

Research Article

Inequalities and Changes in Under-Nutrition of Under-Five Children in Bangladesh

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Abstract

Objectives: This study examines inequalities and changes in under-nutrition of under-five children in Bangladesh.

Materials and methods: We used data from the Bangladesh Demographic and Health Surveys conducted in 2004 and 2014. Inequalities in under-nutrition were measured by concentration index. Blinder-Oaxaca decomposition method was applied to examine the magnitude and socioeconomic factors contributing to changes in inequalities in under-nutrition.

Results: Although the prevalence of stunting and underweight has declined and that of wasting has increased, inequalities in under-nutrition have increased between 2004 and 2014. Household wealth and maternal education are the most important determinants of inequalities in childhood malnutrition. Child's age, birth interval, diarrhea, maternal age and education, working status, household wealth and place of residence are important contributing factors of change in inequalities of malnutrition.

Conclusions: Any program to mitigate inequalities of malnutrition between poor and rich should address the prevailing socioeconomic inequalities in the country.

INTRODUCTION

Childhood malnutrition, which includes both under-nutrition and over-nutrition, is a global public health concern, particularly in resource-scarcity countries. Childhood under-nutrition is directly associated with cognitive development and physical growth. It is identified as one of the leading causes of neonatal and infant mortality and morbidity. Evidently, malnourished children are more susceptible to various infectious diseases such as pneumonia, diarrhea, and malaria; and a large proportion of deaths of under-five children are linked to nutrition-related factors [1]. In addition, malnutrition decreases work capacity and thereby economic productivity in adult life [2].

Bangladesh has made remarkable progress in terms of human development indicators over the recent years. According to latest human development report, the country ranked 135th position in 2019, out of 189 countries, with human development index (HDI), 0.614. The Gross National Income (GNI), per capita has increased to US\$ 4,057 in 2019, which was slightly over US\$ 2,500 in 2010. The life expectancy was reported to be 72.3 years (UNDP, 2019) [3]. The maternal mortality ratio (MMR) –defined by maternal deaths per 100,000 live births, decreased by 5.4% per year from 434 in 2000 to 173 in 2017 [4]. Moreover, Bangladesh has achieved the Millennium Development Goal 4, which aimed

to reduce under-five mortality at 48 by 2015 [5]. Despite these achievements, the nutritional status of under-five children is still worse [6,7].

Globally, 144.0 million under-five children were stunted and 47.0 million were wasted respectively in 2019. The prevalence of malnutrition varies disproportionately in the developed and developing countries. Although South Asia and Sub-Saharan Africa bear the greatest burden of all forms of malnutrition of the world; South Asia is considered as the home of undernourished children [8]. The inequality in the prevalence of under-nutrition prevails between and within countries (UNICEF et al., 2020) [8]. Among others, wealth inequality, maternal educational and rural-urban disparities in child nutrition are frequently cited in many studies conducted in different developing countries [9-13].

In a developing country like Bangladesh, the existence of high degrees of socioeconomic inequality in the society may hinder the improvement of child wellbeing, particularly nutritional status of under-five children. Studies conducted in Bangladesh on under-nutrition of under-five children are mostly confined to investigate socioeconomic determinants [6,14,15]. Although studies on inequalities and changes in under-nutrition of under-five children are numerous around the world [9-13], little is known on the issue in Bangladesh. The basis of perceived

social determinants may misguide to take proper initiatives on nutrition policies, suggests the need to examine socioeconomic inequalities and sound assessment of the nature, magnitude and underlying factors. This study aims to examine socioeconomic inequalities and changes in under-nutrition of under-five children in Bangladesh using nationally representative data.

MATERIALS AND METHODS

Data source and sample

We used data from the two rounds of the Bangladesh Demographic and Health Surveys (BDHS), conducted in 2004 and 2014. Both surveys are nationally representative and used two-stage sampling procedure covering rural-urban areas as well as all administrative regions of the country. The surveys were conducted as a part of global DHS and gathered information of females' age at first marriage, fertility, contraceptives, maternal and child health and their nutritional status etc. The surveys also gathered information of birth histories of children who were born five years preceding the surveys. However, we excluded children from analysis with various missing information such as child's height-for-age (HAZ), weight-for-age (WAZ), weight-for-height-(WHZ), maternal body mass index (BMI) etc. After excluding the children with missing information the total sample size of under-five children stood at 5,977 for BDHS 2004 and 7,173 for BDHS 2014 respectively, which are the basis of this study.

Outcomes of interest and explanatory variables

The outcome variables of this study are: stunting, underweight and wasting of under-five children who were born five years preceding the survey. To measure stunting, underweight and wasting we followed World Health Organization (WHO), Child Growth Standards [16]. A child with more than two standard deviations (SD), below the median (-2 SD), of the WHO reference population in terms of HAZ is considered as stunted. Children whose WAZ is below two SD (-2 SD), from the median of the reference population are considered as underweight. A child having more than two SD below (-2 SD), the reference median for WHZ is considered as wasted.

The explanatory variables we included for analysis in this study are as follows: child's age (months), sex of child (male and female), had diarrhea recently (no and yes), maternal age (<20, 20-29 and 30-49 years), birth interval (first birth, <24 months and ≥ 24 months), maternal education (no education, primary, secondary and higher), maternal working status (not working and working), household wealth index (poorest, poorer, middle, richer and richest), and place of residence (urban and rural). These variables were shown to have significant effect on childhood nutritional status [5,13,17]. Source of water and sanitation facility were not included as those variables were used to construct wealth index [5]. Household wealth index has been used in this study as a proxy for socioeconomic status. The wealth asset is a composite score of ownership of consumer goods, materials used in dwelling house, water and sanitation facilities and other daily used household materials. Using principal component analysis the composite score was divided into five quintiles. The details of the construction of household wealth index are provided elsewhere [5,13].

Statistical analysis

Analysis of inequity in under-nutrition:We used concentration index (CI) to measure the degree of socioeconomic inequalities in childhood under-nutrition: stunting, underweight and wasting following the formula:

$$CI = \frac{2}{\mu} \text{cov}(h, r) \tag{1}$$

Here, μ denotes the mean of under-nutrition, h represents the value of malnutrition of individual, and r is the household rank in terms of wealth index. The CIs ranges between -1 and 1. If the status of under-nutrition is quite equal between the poor and rich, then the value of CI would be exactly 0. The negative value of CI denotes that under-nutrition is concentrated to the poor and vice versa.

Decomposition of socioeconomic inequalities and their change: The difference in proportions was tested by chi-square tests. To examine possible significant determinants of stunting and underweight, multivariable logistic regression models were constructed. In this study, we decomposed the CIs of stunting and underweight of under-five children for two time points BDHS 2004 and BDHS 2014. Decomposition helps to improve understanding the contribution of the socioeconomic factors in the inequalities of health outcomes. The CI can be decomposed when the regression model is linear. The linear regression model we used is as follows:

$$y = \alpha + \sum_{k=1}^q \beta_k x_k + \varepsilon \tag{2}$$

where, β_k denotes the coefficients of the factors x_k ; and ε is the error term. Replacing by equal amount of y in equation (2), equation (1) can be decomposed using equation (3) as follows:

$$C = \sum_{k=1}^q \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k + \frac{GC_\varepsilon}{\mu} \tag{3}$$

where, μ denotes the mean of the outcomes of interest, β_k is the coefficients, \bar{x}_k represents the mean of the determinant x_k , C_k is the CI of x_k , and is the generalized CI of the error term ε_i

.¹⁸ The term $\left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k$ is an explained component and $\frac{GC_\varepsilon}{\mu}$ is the unexplained component. In the explained component, $\frac{\beta_k \bar{x}_k}{\mu}$ is the elasticity which represents the effect of each C_k

of the total CI of y . Finally, the contribution of socioeconomic factors in changing the prevalence of stunting and underweight was assessed by the Blinder–Oaxaca decomposition method for nonlinear regression models [19]. Blinder–Oaxaca decomposition was restricted to only stunting and underweight, as we did not

find significant difference of inequality of wasting between two surveys. All statistical analyses were performed by STATA^(R) 15. Results of logistic regression analysis were presented by odds ratios (OR) with 95% confidence interval. Multi-collinearity was checked prior to conduct the multivariable analysis. The level of statistical significance was set at $\alpha = 0.10$. Data were made weighted by using the weighting factor provided in the raw data sets.

Ethics

The basis of this study is secondary data collected as a part of global DHSs and was obtained upon request to MEASURE DHS. Both oral and written consent from all respondents were taken prior to start the survey. The information used in this study is de-identified. Besides, ethical clearance was taken from the Ministry of Health and Family Welfare of Bangladesh prior to the survey. Thus it was not necessary to take further ethical clearance from any other institutional review board.

RESULTS

Trends in child malnutrition and socioeconomic inequality

Table 1 shows the percentage distribution and change of under-nutrition of under-five children in Bangladesh by socioeconomic status for two time points 2004 and 2014. As shown in the table, stunting and underweight declined by 6.8% and 14.9% respectively and wasting increased significantly by 1.5% in a decade 2004-2014. Although the prevalence of wasting and underweight decreased in all categories of wealth index, the rate of decrease of stunting and underweight was higher in the richer; and increase of wasting was more pronounced in the poorer as compared to other categories of wealth index.

The estimated negative values of CIs for the indicators of under-nutrition indicating that, stunting, underweight and wasting were more concentrated to the poor. The absolute values

of CI for stunting, underweight and wasting was found higher in 2014 than 2004, indicating that inequalities in the prevalence of under-nutrition has increased over time between poor and rich. Though the difference of CI values between 2004 and 2014 for wasting was not found to be statistically significant, the increase of inequalities in stunting and underweight were significant ($P < 0.01$) throughout the period.

Determinants of childhood under-nutrition

Table 3 demonstrates the determinants of under-nutrition of under-five children. The results confirm those obtained in Table 1, which shows that the risk of being stunted and underweight has significantly ($P < 0.01$), decreased and that of being wasted has increased in 2014 as compared to 2004, even after being adjusted with other socio-demographic factors. Having affected from diarrhea recently, adolescent motherhood and poor household wealth were positively associated with all indicators on childhood under-nutrition. Child’s age was positively associated with stunting and underweight but not for wasting. First ranked birth was negatively associated with all indicators of under-nutrition. Although women’s level of education was negatively associated of being stunted and underweight, the variable was found to have no significant effect on wasting. Children with working mothers were more likely to be wasted than those with non-working mothers. However, working status of women was appeared to be an insignificant factor for stunting and underweight. Although rural children were significantly less tended to be stunted and underweight, this variable had no significant effect on wasting.

Decomposition of socioeconomic inequalities in childhood under-nutrition

Table 4 shows the relative contribution of the socioeconomic factors to the overall CIs of stunting and underweight as obtained by decomposition. Since there was no significant difference in the CI values for wasting between 2004 and 2014 (Table 2), hence we did not decompose this indicator of under-nutrition. As can be seen in the table, in both survey periods, the main determinants

Table 1: Percentage distribution and change of under-nutrition of under-five children in Bangladesh by socioeconomic status, 2004 and 2014.

		% of under-nutrition					
		Poorest	Poorer	Middle	Richer	Richest	All
Stunted							
	BDHS 2004	54.4	47	42.5	39.8	25.1	43
	BDHS 2014	49.4	42.3	36.2	31.3	19.5	36.2
	Difference	-5.0 ^a	-4.7 ^a	-6.3 ^a	-8.5 ^a	-5.6 ^a	-6.8 ^a
Underweight							
	BDHS 2004	59.3	53.3	44.9	43.3	30	47.5
	BDHS 2014	45.4	38.6	32	27.3	17.4	32.6
	Difference	-13.9 ^a	-14.7 ^a	-12.9 ^a	-16.0 ^a	-12.6 ^a	-14.9 ^a
Wasted							
	BDHS 2004	15.5	13.6	13.5	10.9	9.4	12.9
	BDHS 2014	17.1	16.6	12.6	13.2	11.8	14.4
	Difference	1.6	+3.0 ^b	-0.9	+2.3 ^c	+2.4 ^c	+1.5 ^a

Note: Level of significance: ^a $P < 0.01$; ^b $P < 0.05$; and ^c $P < 0.10$.

Table 2: Concentration Indices of under-nutrition of under-five children in Bangladesh, 2000 and 2011.

	Stunted		Underweight		Wasted	
	CI (SE)	P-value	CI (SE)	P-value	CI (SE)	P-value
BDHS 2004	-0.150 (0.01) ^a	<0.01	-0.167 (0.02) ^a	<0.01	-0.072 (0.02)	<0.01
BDHS 2014	-0.179 (0.02) ^a	<0.01	-0.183 (0.02) ^a	<0.01	-0.086 (0.02)	<0.01
Difference	-0.029 (0.02) ^a	<0.01	-0.017 (0.02) ^a	<0.01	-0.013 (0.03)	0.23

Note: Level of significance: ^a P < 0.01; ^b P < 0.05; and ^c P < 0.10.

Table 3: Multivariable logistic regression analysis showing the results of under-nutrition of under-five children in Bangladesh, 2004 and 2014.

	Stunted		Underweight		Wasted		
	OR	95% CI	OR	95% CI	OR	95% CI	
Survey year							
	BDHS 2004	1	---	1	---	1	---
	BDHS 2014	0.86 ^a	0.79-0.93	0.58 ^a	0.54-0.63	1.15 ^a	1.03-1.28
Child's age (in month)		1.11 ^a	1.10-1.12	1.09 ^a	1.08-1.10	1.01	0.99-1.02
Child age squared		0.99 ^a	0.98-0.99	0.99 ^a	0.98-0.99	1	1.00-1.01
Sex of child							
	Male	1	---	1	---	1	---
	Female	0.98	0.91-1.05	1.01	1.00-1.16	0.91 ^b	0.82-1.00
Had diarrhea recently							
	No	1	---	1	---	1	---
	Yes	1.38 ^a	1.20-1.60	1.27 ^a	1.09-1.47	1.21 ^c	1.00-1.46
Maternal age							
	<20	1	---	1	---	1	---
	20-29	0.83 ^a	0.75-0.92	0.83 ^a	0.75-0.93	0.84 ^a	0.73-0.96
	30-49	0.80 ^a	0.70-0.92	0.79 ^a	0.68-0.90	0.73 ^a	0.60-0.88
Birth interval							
	First	1	---	1	---	1	---
	<24 months	1.46 ^a	1.26-1.69	1.49 ^a	1.29-1.73	1.02	0.83-1.26
	≥24 months	1.10 ^b	0.99-1.22	1.08	0.97-1.20	1.12 ^c	0.97-1.29
Maternal education							
	No education	1	---	1	---	1	---
	Primary	0.95	0.86-1.05	0.91 ^c	0.83-1.01	0.99	0.87-1.14
	Secondary	0.70 ^a	0.63-0.78	0.75 ^a	0.67-0.84	0.97	0.83-1.13
	Higher	0.46 ^a	0.37-0.56	0.49 ^a	0.40-0.60	0.96	0.74-1.23
Working status							
	Not working	1	---	1	---	1	---
	Working	1.03	0.95-1.13	1.07	0.98-1.17	1.18 ^a	1.05-1.33
Wealth index							
	Poorest	1	---	1	---	1	---
	Poorer	0.80 ^a	0.71-0.88	0.81 ^a	0.72-0.90	0.93	0.80-1.07
	Middle	0.68 ^a	0.61-0.76	0.63 ^a	0.56-0.70	0.78 ^a	0.67-0.91
	Richer	0.56 ^a	0.50-0.64	0.54 ^a	0.48-0.61	0.73 ^a	0.62-0.87
	Richest	0.32 ^a	0.28-0.37	0.33 ^a	0.29-0.39	0.68 ^a	0.55-0.82
Place of residence							
	Urban	1	---	1	---	1	---
	Rural	0.86 ^b	0.78-0.95	0.92 ^c	0.83-1.02	1.07	0.93-1.23

Note: Level of significance: ^a P < 0.01; ^b P < 0.05; and ^c P < 0.10.

Table 4: Decomposition of concentration indices of stunting and underweight of under-five children in Bangladesh, 2004 and 2014.

	Stunted				Underweight			
	BDHS 2004		BDHS 2014		BDHS 2004		BDHS 2014	
	Contribution	%	Contribution	%	Contribution	%	Contribution	%
Child's age	-0.0274	19.75	-0.0151	9.78	-0.0328	21.56	-0.0081	5.21
Child's age squared	0.0291	-20.98	0.0226	-14.64	0.0386	-25.37	0.0108	-6.95
Sex of child								
Male	Ref.	---	Ref.	---	Ref.	---	Ref.	---
Female	0.0005	-0.36	0.0001	-0.06	0.00084	-0.55	0	0
Had diarrhea recently								
No	Ref.	---	Ref.	---	Ref.	---	Ref.	---
Yes	-0.0004	0.29	-0.0012	0.78	-0.001	0.66	-0.0002	0.13
Maternal age								
<20	Ref.	---	Ref.	---	Ref.	---	Ref.	---
20-29	-0.0009	0.65	-0.0014	0.91	-0.0005	0.33	-0.0019	1.2
30-49	0.0007	-0.5	0.0015	-0.97	0.0008	-0.53	0.0016	-1.03
Birth interval								
First	Ref.	---	Ref.	---	Ref.	---	Ref.	---
<24 months	-0.001	0.72	-0.0021	1.36	-0.0011	0.72	-0.0021	1.35
≥24 months	0.0005	-0.36	-0.0034	2.2	0.0013	-0.85	-0.0036	2.32
Maternal education								
No education	Ref.	---	Ref.	---	Ref.	---	Ref.	---
Primary	0.0002	-0.14	0.0039	-2.53	0.0005	-0.33	0.0029	-1.87
Secondary	-0.0176	12.69	-0.0215	13.92	-0.0159	10.45	-0.0149	9.59
Higher	-0.0201	14.49	-0.0175	11.33	-0.0202	13.28	-0.0133	8.56
Working status								
Not working	Ref.	---	Ref.	---	Ref.	---	Ref.	---
Working	0.0014	-1.01	-0.0022	1.42	0.0023	-1.51	-0.0038	2.45
Wealth index								
Poorest	Ref.	---	Ref.	---	Ref.	---	Ref.	---
Poorer	0.0264	-19.03	0.0193	-12.5	0.0203	-13.34	0.0198	-12.74
Middle	-0.0306	22.06	-0.0267	17.29	-0.04	26.29	-0.0303	19.5
Richer	-0.0348	25.09	-0.0455	29.47	-0.0403	26.49	-0.0458	29.47
Richest	-0.0713	51.41	-0.076	49.22	-0.072	47.32	-0.0705	45.37
Place of residence								
Urban	Ref.	---	Ref.	---	Ref.	---	Ref.	---
Rural	0.0066	-4.76	0.0108	-6.99	0.007	-4.6	0.004	-2.57

of inequalities in under-nutrition were household wealth and maternal education. The contribution of household wealth in the equalities of stunting in 2004 was 80%, which increased at 83% in 2014. For underweight, the household wealth contributed 87% in the total inequalities in 2004 and slightly reduced at 82% in 2014. The contribution of maternal education in the equalities of stunting was 27% in 2004 and 23% in 2014. Maternal education contributed 23% and 16% in 2004 and 2014 respectively in the equalities of underweight. The contributions of other variables in the equalities of stunting and underweight were very little or negligible. Relatively very low contribution of the residual suggests that the model we constructed for decomposition of socioeconomic inequality in under-nutrition was well suited.

Table 5 shows the summary of Blinder-Oaxaca decomposition method. The overall change in stunting and underweight between 2004 and 2014 was low but significant. Of the overall change in inequality in stunting, 52.9% was attributed to the compositional factors, i.e. due to the difference in the socioeconomic factors; and equally 52.9% was attributed to the unexplained inequality, i.e. due to coefficients (Table 6). In the endowments, the factors contributed significantly to the inequality of stunting were: having affected from diarrhea recently, maternal age birth interval, maternal education, wealth index and place of residence. Of the compositional factors, i.e., coefficients, the variables contributed significantly to the inequality of stunting were child's sex, maternal age, birth interval, maternal education and working

Table 5: Mean value of stunting and underweight of under-five children of Bangladesh, 2004 and 2014.

Overall		Stunting		Underweight	
		Coefficient	P-value	Coefficient	P-value
Mean prediction: 2004		0.43	0	0.475	0
Mean prediction: 2014		0.362	0	0.326	0
Total difference		0.068	0	0.148	0
	Difference due to endowments	0.036	0	0.027	0
	Difference due to behavior	0.036	0	0.116	0
	Difference due to interaction	-0.004	0.54	0.006	0.34

Table 6: Blinder-Oaxaca decomposition of inequality of stunting and underweight of under-five children of Bangladesh, 2004 and 2014.

	Stunted					Underweight								
	End.	Coeff.	Int.	Total	%	End.	Coeff.	Int.	Total	%				
Child's age (in month)	0.0033	0.001	0	0.0043	6.35	0.0018	0.4105	0.0023	0.4146	278.63				
Child's age squared	-0.0032	0.0226	0.0002	0.0196	28.95	-0.0015	-0.2486	-0.0026	-0.2527	-169.83				
Sex of child	28.95					8.6								
	Male	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	Female	-0.0002	0.0194	0.0004	0.0196	28.95	0.0001	0.0124	0.0003	0.0128	8.6			
Had diarrhea recently	-5.91					3.63								
	No	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	Yes	0.0021	-0.0046	-0.0015	-0.004	-5.91	0.0003	0.0038	0.0013	0.0054	3.63			
Maternal age	19.35					19.42								
	<20	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	20-29	0.0013	0.0046	-0.0003	0.0056	8.27	0.0017	0.0207	-0.0011	0.0213	14.31			
	30-49	-0.0015	0.0079	0.0011	0.0075	11.08	-0.0016	0.0081	0.0011	0.0076	5.11			
Birth interval	-43.28					-22.51								
	First	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	< 2 months	0.0049	-0.0047	-0.0029	-0.0027	-3.99	0.0048	-0.0043	-0.0026	-0.0021	-1.41			
	≥ 2 months	0.0023	-0.0261	-0.0028	-0.0266	-39.29	0.0022	-0.0304	-0.0032	-0.0314	-21.1			
Maternal education	39.73					2.49								
	No education	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	Primary	-0.0007	0.001	0.0001	0.0004	0.59	-0.0005	-0.0056	-0.0007	-0.0068	-4.57			
	Secondary	0.0191	0.011	-0.0048	0.0253	37.37	0.0131	-0.0001	0.0001	0.0131	8.8			
	Higher	0.0053	-0.0076	0.0035	0.0012	1.77	0.0039	-0.012	0.0055	-0.0026	-1.75			
Working status	-15.81					-11.83								
	Not working	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	Working	-0.0022	-0.0125	0.004	-0.0107	-15.81	-0.0038	-0.0205	0.0067	-0.0176	-11.83			
Wealth index	16.7					4.17								
	Poorest	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	Poorer	-0.0008	-0.0027	-0.0003	-0.0038	-5.61	-0.0009	0.0009	0.0001	0.0001	0.07			
	Middle	0.0001	-0.0002	0	-0.0001	-0.15	0.0002	-0.0028	0	-0.0026	-1.74			
	Richer	0.0026	0.0069	-0.0006	0.0089	13.15	0.0027	0.0044	-0.0004	0.0067	4.5			
	Richest	0.0053	0.0011	-0.0001	0.0063	9.31	0.0049	-0.0033	0.0004	0.002	1.34			
Place of residence	-0.74					-12.84								
	Urban	Ref.	Ref.	Ref.	---	---	Ref.	Ref.	Ref.	---	---			
	Rural	-0.0019	0.0013	0.0001	-0.0005	-0.74	-0.0007	-0.0171	-0.0013	-0.0191	-12.02			
Constant	---		0.0174	---		-0.0174	-52.89	---		0.0001	---		0.0001	0.07
Total	0.0358		0.0358	-0.0039		0.0677	100	0.0267		0.1162	0.0059		0.1488	100
% Total	52.88		52.88	-5.76		100	---	17.94		78.09	3.97		100	---

status. Overall, the highest contributing factor in stunting was birth interval (-43.3%), followed by maternal education (39.4%), maternal age (19.4%), and wealth index (16.7%). It is notable that the intercept (0.0174), accounted a large proportion (-52.9%), of the change due to coefficients, indicating that the model fitting yielded some limitations in explaining the inequality in stunting.

Besides, of the overall change in inequality in underweight, only 17.9% was attributed to the endowments, i.e. due to the difference in the socioeconomic factors; and 78.1% were ascribed to compositional change. The significant contributing factors included in the endowments were maternal age, birth interval, women's education, working status and wealth index. In the change of coefficients, all factors except household wealth contributed significantly to the inequality of underweight. Child's age, birth interval, maternal age and working status were more contributing factors of inequalities of underweight.

DISCUSSION

Our study findings disclosed the Inequalities, determinants and changes of inequalities in under-nutrition of under-five children in Bangladesh and also highlighted the links between socioeconomic inequalities and under-nutrition. Findings reveal that, although the prevalence of under-nutrition, particularly stunting and underweight has declined, socioeconomic inequalities in malnutrition of under-five children have significantly increased overtime. In Bangladesh, as stated earlier, with economic growth, there occurred major improvements in income, health status and also in life style in recent years. However, the benefits of economic development may have favored more the advantaged social strata. Consequently, health indicators have been improved more favorably in the members of the better-off households compared to those of the disadvantaged groups, resulting in higher inequality between the poor and rich.

The important determinants of malnutrition identified by logistic regression analysis are: household wealth, place of residence, birth interval, maternal age and affected by diarrhea. Maternal education was appeared as an important determinant for stunting and underweight but not for wasting. Although, child's sex was identified as a mediating factor of wasting, these variables were found to have no significant effect on stunting and underweight.

Although the relationship between household wealth and nutritional status of pre-school children is not conclusive, our findings showed negative association with stunting, underweight and wasting which are consistent with other studies conducted in Bangladesh [20], India [21], Cambodia [13] and Nepal [11]. Generally, household economic wellbeing offers availability of nutritious food, more hygienic environment and better access to health care facilities, which together make a favorable situation for the people and protect children from being undernourished. However, economic growth does not bring always equal benefit for all social segments of people, resulting in economic inequality and hence health disparity.

Rural children as compared to their urban counterparts are disadvantaged in terms of wealth, household living conditions and poor accessibility in health care facilities, placing them to be malnourished than their counterparts. Since long, urban-

rural disparities in nutritional outcomes remained persistent in developing countries. Although many studies have shown that rural children are prone to be undernourished, our findings suggest that urban children were at increased risk of being undernourished. This finding is consistent with that of earlier studies conducted in Bangladesh [6,22]. Plausibly, this finding is related to rural to urban migration. In the studies conducted on Bangladeshi children, it is noted that, a large number of rural people, which are mostly poor, has migrated to urban areas due to avail the better facilities of livelihood and educational opportunity in the urban areas. Many of these poor people are not able to afford the costs of nutritious food and health care facilities which might be the underlying cause of this finding [6,22].

The findings of our study which show that children with short birth interval were more tended to be undernourished than those of first ranked birth or long birth interval, are concurrent with those conducted in India [23], and Bangladesh [6]. Children born to adolescent mothers were at increased risk of being under-nourished than those with adult mothers. In a study from Ghana reported that, children born to teenage mothers were significantly at higher risk of being stunted, underweight and wasting as compared to those with adult mothers [24]. Although, inadequate dietary intake and infections are main causes of under-nutrition, lack of financial controlling, psychological immaturity and inexperience of child rearing among adolescent mothers are also important mediating factors of being their children undernourished. Another possible reason may be biological immaturity of short birth interval among teenage mothers, which place children to the vulnerability of under-nutrition.

Concurrent with earlier studies [22,25], our findings show that children affected from diarrhea were more likely to be undernourished than those who were not affected from diarrhea. Diarrhea is one of the main causes of childhood under-nutrition. During diarrhea, children need additional food, which they cannot absorb. Due to decreased intake of food, diarrhea divested nutrients from normal growth, particularly of under-five children. Coherent with earlier studies [6,22], in our study maternal education appeared to be a protective factor of under-nutrition among children, particularly for stunting and underweight. Generally education act as a vehicle for healthy life. Women with higher education are likely to have better knowledge on health, hygiene, nutrition and access to health care facility compared to those with low education. Even, higher educated mothers can handle properly with limited resource to provide their children nutritional diet, which ultimately protect their children of being malnourished.

The contribution in overall socioeconomic inequality in stunting and underweight in both 2004 and 2014 was attributed to household wealth and maternal education. In 2004, household wealth alone contributed 79.5% in the inequality of stunting, which slightly increased at 83.5% in 2014 in the total contribution. In addition, maternal education was the second contributing factor in the inequality of stunting, which contributed 27.0% in 2004 and slightly decreased at 22.7% in 2014. Besides, in the equality of underweight, wealth alone accounted 86.8% in 2004 which decreased at 81.6% in 2014. In 2004, the contribution of maternal education in the inequality of underweight was 23.4%

which decreased at 16.3% in 2014. These statistics clearly indicate that socioeconomic status is the inveterate cause of inequality of childhood under-nutrition, which was also noted in other studies conducted in Vietnam [26], and Iran [27].

In changing the inequality in childhood under-nutrition, a number of factors were identified in making inequality of childhood-under nutrition over the time; such as birth interval, maternal age, maternal education, working status, wealth and place of residence. However, although socioeconomic status was inversely associated with childhood under-nutrition in one side; on the other side inequality in under-nutrition is mainly attributed to growing socioeconomic inequality among social segments of the country.

STRENGTHS AND LIMITATIONS

The main strength of this study is that, we used nationally representative and large sample data sets collected by internationally and well trained interviewers. Moreover, we used sophisticated statistical models which yielded quantitatively important and reliable estimates. However, the study has several limitations that urge to be discussed. First, we could not include some important variables such as diet given to children, household environment, childhood morbidities etc. which might have impact on under-nutrition of children. Moreover, some existed variables such as antenatal care, size of children at birth, duration of breastfeeding, household were not included in the study due to various missing information.

CONCLUSION

The findings of this study suggest that although prevalence in childhood under-nutrition, particularly stunting and underweight has decreased, inequalities in childhood malnutrition have been widened in a decade. Our study confirms that, inequalities in under-nutrition are mainly the outcome of persistent socioeconomic inequalities in the society. Thus any programs to mitigate inequalities of malnutrition between poor and rich should address the prevailing socioeconomic inequalities in the society. Emphasis should be given to enhance women's education not only to minimize inequalities in childhood under-nutrition, also to overall individual and societal wellbeing.

REFERENCES

- Khanam M, Shimul SN, Sarker AR. Individual-, household-, and community level determinants of childhood undernutrition in Bangladesh. *Health Serv Resh Manag Epidemiol.* 2019; 6: 2333392819876555.
- Langley-Evans SC. Nutrition in early life and the programming of adult disease: A review. *J Hum Nutr Diet.* 2015; 28: 114.
- United Nations Development Programme (UNDP). Human development report 2019. Beyond income, beyond averages, beyond today: Inequalities in human development in the 21st century. New York: United Nations Development Programme. 2019.
- World Health Organization (WHO). Trends in maternal mortality 2000 to 2017. Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: World Health Organization. 2019.
- National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ICF International. Bangladesh Demographic and Health Survey 2014. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT, Mitra and Associates, and ICF International. 2016.
- Sultana P, Rahman, MM, Akter J. Correlates of stunting among under-five children in Bangladesh: A multilevel approach. *BMC Nutr.* 2019; 5: 41.
- Ara, G, Sanin KI, Khanam M, Sarker SI, Khan SS, Rifat M, et al. Study protocol to assess the impact of an integrated nutrition intervention on the growth and development of children under two in rural Bangladesh. *BMC Public Health.* 2019; 19: 1437.
- United Nations Children's Fund (UNICEF), World Health Organization (WHO), International Bank for Reconstruction and Development/The World Bank. Levels and trends in child malnutrition: Key Findings of the 2020 Edition. Joint Child Malnutrition Estimates. Geneva: World Health Organization. 2020.
- Baye K, Laillou A, Chitweke S. Socio-economic inequalities in child stunting reduction in Sub-Saharan Africa. *Nutrients.* 2020; 12: 253.
- Asuman D, Ackah CG, Fenny AP, Agyire-Tettey F. Assessing socioeconomic inequalities in the reduction of child stunting in sub-Saharan Africa. *J Public Health (Berl.).* 2019.
- Mohammed SH, Muhammad F, Pakzad R, Alizadeh S. Socioeconomic inequality in stunting among under-5 children in Ethiopia: a decomposition analysis. *BMC Res Notes.* 2019; 12: 184.
- Vollmer S, Harttgen K, Kupka R, Subramanian SV. Levels and trends of childhood undernutrition by wealth and education according to a Composite Index of Anthropometric Failure: Evidence from 146 Demographic and Health Surveys from 39 countries. *BMJ Glob Health.* 2017; 2: e000206.
- Hong R, Mishra V. Effect of wealth inequality on chronic under-nutrition in Cambodian children. *J Health Popul Nutr.* 2006; 24: 89-99.
- Sarma H, Khan JR, Asaduzzaman M, Uddin F, Tarannum S, Hasan MM, et al. Factors influencing the prevalence of stunting among children aged below five years in Bangladesh. *Food Nutr Bull.* 2017; 38: 291-301.
- Talukder B. Regional differences of child under-nutrition in Bangladesh. *Finnish Yearbook Popul Res.* 2013; 48: 189-201.
- World Health Organization (WHO), Multicentre Growth Reference Study Group. WHO Child growth standards: Length/height-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva, Switzerland: WHO. 2006.
- Dessie ZB, Fentie M, Abebe Z, Ayele TA, Muchie KF. Maternal characteristics and nutritional status among 6-59 months of children in Ethiopia: Further analysis of demographic and health survey. *BMC Pediatr.* 2019; 19: 83.
- Van Doorslaer E, Van Ourti T. Measuring inequality and inequity in health and health care. In S. Glied, & P. C. Smith (Eds.), *The Oxford handbook of health economics* (pp. 837-869). Oxford University Press. 2011.
- Jann B. A Stata implementation of the Blinder-Oaxaca decomposition. *Stata J.* 2008; 8: 453-479.
- Kamal SMM, Manaf RA, Islam MA. Effects of wealth on nutritional status of pre-school children in Bangladesh. *Malays J Nutr.* 2010; 16: 219-232.
- Bharati S, Pal M, Chakrabarty S, Bharati P. Trends in socioeconomic and nutritional status of children younger than 6 years in India. *Asia Pac J Public Health.* 2011; 23: 324-340.
- Das S, Gulshan J. Different forms of malnutrition among under five children in Bangladesh: A cross sectional study on prevalence and determinants. *BMC Nutrition.* 2017; 3: 1.

23. Chungkham HS, Sahoo S, Marbaniang HS. Birth interval and childhood undernutrition: Evidence from a large scale survey in India. *Clin Epidemiol Glob Health*, (in press).
24. Wemakor A, Garti H, Azongo T, Garti H, Atosona A. Young maternal age is a risk factor for child undernutrition in Tamale Metropolis, Ghana. *BMC Res Notes*. 2018; 11: 877.
25. Iskandar WJ, Sukardi W, Soenarto Y. Risk of nutritional status on diarrhea among under five children. *Paediatric Indonesiana*. 2015; 55: 235-238.
26. Kien VS, Lee HW, Nam YS, Oh J, Giang KB, Minh HV. Trends in socioeconomic inequalities in child malnutrition in Vietnam: findings from the Multiple Indicator Cluster Surveys, 2000–2011. *Glob Health Action*. 2016; 9: 29263.
27. Kia AA, Goodarzi S, Asadi H, Khosravi A, Rezapour A. A Decomposition analysis of inequality in malnutrition among under five children in Iran: Findings from multiple indicator demographic and health survey, 2010. *Iran J Public Health*. 2019; 48: 748-757.

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