(6.4%) | 630(78.8%) | 118(14.8%) | 800(100%) |

Chi-square test was utilized in this study to select the independent variable for multinomial logistic regression model. Only the factors which were significantly associated with children malnutrition were considered as the independent variables for multinomial logistic regression model.

## MULTINOMIAL LOGISTIC REGRESSION ANALYSIS

### *Underweight Compared to Normal Weight*

Multinomial logistic regression analysis demonstrated that girls were 2.517 times more likely ($p<0.01$) to become underweight (95% CI: 1.334-4.750) than boys. Children of monthly family income of taka 5000 to 10000 were 5.027 times more inclined (95% CI: 2.180-11.592) to become underweight ($p<0.01$) than their counterparts. Children of underweighted father had a 3.258 times higher of getting underweight (95% CI: 1.137-9.331) ($p<0.05$) children compared to children whose father were overweight and obese. Children of underweighted mothers had 11.124 times higher of getting underweight (95% CI: 2.878-42.988) ($p<0.01$) compared to children whose mothers were overweight and obese. Children of normal weighted mothers body size had a 4.115 times more of getting underweight (95% CI: 1.631-10.381) ($p<0.01$) compared to children whose mothers were overweight and obese (see Table 2).

### *Overweight and Obese Relative to Normal Weight*

Multinomial logistic regression analysis demonstrated a positive association between Parent vs. children discuss about advertisement of meals and health of society and children body mass index; No were 1.881 times more likely ($p<0.05$) to become Overweight & Obese (95% CI: 1.111-3.185) than Yes. Children of monthly family income of taka 5000 to 10000 were 2.191 times more inclined (95% CI: 1.155-4.155) to become Overweight & Obese ($p<0.05$) than their counterparts. Children of Overweight & Obese mother had a 0.618 times more of getting Overweight & Obese (95% CI: 0.399-0.957) ($p<0.05$) compared to children whose mother were normal weight (Table 2).

## DISCUSSION

Body Mass Index (BMI) is an important anthropometric index, and it is commonly used for determining the nutritional status of a nation. In the current study, we investigated the prevalence of nutritional status among primary students in Bangladesh. Rajshahi District was our target area, and students of this district were our target population. Multinomial Logistic regression demonstrated that under-nutrition children were especially pronounced among girls came from poor family, and underweight parents. Over-weighted parents was more likely to get overweight children than their counterparts, also a child came from rich family was a more chance to get overweight. The prevalence of stunting,

TABLE 2

*Effects of socio-economic and demographic factors on malnutrition among 6-10 years old school going children*

| Variable | Category | Odd ratio (OR) | 95% CI of OR (Lower-Upper) | | Odd ratio (OR) | 95% CI of OR (Lower-Upper) |
|---|---|---|---|---|---|---|
| Gender | Girls | 2.517** | 1.334-4.750 | Over nutrition | 0.758 | 0.493-1.166 |
| | Boys | Ref | Ref | | Ref | Ref |
| Mothers height | 120-149 cm | 1.815 | 0.838-3.928 | | 0.984 | 0.646-1.498 |
| | 150 cm to above | Ref | Ref | | Ref | Ref |
| Fathers occupation | Others | 1.347 | 0.587-3.087 | | 0.770 | 0.487-1.217 |
| | Agriculture | Ref | Ref | | Ref | Ref |
| Family monthly income | 5000 to 10000 taka | 5.027** | 2.180-11.592 | | 2.191* | 1.155-4.155 |
| | Above 10000 taka | Ref | Ref | | Ref | Ref |
| Fathers body size | Under nutrition | 3.258* | 1.137-9.331 | | 0.676 | 0.241-1.891 |
| | Normal weight | 0.668 | 0.330-1.352 | | 1.238 | 0.775-1.980 |
| | Over nutrition obese | Ref | Ref | | Ref | Ref |
| Mothers body size | Under nutrition | 11.124** | 2.878-42.988 | | 1.744 | 0.826-3.680 |
| | Normal weight | 4.115** | 1.631-10.381 | | 0.618* | 0.399-0.957 |
| | Over nutrition obese | Ref | Ref | | Ref | Ref |
| | Parent vs. children discuss about ad of meals and health of society | No | 0.615 | 0.305-1.239 | 1.881* | 1.111-3.185 |
| | | Yes | Ref | Ref | Ref | Ref |

N.B.: *: 5% level of significance, **: 1% level of significance
Ref: Normal weight or healthy weight

overweight and wasting of Afghanistan was 40.9%, 5.4% and 9.5% respectively; China was 9.4%, 6.6% and 2.3% respectively (Martineau *et al*., 2014). Iraq was 22.6%, 11.8% and 7.4% respectively (Martineau *et al.,* 2014). Maldives was 20.3%, 6.5% and 10.2% respectively (Martineau *et al.,* 2014) and Zimbabwe was 27.6%, 3.6% and 3.3% respectively (Martineau *et al.,* 2014). The prevalence of stunting, overweight and wasting of Bangladesh is 36.1%, 1.4% and 14.3% respectively (Martineau *et al*., 2014). The high percentages in less than 5 year olds of moderate and severe underweight in Afghanistan (33), Bangladesh (41), Bhutan (13), India (43), Maldives (17), Nepal (39), Pakistan (31) and Sri Lanka (21) indicate the need for urgent attention. (38th General Internal Medicine 2015).The high percentages of stunted linear growth in children in South Asia [Afghanistan (59), Bangladesh (43), Bhutan (34), India (48), Maldives (19), Nepal (49), Pakistan (42) and Sri Lanka (17)] is alarming, because of its association with long term adverse effects for the stunted individual and for society (Khadilkar *et al.,* 2016). The percentage of overall overweight and obesity was 7.6 and 1.1 in Bangladesh, 23.4 and 5.3 in Bhutan, 11 and 1.9 in India, 51.4 and 19.4 in Iran, 35.4 and 12.9 in Maldives, 9.1 and 1.4 in Nepal, 27.1 and 7.8 in Pakistan and 21.9 and 5.1 in Sri Lanka (Khadilkar *et.al.,* 2016). The similar study of different region we got the following results: The chances of becoming obese at age 11 years were 5.7% (95% CI: 5.2 to 6.2%) for a normal-weight 5-year-old child and 32.3% (95% CI: 29.8 to 34.8%) for an overweight 5-year-old child (Mead *et.al.,* 2016). An obese 5-year-old child had a 68.1% (63.8 to 72.5%) chance of remaining obese at 11 years .Severely obese 5-year-old children had a 50.3% (95% CI :43.1 to 57.4%) chance of remaining severely obese. There were no substantial differences between sexes (Mead *et.al*, 2016). No deprived obese 5-year-old boys had a lower probability of remaining obese than deprived obese boys: -21.8% (-40.4 to -3.2%). This association was not observed in obese 5-year-old girls, in whom the

no deprived group had a probability of remaining obese 7% higher (-15.2 to 29.2%). The sex difference in this interaction of deprivation and baseline weight status was therefore -28.8% (-59.3 to 1.6%) (Mead *et al.,* 2016). Children who remain living low-income throughout childhood were more likely to maintain overweight (AOR = 2.55, 95% CI = 1.03, 5.42) and children who moved into low-income during childhood were more likely to be obese (AOR = 2.36, 95% CI = 1.12, 5.93) compared to children who were never low-income. Maternal overweight/obesity was significantly associated with a child become obese (AOR = 8.31, 95% CI = 3.80, 18.20), become overweight (AOR = 2.37, 95% CI = 1.34, 4.22), and stay overweight (AOR = 1.79, 95% CI = 1.02, 3.14). Excessive gestational weight gain was associated with increased likelihood of a child becoming overweight trajectory (AOR = 2.01, 95% CI = 1.01, 4.00) (Demment *et al.,* 2014). The sample of 595 children included 306 girls (51.4%) and 289 boys (48.6%), as reported in four hundred thirty-eight children (73.6%) had a normal BMI between the 88th and 16th percentile, and 92 (15.5%) were overweight (57 cases, 9.6%) or obese (35 cases, 5.9%), respectively. The prevalence of thinness was 10.9% (65 cases): grade 1 was detected in 29 cases (4.9%) and grade 2 in 36 (6%), respectively. Prevalence of obesity and thinness grades 1 and 2 were not different significantly in males and females (6.2% versus 5.6%, 4.8% versus 4.9%, and 5.6% versus 6.5%, resp.). The prevalence of overweight was statistically significant between genders (13.1% males versus 6.2% females) (Demment *et al.,* 2014). In another article the sample comprised 300006 adults (Booth, Prevost and Gulliford, 2014:39). "The initial sample included 300 006 participants (see Booth, Prevost and Gulliford, 2014:39) After excluding participants with no BMI data for the years 2005-11, 223089 (74%) patients remained, contributing 1374109 person – years of observation to the analysis. BMI was recorded in year for 49% of person – time after imputation; individuals" (extracted from original article). After excluding participants with BMI never recorded, data were analyzed for (74%) contributing person–years. In normal weight men, the standardized prevalence of multimorbidity was 23%, raising to 27% in overweight, 33% in category I obesity, 38% in category II and 44% in category III obesity. In women, the corresponding values were 28%, 34%, 41%, 45% and 51%. In category III obesity, the adjusted odds, relative to normal BMI, were 2.24 (2.13-2.36) for a first condition; 2.63 (2.51-2.76) for a second condition and 3.09 (2.92-3.28) for three or more conditions. In a cross-sectional analysis, 32% of multimorbidity was attributable to overweight and obesity (Chen *et al*., 2016). Unadjusted rates of being underweight varied from 12.6% (Egypt) to 31.9% (Djibouti), while being overweight ranged from 8.7% (Ghana) to 31.4% (Egypt). Obesity rates ranged from 0.6% (Benin) to 9.3% (Egypt). Females had a higher overweight prevalence for every age group in five of the countries, exceptions being Egypt and Malawi. Overall, being overweight was more prevalent among younger (d"12) adolescents and decreased with age. Males had a higher prevalence of being underweight than females for every country. There was a tendency for the prevalence of being underweight to increase starting in the early teens and decrease between ages 15 and 16. Most of the potential risk factors captured by the GSHS were not significantly associated with weight status (Blum *et al.,* 2014). A total of 842 children born in 2005 were identified. Of those, 72% (N = 607, 308 boys and 299 girls) had a recorded weight and height in the study period. In total, 74.6% (71.2-78.1) were categorized as of normal weight. The proportion of children with overweight was 15.8% (12.9-18.7) while 6.8% (4.8-8.8) were obese. In all, 2.9% were categorized as thin. The proportion of overweight among boys (12.7%) was lower (p=0.031) than among girls (19.1%), and boys in Nuuk had a lower median BMI compared to the rest of Greenland. No differences in distribution of age and gender-specific overweight and obesity were observed between the capital and the rest of Greenland (Rex *et al*., 2014). It is important to determine the risk factors which are to be associated to malnutrition among primary students in Bangladesh. Clearly, more studies are required regarding BMI. These results suggest that there are dual burden of malnutrition among primary school children in Bangladesh. Under nutrition is the common phenomenon in Bangladeshi children especially for girls, living in poor family; the other hands over-nutrition is common for boys and living in rich family. Consequently, malnutrition can be

considered as one of the major health problems of Bangladeshi children and requires attention.

## CONCLUSIONS

The results from the present study suggest that father's occupation, family monthly income, parents BMI, gender, mothers height, and parent vs. children discuss about advertisement of meals and health are significantly common factors which affect children's nutritional status in the rural area of Rajshahi district, Bangladesh. Consequently, malnutrition can be considered as the major health problem for school going children in Bangladesh. Government and Nongovernment health organizations should take care of malnutrition children, and try to early detect and provide appropriate treatment of malnourished children.

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