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Original article

Nutritional Status and Academic Performance of High School Students (Level 6 - 8) in Rajshahi District, Bangladesh

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ABSTRACT

School education is a vital stage in the development of the consciousness and personality of children. The study on the effect of nutritional status on academic performance among high school students (level 6 to 8) are poorly documented in Bangladesh.

The main objective of this study was to investigate the effect of nutritional status on academic performance of level 6 to 8 students in Rajshahi district, Bangladesh. Data was collected from the different schools in urban and rural locations of the region. Multi stages sampling was used for selecting the sample. Frequency distribution and descriptive statistics were used.

In this study, 51.9% and 48.1% female and male students were considered, among them 50.9% and 49.1% came from urban and rural areas respectively. This study revealed that the mean height, weight and body mass index (BMI) of students were 151.00±9.12 cm, 41.42±9.37 kg and 18.08 ±3.39 kg/m^2 respectively. The mean height, weight and BMI of urban students were higher than rural students. This study revealed the significant relationship ($p < 0.01$) between the nutritional status and the academic results regarding the high school students from rural and urban. The average grade point average (GPA) of 6 to 8 level students was 3.70, and it was noted that the average GPA of urban students was higher than rural students.

Furthermore, the study observed that some modifiable factors such as wealth index, education, residence, mothers' anemia were associated with mothers and their under five children malnutrition in Bangladesh. These factors can be considered for reducing the frequency of malnutrition among mothers and their under five children in Bangladesh.

Key words: Nutritional status, Academic performance, High school students, Rajshahi

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INTRODUCTION

Children are considered the greatest national resource of any country who will build the future of the Nation. Schooling is an instrument of individual and social change, increasing the probabilities of general well-being (UNESCO, 1984). Primary and junior high school education is a vital stage in the development of the consciousness and personality of the child as it is at this juncture that a whole new world of bright ideas and knowledge open up in front of their eyes. At this stage children are extremely inquisitive and elementary education must encourage this tendency among the children. The development of a nation is closely interlinked with the education level and nutritional status of its population. Various studies have provided evidence of the importance of proper nutrition to the cognitive development of an individual which also affects their educational achievements.

Nutrition is an endogenous factor that affects the learning ability and skills before and after the child is in school (UNESCO, 1984). Several studies on the relationship between undernutrition, wasting, stunting and academic achievement have been published (Pollitt, 1990; Themane et al., 2003; Mukudi, 2003; Ivanovic et al., 2004 and Cueto, 2005) and all of them have reported significant associations between nutritional status indicators and cognitive test scores or school performance indicators. The relationship between nutrition, health and educational achievement of school-age population in less-developed countries has been of interest to many researchers due to the frequent observation that many children did not complete primary education and those who completed, did not perform well as children in the developed countries. Several studies in developing countries found that height-for-age, which is an indicator of stunting, is related to educational achievement (Shariff et al., 2000; Glewwe et al., 2001; Alderman et al., 2001 and Aturupane et al.,2006). Height-for-age reflects the accumulation of nutritional deprivation throughout the years, which may consequently affect the cognitive development of the children (Shariff et al., 2000). The high prevalence of underweight among children is serious health concern in Bangladesh and nutritional status influence students' academic performance directly or indirectly (Hossain et al, 2014). Poor health and nutrition among children reduce their time in school and their learning during that time (Paul et al, 2008). The United Nations estimates that one third of preschool age children in less developed countries (a total of 180 million children under age 5) experience stunting

growth relative to international norms (United Nations, 2000), while hundreds of millions suffer from tropical diseases, including malaria and intestinal parasites (WHO, 2000). To the extent that poor health and nutrition among children has a negative impact on their education, increase children's health status will also improve their education outcomes. Given the importance of education for economic development (World Bank, 2001), this link could be a key mechanism to improve the quality of life for people in less developed countries. Utilization of health services is a complex behavioral phenomenon. Empirical studies of preventive and curative services have often found that the use of health services is related to the availability, quality and cost of services, as well as social structure, health beliefs and personal characteristics of the users (Ahmed, et al, 2012; Faruque, 2008; UNFPA 2000). School age is the active growing phase of childhood. Primary and junior high school age is a dynamic period of physical growth as well as the mental development of the child. Research indicates that health problems due to miserable nutritional status in primary school- age children are among the most causes of low school enrolment, high absenteeism, early dropout and unsatisfactory class room performance. Under nutrition in childhood is one of the reasons behind the high child mortality rates observed in developing countries. Chronic under nutrition in childhood is linked to slower cognitive development and serious health impairments later in life that reduce the quality of life of individuals. Nutritional status is an important index of this quality. In this respect, understanding the nutritional status of children has far- reaching implications for the better development of future generations (Srivasstava & Mahmood, 2012).

Lahey and Rosen (2010) opined that nutrition affects learning and behavior and suggested that diet can influence cognition and behavior in many ways, which include the condition of not enough nutrition or the condition of the lack of certain nutrients. About one-third of children who completed a food-habit questionnaire had inadequate fruit and vegetable intake. These students also showed poor school performance as compared to those students who had an adequate intake of fruits and vegetables (Lahey & Rosen, 2010). Academic performance was measured by a test designed to assess basic school performance. Li et al. (2008) observed that being overweight was not the root cause of poor academic performance but found that obese adolescents consider themselves worse students. To the best of our knowledge, many studies of nutritional status among children and their academic performance

have been done with other populations, and such kind of important study is poorly documented in Bangladesh.

The aim of this study was to investigate the relationship between nutritional status and academic performance among high school (level 6-8) students in Rajshahi district, Bangladesh.

MATERIALS AND METHODS

Target Area and Population:

In this cross-sectional study, Rajshahi district was the target area and all high school (level 6-8) students were considered as our target population. Rajshahi is one of the old districts in Bangladesh with population density of 4,890/km and is located at the border with India separated by the Padma river (Uddin et al. 2014).

Sample size determination and sampling procedure:

An appropriate mathematical formula was used for calculating sample size for this study; where 80% power of study and 5% level of significance were considered. The formula provided that 500 students was the aquacade sample size for the present study. However, 600 students (20% extra) were considered for the study for allowing some failure cases. Multistage stratified random sampling was utilized for selecting sample from the population. In the first stage, 3 *Upazilas* (sub-districts) were selected randomly from 9 *Upazilas* in Rajshahi district. In the second stage, 3 high schools (one of them from urban) were selected randomly from each selected *Upazilas*. In the third and final stage, 67 students were selected from each selected school by stratified random sampling with proportional allocation. The information of students was collected from respective school. Before, collecting data, we discussed about our research with students and teachers, and were taken written permission and consent from respective school authority and each student if he/she agreed, respectively.

Data collection:

A standard pre-tested questionnaire was used to collect information from each of our selected student. We prepared a questionnaire and sent to some experts for taking their opinions/suggestions. We followed experts' suggestions and revised our questionnaire. Some

information had been taken from their school records. Body mass index (BMI) was derived from students' weight (in kg) and height (in meter), BMI=$\frac{\text{weight(kg)}}{\{\text{height(m)}\}^2}$. Weight and height were measured by weighng machine without shoes and bulky clothing and stadiometer without shoes respectively.

Variables:

Student's results of the last annual examination, and their nutritional status were our outcome variables. Results were collected from student's school records. BMI percentile was considered for measuring nutritional status of school children (level 6 -8). Students were classified by their nutritional status such as (i) under nourished (BMI percentile<5^{th}), (ii) normal weight or healthy (5^{th} <BMI percentile<85^{th}) and (iii) over nourished (BMI percentitle≥85^{th}) ((WHO, 2006). The results were classified into four grades according to GPA (Table 1).

Table 1: Nutritional status corresponding to BMI percentile and the academic result grade classification used in this study

Categories of BMI percentile	**Nutritional Status**
≥ 95^{th} Percentile	Obese
85^{th} to < 95^{th} Percentile	Overweight
5^{th} to < 85^{th} Percentile	Healthy Weight
< 5^{th} Percentile	Underweight
Academic results in grade point average range	**Academic result grade**
< 3.00	B
3.00 - 3.99	A-
4.00 – 4.99	A
5.00	A+

Some socio-economic and demographic variables were collected from each selected student. These variables were selected on the basis of previous studies. Most of the independent variables were selected on the basis of one of the previous studies (Hossain et al, 2014).

Statistical Analysis:

Frequency distribution and descriptive analysis of the socio-economic and demographic variables were performed for calculating the prevalence of nutritional status and the status of the other variables of students respectively. The Chi-square test was performed to find the association between the nutritional status (BMI) and the other variables. To find the significant difference between two mean values, the t-test was used. The ANOVA was used to determine the variation among three or more groups. Finally, the multinomial logistic regressions have been performed to identify the significant effect of the variables associated with the nutritional status of the school going students considered in this study. A p-value < 0.05 was considered as statistically significant in this study. SPSS (IBM, Version 20) was used to analyze the data.

RESULTS AND DISCUSSION

A total number of 405 students of level 6 to 8 living in Rajshahi district, Bangladesh were recruited as participants for studying their nutritional status and academic performance. Out of total participants 199 (49.1%) and 206 (50.9%) were from urban and rural areas respectively, and male and female students were 195(48.1%) and 210 (51.9%) respectively. The descriptive statistics of level 6 to 8 high school student's socioeconomic and demographic variables were calculated with 95% confidence interval (CI) of each mean by their residence and gender. The age difference between the male (13.16±1.223 years) and female (13.06±1.088 years) students from rural (13.16±1.09 years) and urban (13.06±1.22 years) area was statistically insignificant (p-value > 0.05) when the mean age of the entire students was 13.11±1.15 years. The mean height and weight of the students are 151±9.12 cm and 41.42±9.37 kg respectively. The mean difference of height of the students according to their residence (rural=150.33±9.12 cm; urban=151.65±9.82cm) was statistically insignificant (p-value >0.05), when it was noted that the mean height of male students (153.74±10.45 cm) was significantly higher than that of female students (148.45±6.79 cm) (p-value <0.001). The mean difference between the weight of the male (42.38±10.77 kg) and female (40.54±7.76 kg) students as well as between the weight of students from rural (39.15±7.81 kg) and urban (43.63±10.20 kg) both are statistically significant (p-value <0.001). It was observed that most of participants (33.3%)

family income was 15001-25000 *taka* (Bangladesh currency), 32.3% participants family income were 10001-15000 taka. Some participants (18.5%) family incomes were below 10000 taka and 15.8% participants' family incomes were above 25000 takas.

Prevalence of nutritional status and descriptive statistics of academic results:

In this study, nutritional status (i.e. BMI percentiles) and academic performance were investigated among school going students in Rajshahi district, Bangladesh. The prevalence of nutritional status i.e. BMI percentile of the students of level 6 to 8 is provided in **Table 2.**

Table 2: The frequency distribution of the nutritional status according to the BMI percentiles of the students of level 6-8 in Rajshahi district, Bangladesh

Gender	**Children BMI Group**				**Overall (N, %)**
	Underweight (n, %)	Healthy Weight (n, %)	Overweight (n, %)	Obese (n, %)	
Male	14 (7.18%)	153 (78.46%)	21 (10.77%)	7 (3.59%)	195 (48.15%)
Female	6 (2.86%)	172 (81.91%)	19 (9.05%)	13 (6.19%)	210 (51.85%)
Type of residence					
Urban	13 (6.31%)	145 (70.39%)	31 (15.05%)	17 (8.25%)	206 (50.85%)
Rural	7 (3.52%)	180 (90.45%)	9 (4.52%)	3 (1.51%)	199 (49.15%)
Overall	20 (4.94%)	325 (80.25%)	40 (9.88%)	20(4.94%)	405 (100%)

The average BMI of high school (level 6 to 8) students was 18.08±3.39 kg/m^2 when the mean BMI percentile of urban students (18.89±3.84 kg/m^2) was significantly higher (p-value <0.001) than that of rural students (17.23±2.61 kg/m^2). The mean BMI of male students (17.77±3.58 kg/m^2) was lower than that of female students (18.36±3.19 kg/m^2), and the difference between male and female student's nutritional status (BMI percentiles) was statistically insignificant (p-value >0.05). The prevalence of underweight was 4.94%, where the value was higher among the male students (14, 7.18%) than the female (6, 2.86%) students as well as higher among the urban students (13, 6.31%) than rural students (7, 3.52%). It was observed that the prevalence of female obese students (13, 6.19%) is higher than the male obese

students (7, 3.59%) as well as according to the prevalence of obese urban students (17, 8.25%) suffer from obesity more than the rural students (3, 1.51%). The prevalence of healthy weight and overweight students was almost similar to male and female students **(Table 2)** but, there had significant difference among the urban and rural students **(Table 2)**. The BMI of urban students was higher than that of rural students for each age group. It was observed that the difference in BMI between urban and rural students was statistically significant for each group; i.e 11 years+ ($p<0.01$), 13years+ ($p<0.01$), 14 years+ ($p<0.05$) and 15 years+ ($p<0.01$).

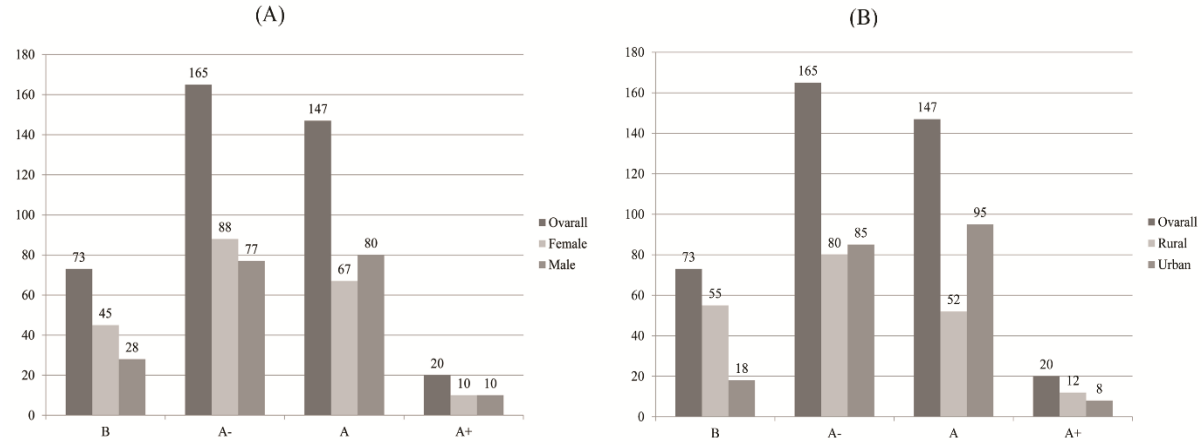

Fig.1: The academic results comparison of the students according (A) to their gender and (B) according to their type of residence

The academic results of the level 6 to 8 high school students were collected in this study from their academic records. From the frequency distribution of academic results, it was observed that most of the students (40.7%) obtained average A- grade (GPA 3.00-3.99), 36.3% students obtained A grade (GPA 4.00-4.99) GPA. Some students (18.0%) obtained B grade (GPA below 3.00) and only 4.9% students got A+ grade (GPA 5.00). It was also observed that the highest number of students (41.0%) at level 6 was obtained A- grade (GPA 3.00-3.99) then followed by 31.0%, 24.6% and 3.0% students got B grade (GPA <3.00), A grade (GPA 4.00-4.99) and A+ grade (GPA 5.00) respectively.

The highest number of students (42.8%) at level 7 was obtained A- then followed by 30.4%, 23.2% and 3.6% students got A grade, B grade and A+ grade respectively. At level 8, the highest number of students (47.4%) got A grade then followed by 38.3%, 8.3% and 6.0% obtained A-, A+ and B grade respectively. These results show that students at level 8 got good

results than students at level 6 and 7. Although the academic results comparison among the male and female students show less significant difference in four grade categories **(Fig. 1A)**, the academic results comparison among the students according to their type of residence (urban and rural) shows the significant differences into four results grades **(Fig. 1B)**.

Association between academic results and other variables:

The association among the variables and the academic results of the high school were observed to find out the variables which are significantly associated with the academic results. Among the socio-economic and demographic variables, the family wealth index, student's order of birth, type of residence and nutritional status (BMI percentiles) showed significant association (p-value <0.01) **(Table 3).**

Association between GPA and gender; GPA and type of residence; GPA and family income of school going students for each level were observed. It was observed that girl's result was better than boy's results for each level. Fisher exact test demonstrated that only the association between results and gender at level 7 was statistically significant ($p<0.01$), while the association at level 6 and 8 students were not significant ($p>0.05$). Though the association between student's living place and academic result are significant for all level 6 and 8, but the family income is significantly associated with the result ($p<0.01$). It was noted that the increasing of students' results with increasing their family income. On the other hand, order of birth and BMI of the school going students are significantly associated with their academic results ($p<0.01$). This result suggests that money is essential for getting good results among school going students in Bangladesh. A student needs money for admission a coach center and for a good tutor because in Bangladesh only school teaching is not enough for getting good results.

Relation between academic results and nutritional status among school going students at level 6 to 8

The correlation co-efficient between BMI and academic results was found that positive correlation ($r = 0.188$) between students' BMI and their academic results ($p<0.01$) (**Table 4**). The mean results of students by their nutritional status have been checked. It was noted that increasing the results with increasing nutritional status among students. Before going to apply

ANOVA, we checked the standard assumption of ANOVA. Earlier we mentioned this data is no serious problem regarding the normal distribution. The Levene test applied to check homogeneity of variances in results among nutritional status, and it was found that the data was homogeneous.

Table 3: Association between the academic results and the other significant variables

Variables (N, %)	**Result groups**				**χ^2-value**	**p-value**
	B (n(%))	**A- (n(%))**	**A (n(%))**	**A+ (n(%))**		
Wealth index (N, %)						
<=10000 (75, 18.5%)	10(13.3%)	38(50.7%)	27(36.0%)	0(0.0%)	53.83	p<0.01
10001-15000 (131, 32.3%)	30(22.9%)	60(45.8%)	39(29.8%)	2(1.5%)		
15001-25000 (135, 33.3%)	32(23.7%)	52(38.5%)	42(31.1%)	9(6.7%)		
25000+ (64, 15.8%)	1(1.6%)	15(23.4%)	39(60.9%)	9(14.1%)		
Order of Birth (N, %)						
Position One (176, 43.5%)	29(16.5%)	69(39.2%)	69(39.2%)	9(5.1%)	5.813	p<0.01
Position Two (143, 35.3%)	24(16.8%)	56(39.2%)	55(38.5%)	8(5.6%)		
Position three and above (86, 21.2%)	20(23.3%)	40(46.5%)	23(26.7%)	3(3.5%)		
Type of place of residence (N, %)						
Urban (206, 50.9%)	18(17.3%)	85(60.9%)	95(21.8%)	8(3.9%)	32.17	p<0.01
Rural (199, 49.1%)	55(26.9%)	80(62.8%)	52(10.3%)	12(6.0%)		
BMI Group (N, %)						
Under weight, (255, 63.0%)	53(20.8%)	107(42.0%)	85(33.3%)	10(3.9%)	9.52	p<0.01
Normal weight, (137, 33.8%)	20(14.6%)	54(39.4%)	54(39.4%)	9(6.6%)		
Overweight or obese, (13, 3.2%)	0(0.0%)	4(30.8%)	8(61.5%)	1(7.7%)		

Table 4: Pearson correlation co-efficient between BMI and academic results of high school students (level 6 to 8)

		BMI	Result
BMI	Pearson Correlation	1	0.188**
	Sig. (2-tailed)		.000
	N	405	405
Results	Pearson Correlation	0.188**	1
	Sig. (2-tailed)	.000	
	N	405	405

N.B.: **. Correlation is significant at the 0.01 level of significant (2-tailed)

ANOVA results for variation in academic results of high school students among their nutritional status are determined. F-test demonstrated that there was a significantly ($p<0.01$) variation in academic results among students having different nutritional status. Post hoc comparison (LSD) test was applied in this study to find pair wise difference in results among students' nutritional status. It was observed healthy and over nourished students had better results than that of under nourished students. The difference in results between under nourished and healthy ($p<0.05$), under nourished and over nourished students ($p<0.05$) were significant. It was also found that over nourished students had better results than healthy students, and the differences between these two results was significant ($p<0.05$). The healthy students got better results than unnourished students.

Multinomial logistic Regressions Analysis:

Multinomial logistic regression analysis was conducted among the academic result and the associated factors which were predefined by the researcher. The multinomial logistic regression interaction model results are represented on Table 5.

A- Grade (GPA 3.00-3.99) compared to B Grade (GPA<3.00)

The multinomial logistic regression analysis demonstrated that the students who have more BMI have a greater (healthy 3.116 times, p-value<0.01; overweight 3.472 times, p-value<0.05; Obese 3.726 times, p-value < 0.05) chance to get good GPA. The urban students are 1.436 more likely to get A- than the rural students (p-Value <0.01). The students from

lower-level classes are more likely to achieve lower GPA than their counterpart (p-value<0.01) (Table 5).

Table 5: Effect of socioeconomic, demographic and nutritional factors on student's academic results obtained from the multinomial logistic regression analysis.

Result group (Ref: GPA-3.00)	**Variables**	**Coefficient (B)**	**p-Value**	**AOR**	**95% CI**	
					lower	**Upper**
GPA 3.00-3.99	**BMI group** (Ref: < 5th Percentile (Underweight))					
	5th to < 85th Percentile (Normal)	3.116	0.009**	22.546	2.195	231.629
	85th to < 95th Percentile (Overweight)	3.472	0.013*	32.186	2.049	505.489
	≥ 95th Percentile (Obese)	3.726	0.021*	41.505	1.748	985.461
	Order of Birth (Ref: Position three and above)					
	Position One	0.305	0.435	1.356	0.632	2.913
	Position Two	-0.016	0.969	0.985	0.451	2.15
	Gender (Ref: Male)					
	Female	-0.074	0.82	0.929	0.49	1.76
	Class (Ref: Class Eight)					
	Class Six	-1.639	0.001**	0.194	0.076	0.497
	Class Seven	-1.446	0.002**	0.235	0.095	0.585
	Type of Residence (Ref: Rural)					
	Urban	1.436	0**	4.203	2.066	8.552
	Family Income (BDT) (Ref: 25000+)					
	<=10000	-0.715	0.53	0.489	0.052	4.567
	10001-15000	-1.811	0.101	0.164	0.019	1.424
	15001-25000	-1.908	0.083	0.148	0.017	1.279

GPA 4.00-4.99	**BMI group** (Ref: < 5th Percentile (Underweight))					
	5th to < 85th Percentile (Normal)	3.611	0.002**	36.985	3.563	383.906
	85th to < 95th Percentile (Overweight)	4.545	0.001**	94.121	5.954	1487.771
	≥ 95th Percentile (Obese)	4.695	0.004**	109.415	4.499	2660.804
	Order of Birth (Ref: Position three and above)					
	Position One	0.772	0.076	2.163	0.921	5.078
	Position Two	0.367	0.408	1.444	0.605	3.445
	Gender (Ref: Male)					
	Female	-0.231	0.506	0.794	0.402	1.568
	Class (Ref: Class Eight)					
	Class Six	-2.158	0**	0.116	0.043	0.308
	Class Seven	-1.983	0**	0.138	0.053	0.355
	Type of Residence (Ref: Rural)					
	Urban	1.744	0**	5.723	2.693	12.159
	Family Income (BDT) (Ref: 25000+)					
	<=10000	-1.613	0.156	0.199	0.021	1.853
	10001-15000	-2.908	0.008**	0.055	0.006	0.471
	15001-25000	-2.75	0.012*	0.064	0.008	0.543
GPA 5.00	**BMI group** (Ref: < 5th Percentile (Underweight))					
	5th to < 85th Percentile (Normal)	3.038	0.031*	20.873	1.331	327.393
	85th to < 95th Percentile (Overweight)	4.673	0.005**	107.049	4.248	2697.471
	≥ 95th Percentile (Obese)	5.153	0.009**	172.987	3.708	8070.036
	Order of Birth (Ref: Position three and above)					
	Position One	0.667	0.402	1.948	0.409	9.269
	Position Two	0.439	0.587	1.551	0.318	7.553

	Gender (Ref: Male)					
	Female	-0.282	0.62	0.754	0.247	2.301
	Class (Ref: Class Eight)					
	Class Six	-2.494	0.001**	0.083	0.018	0.371
	Class Seven	-2.081	0.004**	0.125	0.03	0.517
	Type of Residence (Ref: Rural)					
	Urban	0.227	0.732	1.255	0.342	4.607
	Family Income (BDT) (Ref: 25000+)					
	<=10000	-21.93	0.998**	0.008	0.003	0.120
	10001-15000	-4.691	0.001**	0.009	0.001	0.130
	15001-25000	-3.099	0.009**	0.045	0.004	0.466

N.B: * means p-value < 0.05 and ** means p-value < 0.01

A grade (GPA 4.00-4.99) compared to B grade (GPA <3.00)

The analysis revealed that the students having more BMI (Healthy, overweight) are more likely to achieve good results compared to the BMI group -underweight students (p-value < 0.01) (Table 5). As like as before, the students from lower-level class have less chance to achieve A grade compared to the class eight students (p-value < 0.01) (Table 5) and students from urban area are 1.744 times more likely to achieve good than their counterpart (p-value <0.01). The family income was one of the key factors associated with the quality academic results (Table 5). The students having their family income (FI) 10001-15000 BDT and 15001-25000 BDT are 2.908 and 2.75 times less likely to score A grade results than the students having FI more than 25000 BDT respectively (p-value < 0.05).

A+ Grade (GPA 5.00) compared to B Grade (GPA <3.00)

The multinomial logistic interaction model inclined that the healthy, overweight and obese students are 3.038 (p-value<0.05), 4.673 (p-value<0.01) and 5.153 (p-value<0.01) times higher to get A+ grade than the underweight students. The class six and class seven student are 2.494 (p-value<0.01) and 2.081 (p-value<0.01) times less likely to get A+ grade than the class eight students respectively (Table 5). The type of residence was an effective factor for the A-

and A grade results but for A+ grade result, the type of residence is not significant factor (Table 5). The students having their family income 10001-15000 BDT and 15001-25000 BDT are 4.691 times (p-value <0.01) and 3.099 times (p-value <0.01) less likely to achieve A+ grade compared to the high-income family (Table 5).

CONCLUSION

In this study authors collected data from school going students at level 6 to 8 for investigation of students' nutritional status and their academic results. In addition, the association between nutritional status and academic results among high school students were investigated. For the purpose of the objectives, frequency distribution, Chi-square test, t-test, ANOVA, Post-hoc comparison (LSD) test was considered in this study. Moreover, the multinomial logistic regressions analysis demonstrated that the healthier children are more likely to have good results than the normal or unhealthy children in their high school level. Besides the nutritional status, the family income and their type of residence are also vital influencing factors for the children academic results. These statistical models/techniques/approaches proved that there is a positive correlation between the nutritional status and academic results among high school students in Rajshahi, Bangladesh. Furthermore, some modifiable factors such as wealth index, education, residence, mothers' anemia were associated with mothers and their under five children malnutrition in Bangladesh. These factors can be considered for reducing the frequency of malnutrition among mothers and their under five children in Bangladesh. This study will play a significant role to the policy-maker to take initiatives for the improvement of the nutritional status among the Bangladeshi school going children.

Strength and limitation of this study:

Perhaps this was the first time we attempted to study on nutritional status and academic performance among high school students (level 6-8) in Bangladesh. Appropriate statistical tools/models were used to find the effect of nutritional status on academic performance of school students. However, there were many limitations of this study; (i) we considered only students living in Rajshahi district which is the small part of Bangladesh, it should be considered all high school students in Bangladesh as population, (ii) only high school students

(level 6-8) were considered, it should be considered all levels of students, (iii) some important variables were not considered which were most probably able to put contribution to change the nutritional status and academic performance of students such as parents' education level, parents' occupations, study hour, physical activities etc. It is clear that more research is required regarding nutritional status and academic performance among Bangladeshi students.

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