Prevalence and Determinants of Malnutrition among Under Five Years Children in Bangladesh

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Abstract

Background: Malnutrition is a major health issue in underdeveloped nations like Bangladesh. This research aims to find out the prevalence of nutrition status and determine the associated factors influencing the nutrition status of children under the age of five (0-59 months) in Bangladesh using multiple indicator cluster survey data, 2019. To obtain the most recent prevalence of malnutrition and its associated factors we apply MICS-2019 data since this is the latest version of the available secondary data.

Methods: Body Mass Index (BMI) is used to measure the nutrition status of children. Descriptive statistical tools along with multiple linear regression model are used for data analysis in this study. We also performed an Analysis of Variance (ANOVA) and t-test to test the significance of different factors on under five children's nutritional status.

Results: The mean BMI of children is (15.01 ± 1.44 kg/m^2). The mean BMI of urban area children (15.13 ± 1.47 kg/m^2) is higher than rural area children (14.99 ± 1.43 kg/m^2). The prevalence of underweight, overweight, and obese among under five children is 14.21%, 12.92%, and 2.94% respectively and the prevalence of underweight among girls (17.21%) is higher than that of boys (11.4%) while the prevalence of healthy or normal weight among boys (70.65%) is higher than that of girls (69.15%%). We also found that the prevalence of obesity among girls (2.48%) is lower than that of boys (3.38%) while the prevalence of overweight among boys (14.57%) is superior to that of girls (11.16%) for children of age under five. Also, the analysis shows that gender, age of children, wealth index, area of children, division, and mother's education are significant ($p < 0.05$) determinants of the nutrition status of children.

Conclusion: The government might consider creating specific nutrition intervention approaches to ensure that health education and information are readily available to parents, along with continuous initiatives aimed at enhancing child health. According to our findings, we observed that there are 30.07% of children are in a state of malnutrition. Special attention needs to be paid to the most vulnerable groups, such as children from the poorest socio-economic background or those residing in rural areas. Mothers should be prioritized when designing intervention programs.

Keywords: Malnutrition • Body Mass Index (BMI) • Multiple Indicator Cluster Survey (MICS) • Multiple linear regression • Underweight • Policymakers

Introduction

Malnutrition is defined as the under-nutrition and over-nutrition state of a person. Nutritional assessment is a positive health indicator [1]. One-third of children under five years in low and middle-income countries are malnourished [2]. According to the World Health Organization's report [3], malnutrition leads to a range of health problems and infections [4], and is responsible for more than 64 percent of the annual mortality among children under the age of five, which amounts to 7.6 million deaths globally each year.

In 2013, the United Nations Children's Fund (UNICEF) asserted that malnutrition impedes children's ability to develop their social skills and stunts their physical and mental growth [5]. Bangladesh's under-five children nutritional situation is supposed to be the worst among all Asian countries having 41% underweight [6]. Although the percentage of underweight children decreases day by day till now it is very high.

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In underdeveloped countries, malnutrition is a persistent phenomenon for children under the age of five. One-third of younger children under five in developing nations experience linear growth retardation, also referred to as malnutrition [7]. Approximately 219 million children in developing nations fail to reach their full developmental potential in the first five years of life due to factors such as poverty, poor health, and malnutrition [8]. A global report from 2010 revealed that 16% (104 million) of the world's children were underweight [9]. Equally concerning is the distressing statistic that 10.5 million children under the age of five perish each year across the globe, with 98% of these tragic deaths occurring in underprivileged regions [10]. According to the World Health Organization, malnutrition accounts for approximately 60% of fatalities in children under the age of five in impoverished countries. Recently, a study confirmed that 6.9 million children under five years old have lost their lives worldwide. In comparison, 178 million are stunted, 55 million are debilitated, and 19 million are at high risk of premature death [11].

According to the Multiple Indicator Cluster Survey (MICS) 2012-2013, 32% of children whose age are under five years are malnourished. Also, the Multiple Indicator Cluster Survey (MICS) 2019 shows that the percentage of underweight under-five year's children is 23% out of all under-five children. There are several reasons associated with malnutrition. Malnutrition is linked to poverty, inadequate food production and aid, limited market access, and natural calamities that jeopardize food security [12]. People who are poor and in debt tend to eat simpler foods, which raises the prevalence of diseases and undernutrition.

The risk of morbidity and mortality increases in children who are undernourished [13,14] and has been associated with a slowed rate of mental development [15] decreased intellectual and physical capacity and worse educational performance in adulthood [16].

The main aim of our research is to explore the prevalence of nutritional status, determinants of malnutrition and to analyze the association between socio-demographic factors and child malnutrition among Bangladeshi under-five children.

Materials and Methods

Data and variables

In this research, we applied nationally representative survey data, Multiple Indicator Cluster Survey (MICS 2019), which was developed by the BBS in collaboration with UNICEF using two-step stratified cluster-sampling approach. This is the sixth edition of a survey conducted from January to May 2019, encompassing 3,220 Primary Sampling Units (PSUs) and 64,400 households. The comprehensive data covers 8 divisions and 64 districts, analyzing various socioeconomic factors such as gender, age, urban-rural disparities, maternal educational level, disability, and wealth index quintiles. See the MICS 2019 report for more details [17].

Response variable

The outcome variable of this study was the Body Mass Index (BMI) of children under the age of five. We consider BMI as an outcome variable to assess children's nutritional status because BMI is recognized by the World Health Organization (WHO) as a valid indicator of nutritional status also BMI is widely accepted as the 'gold standard' indicator of malnutrition [18]. Body Mass Index (BMI) was continuous quantity. For the purpose of obtaining the prevalence of nutrition status of under-five children the BMI values were subdivided into four categories according to the World Health Organization (WHO) most widely used categories of BMI for children and these were:

- Underweight-BMI values less than 13.5,
- Normal weight-BMI values 13.5 to 16.5,
- Overweight-BMI values 16.5 to 18.0 and
- Obese-BMI values greater than 18.0.

Predictor variables

This study utilizes a set of independent variables associated with the nutritional status of children under the age of five. These variables include: Gender (male, female), age of children (0, 1, 2, 3, 4), area of residence (urban, rural), wealth index (poorest, lower middle, middle, upper middle, richest), mother's education (pre-primary or none, primary, secondary, higher secondary+), mother's functional difficulties (has functional difficulty, has no functional difficulty), division (Barishal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, Sylhet), ethnicity of household head (Bengali, other), and mother's age.

Methodology

Descriptive and inferential statistical techniques were used to analyze the data. Multiple regressions were performed to identify the significant risk factors associated with BMI. We also performed an Analysis of Variance (ANOVA) and t-test to test the significance of different factors on under five children's nutritional status. We performed an ANOVA test if variables had three or more categories and we performed a t-test if variables had two categories only. The data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 25.0. The analysis cutoff for statistical significance was set at $p < 0.05$.

Results

Body Mass Index (BMI) was used in this study to evaluate the nutritional status of children under the age of five. A total of 19248 under-five children were taken into the sample. In our study, we found that the mean value of BMI among the boys (15.15 ± 1.43 kg/m^2) was higher than that of girls (14.85 ± 1.42 kg/m^2). Here, the age of children '0' means the age from birth to 11 months, age '1' means 12 to 23 months, age '2' means 24 to 35 months, age '3' means 36 to 47 months and age '4' means the age of children is 48 to 59 months (Table 1). At every year age, boys had higher BMI than girls.

	Boys		Girls		
Age	Number of children	Mean ± SD	Number of children	Mean ± SD	Mean differences
0	1811	15.87 ± 1.63	1732	15.54 ± 1.59	0.33
1	1930	15.58 ± 1.37	1881	15.18 ± 1.35	0.4
2	2028	15.22 ± 1.29	1810	14.86 ± 1.28	0.36
3	2097	14.79 ± 1.22	1985	14.58 ± 1.26	0.21
4	2056	14.42 ± 1.56	1918	14.18 ± 1.23	0.24
Total	9922	15.15 ± 1.43	9326	14.85 ± 1.42	0.3

Table 1. BMI of under five children in Bangladesh by gender.

In a similar study, we found the mean body mass index for the assessment of nutritional status among adolescent girls (10 to 19 years) in Afar, Northeastern Ethiopia, differed for different ages between 10 to 19. The BMI measurement is regarded as the "gold standard" for empirical health measurement when compared to other health metrics (Table 2) [19].

BMI category of children	Boys no. (%)	Girls no. (%)	Total no. (%)
Underweight	1131 (11.4%)	1605 (17.21%)	2736 (14.21%)
Normal Weight	7010 (70.65%)	6449 (69.15%)	13459 (69.92%)
Overweight	1446 (14.57%)	1041 (11.16%)	2487 (12.92%)
Obese	335 (3.38%)	231 (2.48%)	566 (2.94%)
Total	9922 (51.55%)	9326 (48.45%)	19248 (100%)

Table 2. Prevalence of BMI (body mass index) among under five children in Bangladesh.

We found that the prevalence of normal weight, underweight, overweight and obese among under-five children were 69.92%, 14.21%, 12.92% and 2.94% respectively. The prevalence of underweight among girls (17.21%) was higher than that of boys (11.4%) while the prevalence of healthy or normal weight among boys (70.65%) was higher than that of girls (69.15%). We also found that the prevalence of obesity among boys (3.38%) was higher than that of girls (2.48%) while the prevalence of overweight among boys (14.57%) was superior to that of girls (11.16%) for children of age under five (Table 2).

Multiple regression analysis

The multiple regression model was as follows:

$$BMI=\beta_0+\beta_1 G+\beta_2 AC+\beta_3 AR+\beta_4 WQ+\beta_5 ME+\beta_6 MFD+\beta_7 D+\beta 8EHH+\beta 9MA+\varepsilon$$

Where the BMI (Body Mass Index) was the response variable and the explanatory variables were: Gender (G), Age of Children (AC), Area of children (AR), Wealth Index (WI), Mother's Education (ME), Mother's Functional Difficulties (MFD), Division (D), Ethnicity of the Household Head (EHH) and Mother's Age (MA).

The estimated model was as follows:

$$BMI=16.033-0.310G-0.350AC-0.058PR+0.068WI+0.035ME+0.007MFD-0.003D+0.104EHH+0.001MA.$$

The value of tolerance and VIF revealed that there was no multicollinearity among the explanatory variables (Table 3). According to the results of the aforementioned regression model, the wealth index and mother's education were significantly positively associated (p<0.01) with the BMI of under-five children and we also found a significant negative association between under-five children's BMI and gender (p<0.01), age of children (p<0.01), area of children (p<0.01) and division (p<0.01). On the contrary, mother's functional difficulties, ethnicity of household head, and mother's age were not significant (p>0.05) but had a positive association with under-five children's BMI.

Predictor	Coefficient	t-value	p-value	VIF	Tolerance
Constant	16.033	85.18	<.001	-	-
Gender	-0.31	-16.106	<.001	1	1

Age of children	-0.35	-51.002	<.001	1.005	0.995
Area of children	-0.058	-2.175	0.03	1.143	0.875
Wealth index	0.068	8.41	<.001	1.41	0.709
Mother's education	0.035	2.785	0.005	1.255	0.797
Mother's functional difficulties	0.007	0.092	0.927	1.006	0.994
Division	-0.003	-4.529	<.001	1.029	0.972
Ethnicity of household head	0.104	1.538	0.124	1.045	0.957
Mother's age	0.001	-0.259	0.796	1.001	0.999

Table 3. Risk factors on BMI of under five children.

According to a related study using BDHS 2000 data on child acute malnutrition in Bangladesh, factors such as the mother's Body Mass Index (BMI), media exposure, the child's age, birth weight, and childhood respiratory illnesses were significantly associated with malnutrition [20].

The differential of nutritional status of under-five children with their socioeconomic and demographic factors

To identify if there were any statistically significant variations in the means of the relevant factors (gender, age of child, area of residence, wealth index, mother's education, mother's functional difficulties, division and ethnicity of household head) along with BMI of under-five children we performed the One-way ANOVA (if variables had three or more category) and t-test (if variables had two categories) technique.

The nutritional status of under five children may differ on different factors. To explore the effect of these factors on nutritional status (BMI) we considered the following factors: Gender, area of children, age of children, wealth index, division, mother's education, mother's functional difficulties, and ethnicity of the household head.

We found that the BMI of under five children significantly (p<0.05) differed for male and female children. The mean BMI of male children was higher than female children. The mean BMI of under-five children who lived in urban was significantly (p<0.05) higher than under-five children who lived in rural areas. We also found that the mean BMI of rich family children was significantly (p<0.05) higher than any other economic class family. The mean BMI of the age of child, mother's education, and division were significant (p<0.05) and the mean BMI decreased as the age of child increased; the mean BMI of children who lived in Dhaka city was higher than in other cities also the mean BMI was lowest at Rangpur city children. When compared to other children, the mean BMI of children whose mothers had upper secondary and more education was greater. Furthermore, children whose moms did not have functional difficulty had mean BMI that were greater than those whose mothers had, as well as the children who lived in the Bengali family, had higher mean BMI than others who lived in different ethnic families (Table 4).

Variables	Category	Mean value of BMI	Standard deviation	P-value
Gender	Male	15.15	1.43	<.001
	Female	14.85	1.42	
Area of children	Urban	15.13	1.47	<.001
	Rural	14.98	1.42	
Wealth index	Poorest	14.88	1.38	<.001
	Lower middle	14.91	1.41	
	Middle	15.04	1.42	
	Upper middle	15.09	1.44	
	Richest	15.23	1.5	
Age of children	0	15.71	1.61	<.001
	1	15.38	1.37	
	2	15.05	1.29	

	3	14.69	1.24	
	4	14.3	1.19	
Mother's education	Pre-primary or none	14.81	1.38	<.001
	Primary	14.94	1.4	
	Secondary	15.02	1.43	
	Higher secondary+	15.21	1.48	
Mother's functional difficulties	Has functional difficulty	14.88	1.43	0.145
	Has no functional difficulty	15.01	1.43	
Division	Barishal	14.99	1.43	<.001
	Chattogram	15.01	1.44	
	Dhaka	15.19	1.46	
	Khulna	14.95	1.4	
	Mymenshing	14.99	1.41	
	Rajshahi	14.96	1.39	
	Rangpur	14.89	1.46	
	Sylhet	14.91	1.38	
Ethnicity of household head	Bengali	15.01	1.43	0.75
	Other	14.98	1.36	

Table 4. Differential of nutritional status of under five children with their socioeconomic and demographic factors.

The means plot showed that the mean BMI of the richest family children was very much higher than other economic family children (Figure 1). Also, we observed that the mean BMI of under five children who lived in Dhaka city was the highest among other cities while the mean BMI of under five children who lived in Rangpur city was the lowest among other cities in Bangladesh (Figure 2).
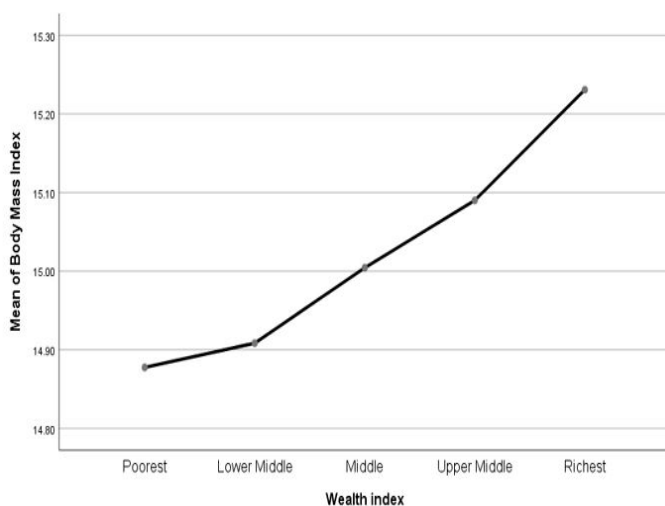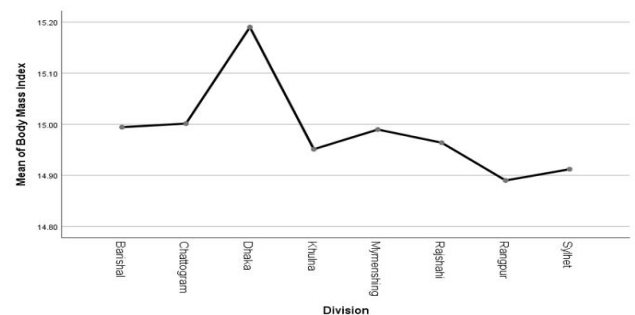

Figure 2. Means plot of BMI assessment with division.

Discussion

Bangladesh has made remarkable achievements in consistently reducing child malnutrition rates over the past decades through various government and development partner intervention programs, the findings of this study (with 30.07% of children under age five in a malnutrition state) the scope of further improvement in the nutrition status of under-five children in Bangladesh. In this study, gender, age of children, area of residence, division, mother's education, and wealth index have a significant association with the child's nutritional status.

Figure 1. Means plot of BMI assessment with wealth index.

This study shows that about 30.07% of under-five aged children are in a malnutrition health state where the underweight, overweight, and obese rate among under-five children is 14.21%, 12.92%, and 2.94% respectively. Our findings indicate that the educational level of mothers significantly influences the nutritional status of children under the age of five. Children whose mothers had attained higher secondary education or above showed better overall health compared to others. This advantage could be attributed to their ease of access to healthcare professionals and their increased awareness regarding both their own health and the nutrition status of their children.

In developing nations, discrepancies in child nutrition between urban and rural areas have remained persistent, potentially stemming from variations in economic status and limited access to healthcare, education, and other essential factors. Numerous prior studies have consistently demonstrated that children residing in rural regions face a higher risk of malnutrition [21-23]. Our investigation into the urban and rural settings revealed that children living in urban areas were more likely to enjoy better health compared to their rural counterparts. This disparity can be attributed to the fact that many individuals residing in rural areas are economically disadvantaged and unable to afford proper nutrition and healthcare facilities. This may be the reason for the increase in malnutrition rates in rural areas, and this issue needs attention from health policymakers.

We observed that the prevalence of nutritious health among girls (69.15%) was almost the same as among boys (70.65%) and also the prevalence of malnutrition among girls (30.85%) was almost close to boys (29.35%). Recent government activities like gender equality and women empowerment may provide various benefits to girl children which results in balanced nutritional conditions with boys. By comparing the age of the child we found that as the age of the child increases the mean BMI values were significantly decreased.

This is a worrying circumstance. Because children who are malnourished throughout their most formative years and when they first start school will have a tough time becoming perfect individuals in their personal, family, societal, and national spheres. Numerous studies indicate a connection between a mother's health condition and the health of her offspring.

Well-nourished mothers were more likely to give birth to healthier babies [24], and in our study, we obtained that children whose mother has no functional difficulties were more likely to have healthy bodies than children whose mother has functional difficulties. Also, children who lived in an ethnic family were likely to have a less healthy life than others.

Our study findings show that children living in the Dhaka division were likely to have healthier life compared with other divisions and children living in the Rangpur division have the worst health condition compared with other divisions.

The wealth index is significantly associated with the nutritional status of children and the prevalence of malnutrition is substantially high among the group of poor people as expected [25-28]. In our study, we found that children who were born in rich families were more likely to be healthy than other economic families and children who were born in poor family was likely to be had poor health condition compared with others. This clearly indicates that, in Bangladesh, there is an acute need for policies to address the needs of poor people in society.

Conclusion

The health and nutrition of a country can be assessed by looking at the nutritional status of children under five years old. This not only reflects the quality of life but also serves as a measure of development, revealing the impact of poverty, low socioeconomic status, and chronic diseases on the overall level of development. As malnutrition represents the cumulative effect of socio-economic, health, and nutritional limitations that might change over time, studying it continuously is necessary. From our research findings, we suggest a few recommendations such as; Firstly, the importance of mothers' education should be taken seriously. A mother of children should have at least a secondary-level education. Secondly, everyone should be knowledgeable about nutrition. The government should take steps to inform household members of the value of ensuring adequate nutrition for mothers and their young children through appropriate intra-household food distribution. Thirdly, geographically speaking, Bangladesh is divided into eight divisions. Some are encircled by hills, while others are by the sea. Because the education level, culture, mindset, and other factors vary from division to division, the government should take different activities for each division because malnutrition varies significantly depending on these factors. Fourthly, the Mother's health condition must be focused on seriously cause an unhealthy mother cannot able to give birth a child safely that's why early intervention initiatives should not only concentrate on children but also on their mothers in order to improve the nutritional status of children because a healthy mother can give birth to well-nourished children. And last, we highly recommend that health and nutrition education should also be a basic part of the entire education system. Therefore, to save our future generation from malnutrition and make a healthy-happy life for them everyone should be aware of this problem of malnutrition and to decrease malnutrition among Bangladeshi children under the age of five, our government should implement more effective measures.

Limitations

There are several restrictions to this study. First of all, the lack of data on potential confounders including physical exercise, diet, smoking behavior of the parents, mothers' job status, and mothers' BMI, we were not able to include this in the analysis. Secondly, due to an irresistible number of missing values and non-responses in the data set, certain crucial variables were irrational.

Declaration

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Author's Contributions

Conceptualization, M.T.U.; Data curation, F.A.; Formal analysis, F.A.; Investigation, M.T.U.; Methodology, M.T.U. and F.A.; Supervision, M.T.U.; Writing original draft, F.A.; Writing review and editing, M.T.U. All authors have read and given their consent to the final, published version of the manuscript.

Availability of Data and Materials

This data is available online. By logging into the UNICEF website account you can get the data.

Competing Interest

The authors declare that they have no competing interests.

Consent for Publication

Not applicable. This manuscript does not contain any data on any individual (there are no individual details, photos, or videos).

Ethics Approval and Consent to Participate

As mentioned earlier, this study is based on the analysis of Multiple Indicator Cluster Survey data for 2019 (MICS-2019 data). Thus this study does not need ethical approval because it is based on secondary data that is available for public usage.

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