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Factors Influencing Nutritional Status of School Going Children in Rural Area of Rajshahi District, Bangladesh: Multiple Regression Analysis

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Abstract

Malnutrition (underweight and overweight/obese) is a major public health problem in any community. Overweight and obese children are more likely to become overweight and obese adults and adult obesity is associated with a number of serious health conditions such as heart disease, diabetes, and some cancers. Body mass index (BMI) is an important indicator to measure nutritional status in a particular population. The aim of the present study was to determine the risk factors for nutritional status among school going students in the rural area of Rajshahi, Bangladesh. Data were collected from 800 students from Rajshahi rural area using a stratified sampling technique between May and October 2015. Multiple regression analysis was used to determine the risk factors for BMI of school going children. The mean age of the student was 7.86±1.35 with range 6 to 10 years. The mean BMI of school going children was 16.60±2.36 kg/m^2, with an increasing tendency was observed with increasing age. The mean value of BMI of boys was higher than that of girl for each age. The prevalence of underweight and overweight/obese among school

going children were 6.4% and 14.8% respectively. Stepwise regression analysis showed that students' upper arm circumference ($p<0.01$), family income ($p<0.01$), mothers' education level ($p<0.01$), mothers' age ($p<0.01$), students' hip circumference ($p<0.01$), fathers' BMI ($p<0.01$) and birth order of children ($p<0.01$) were most important predictors of children BMI. A remarkable number of malnutrition of school going children is found in this study. We find some modifiable risk factors which are related to children BMI. Consequently, malnutrition can be considered as a major health problems of Bangladeshi school going children and requires attention.

Keywords: School going children, Malnutrition, Rajshahi district, Multiple linear regression.

AMS Classification: 62J05.

1. Introduction

Malnutrition (underweight and obese) is a major problem in public health of a particular community. Obese children are more likely to become obese adults (Simmonds, M et.al. 2016) and adult obesity is associated with a number of serious health conditions including heart disease, diabetes, and some cancers (Dietz, W. H et al., 2016). On the other hands underweight children are more likely to develop gastro esophageal reflux disease (GERD), inflammatory bowel disease, chronic vomiting or diarrhea (Koch, K. L., et.al. 2016).The prevalence of under-nutrition and over-nutrition may provide useful information about child health, and reflect the general living environment of a given population. In recent years, this obesity is dramatically increasing throughout the world both in developed and developing countries. WHO reported that in worldwide 22 million under-five aged children are obese (Liu, L., et.al. 2016). It is estimated that

overweight and obesity for school-aged children in the year 2010 is, 1 in 5 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 (Song, Y., et al., 2016). The prevalence of obesity has increased 54% among 6-11 years old children in India (de Kroon, M. L. et al., 2016). In Bangladesh, the prevalence of malnutrition of rural primary school children are as follows 24.34% mild malnutrition, 34.20% moderate malnutrition and 24.06% are severe malnutrition (Ara et al., 2012).

The aim of the present study was to determine the risk factors for nutritional status among school going students in the rural area of Rajshahi district in Bangladesh.

2. Materials and Methods

2.1 Materials

This cross-sectional study was conducted using multistage stratified sampling procedure. Four types of schools (government, semi-government, private and madrasah) were selected for the finding of socio-economic differences for nutritional status of school going children. It has been assumed that students from lower and middle class family go to government or semi-government schools or madrasah, whereas children from upper middle and high income groups attend private or English medium schools. The age range of the subject was 6 to 10 years, who were generally studying in class one to five at the rural area of Rajshahi district in Bangladesh. The date of birth of each student 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. Body mass index (BMI), defined as the ratio of weight in kilograms to height squared in meters, was calculated. The parent's socio-economic and demographic factors were collected using a standard questionnaire. This study sample consisted of 800 (boys 474 and girls 326) at the rural primary school, kintegartain and madrasah of Rajshahi, Bangladesh. Data was collected from May to October 2015.

The outcome variable of this study was child's nutritional status (BMI), and the independent variables were; gender, father's occupation, birth order, mother's height, number of birth child, number of alive child, family monthly income, father's body size, mother's body size, student's HIP and mid upper arm circumference.

2.2 Methods

The nutritional status of children was measured by BMI percentile. The BMI percentile 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, (ii) Healthy weight (normal weight)-BMI 5^{th} percentile up to the 85^{th} percentile, (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). Data was collected from May to October 2015.

Sample size was determined using an appropriate statistical formula. The formula provided that the significant sample size was 400 but we were considered 800 for the present study.

2.3 Statistical Analysis

Descriptive analysis was done for the health, nutritional status, socio-economic, demographic and student activates factors. Multiple regressions were performed to identify the significant factors associated with BMI. Stepwise regression analysis was used in this study for identified the best model.

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.

3. Results and Discussion

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 their body mass index (BMI). The Kolmogorov-Smirnov test was used for testing the normality, and this test showed that our data (BMI) were normally distributed. The mean age of the students was 7.86±1.35 years with the range 6 to 10 years. The mean value of BMI among boys (16.73±2.49 kg/m^2) was higher than that of girl (16.41±2.15 kg/m^2). At age 7 year girls had significantly ($p<0.05$) higher BMI than boys but at 9 years boys had significantly higher ($p<0.05$) BMI than girls (Table1).

Table 1: BMI of School going children in the rural area of Rajshahi by gender

	Boys		Girls		
Age	N	Mean ± SD	N	Mean ± SD	Mean Differences
6	117	15.94±1.19	47	15.61±1.49	0.33
7	85	15.34±1.11	95	15.84±1.80	-0.50*
8	74	16.36±2.16	102	16.48±2.22	-0.12
9	109	18.17±3.50	52	17.07±2.83	1.10*
10	89	17.62±2.26	30	18.06±1.04	-0.44
Total	474	16.73±2.49	326	16.41±2.15	0.32

Note: *5% level of significance

Similar study we have found the mean body mass index of the distribution of lipid profiles in Chinese children differed between younger and older age groups and the tendency of these lipid levels remarkably fluctuated during 10 to 14 years old. BMI had better practical utility in identifying dyslipidemia among school-aged children with obesity compared with other anthropometric measures (Yanna Zhu1 et.al 2016).

Table 2 shows the prevalence of body size among school going boys and girls. The prevalence of underweight and overweight/obese among school going children were 6.4% and 14.8% respectively. The prevalence of underweight among girls (9.8%) was higher than that of boys (9.2%) while the prevalence of overweight/obese among boys (16.5%) was higher than that of girls (12.3%). We observed that near to 80% boys and more than 77% girls were normal weight (Table 2).

Table 2: Prevalence of body mass index percentile among primary school children aged 6-10 years in Rajshahi District of Bangladesh

BMI category of Students	Boys N (%)	Girls N (%)	Total N (%)
Underweight	20 (4.2)	32 (9.8)	52 (6.4)
Healthy weight or Normal weight	376 (79.3)	254 (77.9)	630 (78.8)
Overweight and Obese	78 (16.5)	40 (12.3)	118 (14.8)
Total	474 (59.2)	326 (40.8)	800 (100.0)

3.1 Multiple Regressions Analysis

The multiple regression model used was:

$$BMI = \beta_0+\beta_1 FBS+\beta_2 G+\beta_3 BO+\beta_4 MH+\beta_5 SUAC+\beta_6 FMI+\beta_7 MEL+\beta_8 MA+\beta_9 HIP+\beta_{10} BY+\mathcal{E} \quad (1)$$

where body mass index (BMI) was the response variable and the other variables were predictors: father body mass index (FBS), gender of students (G), birth order of children (BO), mother's height (MH), students' upper arm circumference (SUAC), family income (FMI), mothers' education level (MEL), mothers' age (MA), students' hip circumference (HIP) and birth year (BY).

The estimated model was:

$$BMI = -309.893 - 0.046\,FBS+0.116G-258BO+0.030MH+0.536SUAC+0.001FMI+0.260MEL+0.089MA+0.103HIP+0.153BY+\mathcal{E} \quad (2)$$

The regression coefficients and the VIF of the independent variables are presented in Table 3. The value of VIF showed that there was no multicollinearity problem among the independent variables. The coefficients of the multiple regression

analysis demonstrated that there was a significant positive association between children BMI and mother education level ($p<0.01$), mothers height ($p<0.01$), mothers age ($p<0.01$), family monthly income ($p<0.01$), students MUAC ($p<0.01$), students' hip circumference ($p<0.01$), birth year ($p<0.01$), and a negative association between body mass index and birth order of student ($p<0.01$), and fathers body mass index ($p<0.01$). On the other hand gender is insignificantly and positively associated with children body mass index (Table 3).

Table 3: Effect of risk factors on BMI of school going students

Predictor	Coefficient	t-value	p-value	VIF
(Constant)	-309.893	-2.607	0.009	
Gender of student	0.116	0.871	0.384	1.098
Birth order of student	-0.258	-3.034	0.002	1.313
Mother education level	0.260	2.653	0.008	1.535
Mothers height	0.030	2.870	0.004	1.138
Mothers age	0.089	4.649	0.001	1.342
Family income	0.001	-7.300	0.001	1.580
Students MUAC	0.536	9.932	0.001	2.94
HIP	0.103	5.456	0.001	2.632
Fathers' BMI	-0.046	-1.865	0.063	1.086
Birth year	0.153	2.589	0.010	1.625

3.2 Stepwise Regression Analysis

The stepwise regression analysis showed that a student mid upper arm circumference was included in the first step (Table 4). The R^2 value indicated that there was a 37.4% reduction in the total variation of the BMI due to the predictor variable of students' MUAC for their BMI. The second step included both the students MUAC and family monthly income, and the R^2 value now indicated a 39.2% reduction in the total variation of BMI due to these two predictors. The third step included students MUAC, family income and students' HIP with the R^2 value, indicating a 41.3% reduction in the total variation in the BMI due to these three variables. The fourth step included students' MUAC, family income, students' HIP, and mother age of student with an R^2 demonstrating a 42.0% reduction in the total variation of the BMI due to these four variables. The fifth step included students MUAC, family income, students' HIP, mother age and birth order of student, which led to a 42.7% reduction in the total variation of the BMI. The sixth step included students MUAC, family income, students' HIP, mother age, birth order of student and mother education level, which led to a 43.3% reduction in the total variation of the BMI. The seventh step included students MUAC, family income, students' HIP, mother age, birth order of student, mother education level and birth year of student which led to a 43.7% reduction in the total variation of the BMI and the final step included students MUAC, family income, students' HIP, mother age, birth order of student, mother education level, birth year of student and fathers' body mass index, which led to a 44.1% reduction in the total variation of the BMI due to these eight variables. These results demonstrated that the important socio-demographic factors that influenced the BMI were family monthly income, mother's age, mother education level,

students' mid upper arm circumference, family income, students' hip circumference (Table 4).

Table 4: Summary of the stepwise regression analysis for selected socio-demographic factors

Step	St1	St2	St3	St4	St5	St6	St7	St8
	Co	Co	Co	Co	Co	Co	Co	Co
Students' MUAC	0.723	0.699	0.493	0.490	0.486	0.500	0.542	0.548
Family income		-7.81E-5	-9.55E-5	-9.52E-5	0.00	0.00	0.00	0.00
Students' HIP			0.099	0.097	0.094	0.098	0.102	0.102
Mothers age				0.052	0.077	0.085	0.091	0.096
Birth order of student					-0.262	-0.246	-0.275	-0.288
Mother education level						0.285	0.274	0.283
Birth year of student							0.139	0.145
Fathers' body mass index								-0.058
No of variable	1	2	3	4	5	6	7	8
R Square (%)	37.4	39.2	41.3	42.0	42.7	43.3	43.7	44.1
Adjusted R Square (%)	37.3	39.1	41.1	41.7	42.4	42.9	43.2	43.5

Note: St= Step, Co= Coefficients

Table 5: Mean and Standard deviation of height and weight of primary school children age 6-10 years in Rajshahi District of Bangladesh

Age	N	Gender	Mean(Height) cm	SD(Height)	Mean(Weight) kg	SD(Weight)
6	47	Girl	112.57	3.86593	19.7872	2.62874
6	117	Boy	115.88	5.70112	21.4701	2.87550
7	95	Girl	122.39	5.56068	23.6211	2.16441
7	85	Boy	121.06	7.68944	22.5412	3.00219
8	102	Girl	124.43	6.84844	25.5686	4.32243
8	74	Boy	126.26	6.18008	26.1622	4.59609
9	52	Girl	131.60	7.03844	29.6923	6.12145
9	109	Boy	131.35	5.81883	31.2110	5.89424
10	30	Girl	140.53	5.28324	35.7000	3.20721
10	89	Boy	136.15	9.02843	32.6854	7.08968

5. Conclusions

A total of 800 students were interviewed and examined. A remarkable number of malnutrition of school going children is found in this study. The study found that the mean body mass index of primary school students at Rajshahi district in Bangladesh was 16.60±2.36 kg/m^2, with an increasing tendency was observed with increasing age. The mean body mass index of Bangladeshi primary school students varied from 15.60 to 17.81 kg/m^2. Stepwise regression analysis

demonstrated that the most important predictors for school going students of Rajshahi district in Bangladesh were: students' MUAC, family income, students' HIP, mothers' age, birth order of student, mother education, birth year of student and fathers' BMI. We observed that most of the predictors for children BMI were modifiable risk factors. Consequently, malnutrition can be considered as major health problems of Bangladeshi school going children and requires attention.

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