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Are Mothers and Children Under Five in Bangladesh Nutritionally Secure? Evidence from a Long-term Panel Dataset

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Abstract: Malnutrition, including both undernutrition and overnutrition, affects both mothers and children, with insufficient or excessive caloric intake causing health issues. In Bangladesh, maternal nutrition, particularly pre-pregnancy and pregnancy health, plays a crucial role in pregnancy outcomes and child development. This study utilizes long-term panel data from the Bangladesh Integrated Household Survey (BIHS) for the years 2011, 2015, and 2018 to assess trends and determinants of nutritional outcomes. The analysis focuses on key indicators such as stunting, wasting, and underweight, examining their relationships with demographic, socioeconomic, and health-related factors. Outcomes reveal notable improvements in child nutrition over time, with reductions in stunting, wasting, and underweight prevalence. Height-for-age and weight-for-age Z-scores improved significantly between 2011 and 2018, indicating progress in combating chronic malnutrition. The findings of the study emphasize the importance of Parental Education. According to the study's findings, policymakers might focus on issues such as parental education and improved household economic well-being, especially in areas like nutrition and food security. Strategies may be devised to enhance parental education and awareness to improve nutrition and mitigate malnutrition, as indicated by the study.

Keywords: Malnutrition; Maternal nutrition; Stunting; Wasting; Underweight; Bangladesh Integrated Household Survey (BIHS).

INTRODUCTION

Nutrition security provides equitable access to healthy, safe, affordable food that promotes well-being and prevents disease. The nutritional security of mothers is a complex issue involving several factors, including malnutrition and obesity. One of humanity's most important issues is maternal malnutrition (Abel Fekadu Dadi, 2019). It puts mothers in danger of problems, even death, during pregnancy, and jeopardizes their babies' physical and cognitive development; it undermines economies and harms societies. Despite significant progress in addressing the issue over the last few decades, maternal malnutrition is far from eradicated. Worryingly, approximately 153.8 million women globally continue to be severely malnourished (Seferidi et al., 2022). Furthermore, 22% of children are stunted, and 9% are obese, both of which are obvious indicators of maternal malnutrition (Ekholuenetale et al., 2020). The conflict is still ongoing worldwide, and the implications are terrible. But maybe nowhere are the complexities of the fight against maternal malnutrition more evident than in Bangladesh. For decades, the government of Bangladesh has used a variety of initiatives to address nutrition in general, particularly maternal nutrition. In many respects, the effectiveness of these techniques is noteworthy. The number of undernourished women in Bangladesh has decreased from 34% to 19% in the recent decade, while child stunting and wasting have also decreased. While this is a remarkable development, these figures do not necessarily convey the full picture of how far there is still to go. Despite significant progress, the battle for maternal nutrition in Bangladesh is far from over. In the country, about one in every five women is undernourished, and 36.7% of women aged 15 to 49 have anemia. (Owais et al., 2021). Moreover, almost one-third of children under five years old are malnourished, and more than a quarter exhibit stunting. Obesity has added another layer of complication to the issue of maternal nutrition in recent years. While the number of undernourished women in Bangladesh has decreased from 34% to 19% in the last

decade, the number of obese women has climbed from 9% to 24% (Rahman et al., 2019). In other words, while undernutrition has decreased, obesity has increased. We are interested in using long-term panel data to highlight the causal factors for malnutrition in children under the age of five and reproductive-age women in specific areas.

In theory, malnutrition encompasses both undernutrition and overnutrition. Individuals are considered malnourished if their caloric and protein intake is inadequate for growth and maintenance, or if they cannot effectively utilize the food consumed (undernutrition) or consume excessive calories (overnutrition) due to illness. In this study, we will look at which factors drive mothers and children under 5 to malnutrition in Bangladesh.

A healthy pregnancy outcome depends on a woman's nutritional state both before and during her pregnancy. A risk factor for cesarean birth is maternal short stature, which is primarily connected to cephalopelvic disproportion. A meta-analysis of epidemiological data indicates that women in the lowest stature quartile (146 cm to 157 cm, varying by location) had a 60% (95% CI 50-70) greater need for assisted delivery compared to those in the top quartile. Both the mother and the child are at risk if women who require an operation to ensure a healthy birth cannot get one. Anesthesia and laparotomy elevate the risk of maternal morbidity, despite operational delivery being convenient, cost-effective, and safe. In this paper, we will look at which factors drive mothers' malnutrition in terms of data in Bangladesh.

Bangladesh has experienced one of the largest reductions in child stunting in recent years (Headey & Hirvonen, 2016). Annual child mortality exceeding 10 million significantly impacts the health and well-being of mothers. Acute respiratory infections annually kill an estimated 1.6 million children under the age of five (Jain et al., 2018). It possesses one of the highest rates of stunting globally. Maternal health is a key determinant of a child's early development (Black et al., 2013). Low maternal BMI and height have been widely identified as primary predictors of low birth weight, an important indicator of both maternal and infant health that affects at least one-fifth of Bangladeshi infants (Shaikh et al., 2021). Maternal depression and anxiety have been independently associated with the risk of low birth weight in South Asian countries, more than doubling the risk in a population study of rural Bangladesh (Nasreen et al., 2010).

Social norms such as early marriage, low maternal education, and unequal resource and power distribution within the home have been associated with poor maternal nutrition and child stunting (Bhagowalia et al., 2012). Malnutrition affects millions of people globally, especially women and children (Abir et al., 2015). The Sustainable Development Goals (SDGs) were established in 2015 to eradicate poverty, safeguard the planet, and enhance the well-being and opportunities of all individuals by 2030. To attain the SDG objectives, efficient delivery of effective nutrition treatments and programs is essential for those most in need.

MATERIALS AND METHODS

In our study, we considered the three waves of a nationally representative rural household panel survey called the Bangladesh Integrated Household Survey (BIHS). This survey was conducted by the IFPRI Bangladesh. The survey was conducted in three rounds: 2011–12, 2015, and 2018–19. The first phase was conducted in 2011 12, to study the nutritional status of Mothers and children under five years. BIHS is the sole survey that gathers comprehensive data on:

- agricultural output and practices at the plot level,
- nutritional consumption of household members,
- • anthropometric measurements for all household members, and

The BIHS samples are statistically typical of rural Bangladesh, encompassing all seven administrative divisions of the country, as well as the USAID-supported Feed the Future Zone of Influence in southwestern Bangladesh. The quantity of households included in the Bangladesh Integrated Household Survey (BIHS) fluctuates annually from 6,500 households over 325 primary sampling units in 2012 and 2015 to 5604 households in 2018.

The BIHS dataset is available at no cost and is accessible in user-friendly formats. The data is well-documented and has been used to contribute to knowledge about agriculture, food security, nutrition, poverty, and empowerment. That's why we use BIHS data for our study.

Measuring Malnutrition in Children

The objective of this study is to identify children with general malnourishment, on weight-for-age parameters. An elevation in underweight may be associated with either an acute issue, a chronic issue, or both, so indicating that the weight-for-age criterion reflects a comprehensive assessment of nutritional status. El-Sayed et al. demonstrate that underweight reflects achieved body mass at a given chronological age and is the most commonly used nutritional indicator in defining malnutrition (El-Sayed et al., 2002). Waterlow et al. and also the report of the WHO working group (1986) have recommended that anthropometric approaches of the Z-scores system for measuring the nutritional status of young children have more advantages (F. HDS, 2020). Consequently, the Z-scores methodology for the weight-for-age indicator is employed in this analysis, and the existence of protein-energy malnutrition was evaluated using the subsequent cut-off points:

Severe underweight prevalence

Proportion of studied children with Z-scores below 3 standard deviations ($z < -3$) from the median weight-for-height of the World Health Organization/National Center for

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Health Statistics (WHO/NCHS) reference population (World Health Organization , 2009).

Moderate underweight prevalence

Proportion of studied children with Z-scores between –3 SD and below –2 SD (–3 < z < –2) from the median weight-for-height of the WHO reference population (World Health Organization & United Nations Children's Fund, 2009).

Stunting

Stunting denotes the hindered growth and development of children resulting from persistent undernutrition, usually occurring in early childhood. It is often characterized by low height-for-age and is an indicator of poor nutritional status and inadequate overall well-being. Stunting can have long-term effects on physical, cognitive, and social development. Stunting is assessed using a statistical measure called the "height-for-age" z-score. The z-score evaluates a child's height relative to a reference population of identical age and sex. The formula for calculating the height-for-age z-score is as follows:

$$\text{Height for Age Z\_Score} = \frac{(\text{Child's Height} - \text{Median Height of Reference Population})}{\text{Standard Deviation of Height of Reference Population}}$$

In this formula:

Child's Height: The height of the child being assessed.

Median Height of Reference Population: The median height of the reference population for the child's age and sex.

Standard Deviation of Height of Reference Population: A measure of how much the heights in the reference population vary from the median height.

The result of this calculation gives a z-score, which indicates how many standard deviations the child's height is below or above the median height of the reference population. A child is considered stunted if the height-for-age z-score is below -2 standard deviations from the median. This indicates that the child's height is significantly lower than that of a well-nourished reference population.

Wasting

Wasting, commonly referred to as acute malnutrition, is a state in which a person weighs much less than would be predicted for their height. It is a crucial sign of acute undernutrition and is typically characterized by a low weight-to-height ratio. Wasting is a sign of a recent and quick decline in nutritional status, which can have serious and urgent health effects, especially in youngsters. Wasting is assessed using a statistical measure called the "weight-for-height" z-score. The formula to calculate the weight-for-height z-score is as follows:

$$\text{Weight for Age Z\_Score} = \frac{(\text{Child's Weight Minus Median Weight of Benchmark Population})}{\text{Standard Deviation of Weight of Reference Population}}$$

In this formula:

Child's Weight: The weight of the child being assessed.

Median Weight of Reference Population: The median weight of the reference population for the child's height and sex.

Standard Deviation of Weight of Reference Population: A measure of how much the weights in the reference population vary from the median weight.

A z-score is generated as a result of this calculation, and it represents the number of standard deviations the child's weight deviates from or exceeds the median weight of the reference population. If a child's weight-for-height z-score is less than -2 standard deviations from the median, they are deemed wasted. As a result, it appears that the child weighs considerably less than a similarly-sized, well-nourished reference group.

Underweight or Overweight

Underweight denotes a state in which an individual's weight is below the healthy range for their height, whereas overweight indicates a situation where an individual's weight exceeds the healthy range for their height. Underweight and overweight are generally evaluated by the Body Mass Index (BMI), calculated using the subsequent formula:

$$\text{BMI} = \frac{\text{Weight(kg)}}{\text{Height(m)}^2}$$

If a person's BMI is below 18.5, they are classified as underweight, and if a person's BMI is between 25 and 29.9, they are classified as overweight. A BMI greater than 29.9 is classified as obese.

Statistical Methods

This study is quantitative research. The objective of this research work is to assess the nutritional status of children under 5 years and mothers, and examine the differentials. To meet the objective of the study, we have considered individual frequency, the multiple regression model, the logistic regression model, and the Probit regression model. The trend in children & mother are reported as underweight by year from different censuses and surveys in Bangladesh. The statistical methods applied on the analysis are:

- Descriptive Statistics.
- Multiple regression model.
- Logit & Probit regression models.

Descriptive Statistics

Descriptive statistics provide simple summaries about the sample and about the observations that have been made. Such summaries may be either quantitative or summary statistics, or visual, i.e., simple-to-understand graphs. Summaries, like mean and standard deviation, may serve as the foundation for the preliminary description of the BIHS data inside a broader statistical study.

Multiple Linear Regression Model

Multiple linear regression (MLR) is a statistical technique that uses various explanatory variables to forecast the value of a response variable. The objective of this model is to

represent the linear association between the explanatory variables and the response variables. Essentially, multiple regression is an extension of simple least-squares (OLS) regression as it incorporates several explanatory variables. The equation:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki} + \epsilon_i, \quad i = 1,2,\ldots,n$$

Here:

y_i = i^{th} observation of the dependent variable.
x_i = i^{th} observation of the independent variables.
β_0 = intercept (constant).
β_j = coefficient of the j^{th} independent variable, here, j = 1,2,…,k
ε_i = Error term of the i^{th} observation.

Logit Regression Model

We employ logistic regression, which is a suitable analysis to intervene when the dependent variable is categorical. Logistic regression, similar to all regression modeling, functions as a predictive technique. Logistic regression elucidates the correlation between a categorical predictand variable and one or more independent variables. The formula:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x$$

$$\text{Here, probability, } p = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x)}}$$

Multinomial Logit Model

The Multinomial Logit (MNL) model is a widely used statistical method for analyzing outcomes where the dependent variable is categorical with more than two outcomes that are not ordered. This model allows us to estimate the probability of an observation belonging to a particular category based on one or more independent variables. The equation:

$$\ln\left(\frac{p_j}{p_0}\right) = \beta_{j0} + \beta_{j1} x, \quad j = 1,2,\ldots,k$$

$$\text{Here, } p_j = \frac{e^{\beta_{j0} + \beta_{j1} x}}{1 + \sum_{m=1}^{k} e^{\beta_{m0} + \beta_{m1} x}}, \quad j = 1,2,\ldots,k$$

$$\text{and, } p_j = \frac{1}{1 + \sum_{m=1}^{k} e^{\beta_{m0} + \beta_{m1} x}}$$

if "X" is a vector with multiple predictors, then

$$\ln\left(\frac{p_j}{p_0}\right) = \beta_{j0} + \beta_{j1}^{T} X, \quad j = 1,2,\ldots,k$$

$$\text{Here, } p_j = \frac{e^{\beta_{j0} + \beta_{j1}^{T} X}}{1 + \sum_{m=1}^{k} e^{\beta_{m0} + \beta_{j1}^{T} X}}, \quad j = 1,2,\ldots,k$$

Probit Regression Model

A probit model is a regression for categorical outcomes—most commonly a yes/no (binary) response, where the predictors determine the probability of the "yes" outcome through the standard normal cumulative distribution. Intuitively, it assumes an unobserved (latent) "propensity" that is a linear function of the predictors plus normally distributed noise; the observed outcome is 1 when that latent index crosses a threshold. Coefficients shift the underlying z-score, so their effect on probability depends on where that probability lies (largest near 0.5, smaller near 0 or 1). Variants include ordered probit (for ranked categories) and multinomial probit (for 3+ unordered choices). The formula for binary probit:

$$Y = 1 \text{ iff } Y^* > 0 \text{ where, } Y^* = \beta_0 + \beta_1^{T} X + \epsilon, \quad \varepsilon \sim N(0,1)$$
$$\Phi^{-1}(\Pr(Y = 1)) = \beta_0 + \beta_1^{T} X, \text{ where } \Phi(.) \text{ is the standard normal pdf}$$

Causality Test

A causality test is a statistical method that determines if one variable can be used to predict another variable. There are several types of causality tests, including the Granger causality test, which is used to determine if one time series can be used to forecast another. The domain of statistical methodologies encompasses significant application of regression analysis. T-test, regression and ANOVA are generally used to identify causality between two or more variables.

Chi-square Test

The Chi-square test can assess the independence of two or more variables. The Pearson chi-square test can be employed to assess the null hypothesis regarding the independence of two qualities based on an observed frequency set. Pearson's chi-square test can also be used for a table with any number of columns and rows. Let $O_{ij,}$ where j=1,2,…, k and j=1,2,…, k denote observed frequencies $E_{ij,}$ where j=1,2,…, k and j=1,2,…, k denote expected frequencies. The $\chi 2$ test is defined as

$$\chi^2 = \sum_{i=1}^{k} \sum_{j=1}^{k} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Software and Technical Support of the Study

To examine the data efficiently, effortlessly, and accurately this study uses different statistical software, including STATA and R.

- Microsoft Word
- STATA

RESULTS AND DISCUSSIONS

BMI of mothers:

Figure 1a appears to follow a slightly right-skewed distribution, with most BMI values between 18 and 25. This range aligns with the standard BMI category of "normal weight," suggesting that a significant portion of the study participants had a BMI within a healthy range. The peak of the distribution occurs around a BMI of 20, indicating that this value is the most frequently observed.

There are relatively fewer observations at higher BMI ranges (above 30), which fall into the "obese" category. Similarly, very low BMI values (below 18.5, classified as underweight) are less common in the dataset. Outliers with BMI values exceeding 40 are sparse, reflecting extreme cases within the population. The distribution appears (Figure 1b) unimodal and slightly right-skewed, with most BMI values falling between 18 and 25. This range generally corresponds to the "normal weight" BMI category, suggesting that most

mothers in the dataset have a BMI within the healthy range. The peak density occurs around a BMI of 20, indicating that this value is the most common in the population. The density tapers off gradually for BMI values exceeding 25, corresponding to the "overweight" category, and diminishes significantly beyond 30, representing the "obese" category. The presence of a few values near or above 35 indicates some extreme cases but reflects a small proportion of the total population.

On the lower end, very few observations fall below a BMI of 18.5, the threshold for the "underweight" category. This indicates that underweight mothers are relatively rare in this dataset.

The BMI distribution in 2015 was right-skewed with a peak around 20. Underweight mothers were influenced by factors such as age and non-participation in community clinics. The BMI distribution in 2018 remained unimodal and right-skewed, with improvements in the proportion of mothers in the "healthy weight" category. Factors like age and community clinic participation remained significant, but their impacts varied.

Under the five children's overall health status:

The average child age decreased in 2018 compared to previous yearsHeight-for-age and weight-for-age Z-scores improved over time, indicating better child growth trends. Significant reduction in the "severe" stunting category from 2011 to 2018. Overall, stunting prevalence had reduced dramatically by 2018. Decline in moderate and severe wasting over time, indicating improved nutritional status. Barishal saw a large increase in child representation from 2011 to 2015, but decreased slightly by 2018. Other regions showed slight variations, with Dhaka consistently having the highest proportion. The average child's age decreased in 2018. Z-Scores improved significantly from 2015 to 2018:

Height-for-Age Z-Score: From -1.69 (2015) to -0.84 (2018).

Weight-for-Age Z-Score: From -1.62 (2015) to -0.70 (2018).

Weight-for-Height Z-Score: From -0.96 (2015) to -0.34 (2018).

Factors associated with mothers' BMI

Table 2 reveals the factors associated with mothers' BMI by the multinomial logit model. This also indicates the nutritional status of mothers over the years. Underweight mothers are influenced by their age. A negative and statistically significant coefficient (-0.0401, p = 0.012) suggests that as a mother's age increases, the likelihood of being underweight decreases compared to a mother of healthy weight. Children born to adolescent moms (under 19 years) frequently have an elevated risk of wasting. This is due to factors like incomplete maternal growth, limited nutritional reserves, and socioeconomic challenges. The coefficient of per capita consumption expenditure (PCCE) is negative (-0.00007), but it is not statistically significant (p = 0.240). This implies no strong evidence of a relationship between economic status (measured by PCCE) and being underweight. The variable representing the participation in the community clinic meeting coefficient (0.2012) is positive and significant in 2018, suggesting a meaningful relationship. The coefficient is also greater than that of 2015. Community-based healthcare distributes micronutrient-rich supplements (e.g., iron, folic acid, and calcium) to pregnant and lactating mothers. Also, distribute micronutrient-rich supplements (e.g., iron, folic acid, and calcium) to pregnant and lactating mothers. Regarding education, a positive and statistically significant coefficient (2.2412, p = 0.007) indicates that mothers who have only completed class IV are more likely to be underweight compared to other years of schooling. In the model, variation due to demographic factors like division was considered.

Being overweight, on the other hand, is also influenced by the age of the mother. A positive and highly significant coefficient (0.0574, p < 0.001) indicates that older mothers are more likely to be overweight. The correlation for per capita consumption expenditure is tiny, positive, and significant (0.00013, p = 0.005), indicating that increased economic status correlates with a higher probability of being overweight. The coefficient for attending the community clinic (0.0846) is not statistically significant (p = 0.778), indicating a lack of a strong association. None of the education levels (SSC/Dakhil or BA/BSc Pass/Fazil) show a significant relationship with being overweight (p-values: 0.773 and 0.378, respectively). Only the coefficient for the Khulna division (0.7903) is marginally significant (p = 0.061), indicating a potential association with being overweight in this region.

Those who are obese are positively influenced. The coefficient (0.0573) with marginal significance (p= 0.082) suggests that older mothers may have a higher likelihood of obesity. Per capita consumption expenditure has a small positive coefficient (0.00017) with marginal significance (p = 0.074), indicating that higher economic status may be associated with obesity. A positive but marginally significant coefficient (1.3069, p = 0.093) suggests a potential association between not attending clinic meetings and higher obesity rates. None of the education levels (Completed Class V, SSC/Dakhil, or HSC/Alim) are significant predictors of obesity (p-values: 0.433, 0.843, and 0.134, respectively). The association between maternal age and community clinic participation weakened in 2018 compared to 2015. Per capita consumption expenditure showed minimal influence in both years. The influence of maternal age and economic status remained significant but reduced slightly in 2018. Non-participation in community clinics did not show a strong relationship in either year. Maternal age and economic factors showed increased significance in 2018 compared to 2015. Non-participation in community clinics had a stronger association in 2018.

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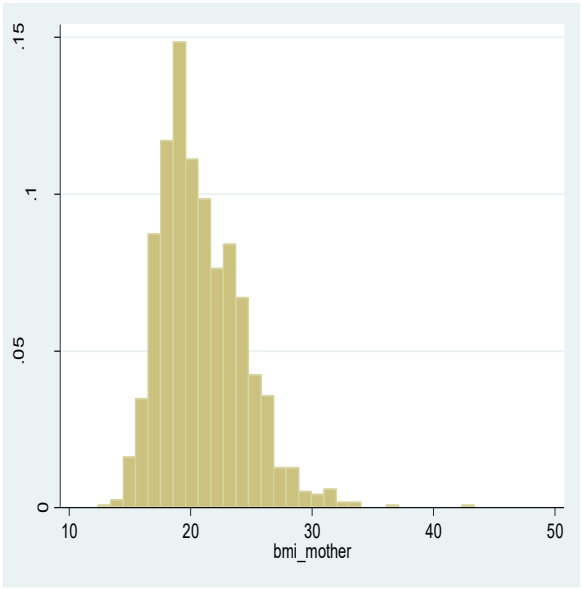

Figure 1a: Histogram of BMI in 2015

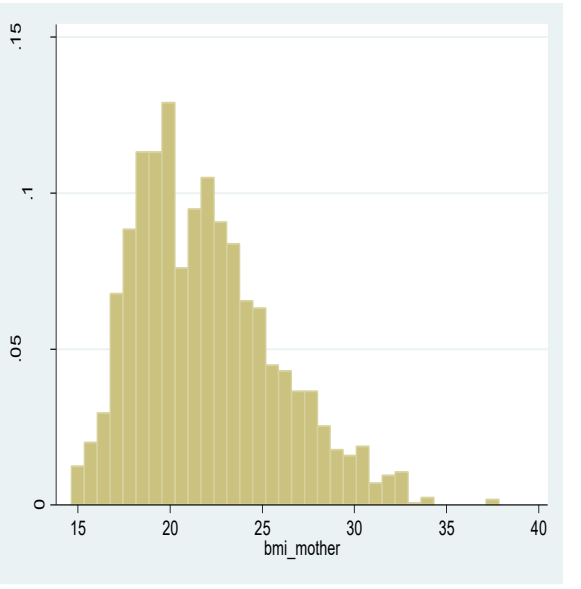

Figure 1b: Histogram of BMI in 2018

Table 1: Descriptive statistics of under-5 children's health outcomes

	2011	**2015**	**2018**
Child's age (months)	31.31	33.03	19.79
Child's gender (male)	0.50	0.53	0.48
Height-for-age Z-score	-1.89	-1.69	-0.84
Weight-for-age Z-score	-1.58	-1.62	-0.70
Weight-for-height Z-score	-0.75	-0.96	-0.34
Stunting			0.20
low	0.79	0.75	
moderate	0.50	0.41	
severe	0.19	0.13	
Wasting			0.06
low	0.39	0.48	
moderate	0.11	0.17	
severe	0.03	0.04	
Barishal	0.076	0.700	0.650
Chittagong	0.168	0.190	0.205
Dhaka	0.308	0.313	0.319
Khulna	0.078	0.075	0.071
Rajshahi	0.108	0.086	0.065
Rangpur	0.110	0.096	0.087
Sylhet	0.153	0.170	0.188

Factors of stunting and wasting at BIHS 2018 (Probit model)

Table 3 depicts the condition of stunting and wasting in the last two waves of the BIHS data set by fitting the probit model. Stunting is associated with several factors, but we only include those to be predicted by the efficient model. The coefficient of child age is 0.0475 and highly significant (p <

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0.001). This indicates a positive relationship, meaning older children are more likely to be stunted. The result aligns with evidence that stunting often develops progressively with age due to prolonged exposure to poor nutrition or health conditions. The coefficient in BMI of the mother is 0.0614 and marginally significant ($p < 0.10$). This suggests a positive association between the z-score of BMI and stunting, although the effect size is relatively small. The coefficient using a community clinic is 0.176 and is statistically significant ($p < 0.05$). This positive relationship may reflect that families with stunted children are more likely to use community clinics, possibly for nutrition or health interventions. The coefficient of Visiting by a health worker is -0.114, but it is not statistically significant ($p > 0.10$). This suggests no meaningful relationship between health worker visits and stunting in this dataset. The constant is -1.537 and is highly significant ($p < 0.001$). This indicates the baseline likelihood of stunting in the absence of other factors.

On the other hand, wasting is also associated with the same group of factors. The coefficient of Child Age is -0.00849, but it is not statistically significant ($p > 0.10$). This suggests no strong relationship between child age and wasting. The coefficient in BMI of the mother is -3.510 and highly significant ($p < 0.001$). This strong negative association implies that a higher BMI z-score significantly reduces the likelihood of wasting, which is consistent with BMI being an indicator of acute nutritional status. The coefficient using community clinics is 0.0399, but it is not statistically significant ($p > 0.10$). This suggests no meaningful relationship between using community clinics and wasting. The coefficient is -0.662 and is statistically significant ($p < 0.05$). This negative relationship indicates that visits from health workers are associated with a reduced likelihood of wasting. Health worker interventions may help address acute malnutrition. The constant is -5.631 and is highly significant ($p < 0.001$). This reflects the baseline likelihood of wasting in the absence of other factors.

In 2015, stunting showed a decreasing trend but still affected a significant proportion of children. By 2018, severe stunting had reduced, with improvements in the height-for-age Z-scores. Factors like the mother's BMI and the child's age were influential. Wasting rates showed some improvements by 2018, but the reduction was less pronounced compared to stunting. The mother's BMI had a significant impact on wasting levels.

Community clinic awareness in BIHS 2018

Out of 2414 total observations in 2018, 1841 individuals (76.3%) reported hearing about community clinics (Table 4). This high percentage suggests a considerable level of awareness regarding community clinics within the population. However, the remaining 23.7% who have not heard about these clinics indicate a gap in information dissemination that could be addressed to improve access to healthcare services.

Among the 1841 individuals who heard about community clinics, 1044 (56.7%) reported using them. While more than half of those aware are utilizing the clinics, the remaining 43.3% indicate potential barriers to utilization, such as accessibility, quality of services, or awareness of available programs.

Out of 2412 observations, only 471 individuals (19.5%) reported being visited by a health worker. This relatively low percentage reflects limited outreach efforts. Strengthening health worker programs could significantly enhance healthcare delivery and education, particularly in underserved areas.

Out of 2412 observations, only 256 individuals (10.6%) attended any group meetings or discussions. This low level of participation suggests that group meetings/discussions are either under-promoted or underutilized. Increasing participation in these activities could foster community engagement and improve health awareness.

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Table 2: BMI 2015 and 2018 (Multinomial logit model)

	2015	**2018**
Underweight		
Age of the mother	-0.268*	-.0400**
Per Capita consumption expenditure	-0.00017	-.0000695
Non-participation in the community clinic	0.156*	.2012**
Education	Yes	Yes
Division	Yes	Yes
Healthy weight	Base	
Overweight		
Age of the mother	0.435*	.0574***
Per Capita consumption expenditure	0.00021*	.000134***
Non-participation in the community clinic	0.0682	.0846
Education	Yes	Yes
Division	Yes	Yes
Obese		
Age of the mother	0.0465*	.05732**
Per Capita consumption expenditure	0.0009	.0001671*
Non-participation in the community clinic	0.895	1.306
Education	Yes	Yes
Division	Yes	Yes

Source: Authors' calculation from BIHS data

Table 4: **Community clinic awareness in BIHS 2018**

Factor	Total Observation	Yes
Hear about the community clinic	2414	1841
Anyone using a community clinic	1841	1044
Visited by any health worker	2412	471
Attended any group meeting/discussion	2412	256

Source: Authors' calculation from BIHS data

Table 3: Factors of stunting and wasting at BIHS 2018 (Probit model)

Factor	Year 2015		Year 2018	
	Stunting	Wasting	Stunting	Wasting
Child age (months)	0.0264* (0.00911)	0.0021 (0.0350)	0.0475*** (0.00645)	-0.00849 (0.0185)
BMI of mother	0.0214* (0.0843)	-2.401*** (0.295)	0.0614* (0.0369)	-3.510*** (0.419)
Using a community clinic	-0.0985** (0.0087)	0.001 (0.120)	-0.176** (0.0848)	-0.0399 (0.272)
Visited by a health worker	-0.114 (0.105)	-0.127** (0.079)	-0.114 (0.105)	-0.662** (0.297)
Constant	-1.207*** (0.203)	-2.19*** (0.407)	-1.537*** (0.224)	-5.631*** (0.770)
Pseudo R^2	0.675	0.236	0.7569	0.503
Prob > chi2	0.000	0.0000	0.000	0.0000
Total observation (N)	2733	2720	2386	2378

Source: Authors' calculation from BIHS data

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CONCLUSION

This study analyzes the nutritional status of mothers and children under five in Bangladesh using longitudinal panel data from the Bangladesh Integrated Household Survey (BIHS) for the years 2011, 2015, and 2018.The main emphasis is on evaluating trends in essential nutritional indicators, including as stunting, wasting, and underweight, while identifying the socio-economic, demographic, and health-related factors that affect these outcomes (Alam et al., 2022).

The study period showed significant decline in stunting, wasting and underweight indicating progress in child nutrition. Overall, there was an increase in maternal BMI but disparities still exist in different regions and socio-economic groups. Nutritional outcomes are influenced by factors such as household income, maternal education, child age and access to community health services. Children born to adolescent mothers in Bangladesh are more likely to suffer from wasting and stunting. Also poor access to healthcare and limited nutritional knowledge are associated with stunting and wasting. Community health programs have a significant role to play in improving maternal nutrition in Bangladesh, addressing the root causes of malnutrition and ensuring healthier pregnancies and better health outcomes for children. Regions such as Dhaka and Sylhet had relatively better nutritional outcomes while regions such as Khulna and Rajshahi lagged behind. Use of community health clinics and visits from health workers were associated with improved child and maternal nutritional status. The study presents evidence-based insights on the progress and challenges in achieving nutritional security in Bangladesh, highlighting the necessity of region-specific targeted policy interventions to address the existing gaps and ensure continued progress.

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Conflict of Interest

The authors have reported no conflicts of interest.

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