Jagannath University Journal of Science
Volume 08, Number II, June 2022, pp. 27–38
https://jnu.ac.bd/journal/portal/archives/science.jsp
ISSN 2224-1698

JnUJSci

Change of Socioeconomic Status of Woman and Inequity in Child Malnutrition in Bangladesh

Research Article

M Sheikh Giash Uddin[1*] and Mohammed Ahsanul Alam[2]

[1]*Department of Statistics, Jagannath University, Dhaka 1100, Bangladesh*

[2]*National Institute of Population Research and Training (NIPORT), Dhaka, Bangladesh*

Received: 03 April 2022
Accepted: 14 May 2022

Abstract: This study aimed at examining the effect of socioeconomic and demographic factors on childhood malnutrition in Bangladesh, using multivariate analysis. The data obtained from four surveys round of Bangladesh Demographic and Health Survey. Binary logistic regression analysis and concentration index were used to investigate the factors which attribute to nutrition status. This study found that undernutrition among children increases from first year of age. Childhood stunting and underweight is more prevalent in rural than urban areas. This differential may be due to differences in social and economic conditions in urban and rural areas, such as mothers' education, work status, and availability of household wealth. Children of working and primary or less educated mothers have higher rates of stunting and underweight. Maternal biological and behavioural factors are also significant for childhood malnutrition. Higher prevalence of stunting are found among children whose mothers have been suffering from malnutrition. This study revealed that children of very low economic group households were more malnourished. The results from this study provided important evidence on the association between maternal factors and child malnutrition. The study found that maternal education rates and employment rates increased. But the rate of malnutrition has not decreased as the rate of this indicators increased. Therefore, necessary policies and programs that affect the essential and underlying socio-economic influences should improve the situation that supports child malnutrition.

Keywords: *Child nutrition • Inequity • Concentration index • Socioeconomic factors*

1. Introduction

The nutritional status of under five children is considered a major indicator of health sector for any country in the world (Das *et al.* 2008). Proper nutrition allows children to grow, develop, learn, play, participate and contribute, while malnutrition robs children of their futures and leaves young lives hanging in the balance (UNICEF *et al.* 2017). Adequate nutrition is one of the major aspects of health, but at present, malnutrition remains a significant health problems and remains the single leading cause of infant mortality worldwide (Messelu and Trueha 2016). According to Gandhi *et al.* (2014), malnutrition is responsible, directly or indirectly, for 60% of the 10.9 million deaths annually among children under five.

Both undernutrition and overnutrition of an individual is term as malnutrition. In developing countries like Bangladesh, undernutrition level is acute than overnutrition. Undernutrition encompasses protein-energy malnutrition, deficiency of micronutrients including

* Corresponding Author: M. Sheikh Giash Uddin
Email: giash@stat.jnu.ac.bd

essential vitamins and minerals (Ahmed *et al.* 2012), and micronutrient deficiency, which is characterized by stunting, wasting and underweight (Rahman 2015). In Bangladesh, child nutritional status is described by three anthropometric indices stunting, wasting and underweight (NIPORT 2016).

Globally, an estimated 155 million children under age five (22.9%) were stunted, 52 million (7.7%) were wasted, and 99 million children (15%) were underweight (UNICEF *et al.* 2017). In South Asia, an estimated 61.9 million children under age five (35.8%) were stunted, 27.9 million (16%) were wasted, and 59 million children (33%) were underweight (UNICEF *et al.* 2017). In Bangladesh, 36 percent of children were stunted, 14 percent were wasted, and 33 percent were underweight (NIPORT 2016). The sociodemographic variables are significantly associated with child malnutrition, demonstrate that the percentage of undernutrition at the national level does not properly represent the undernutrition at the sub-national level. The 2017-18 Bangladesh Demographic and Health Survey estimated that the Sylhet division had the highest prevalence of stunting followed by Rangpur division (NIPORT *et al.* 2020). In addition to the geographical areas, household factors such as wealth, household size and number of under-5 children; maternal characteristics such as education, age, BMI, work status; and child-related characteristics including child age, sex, birth order and recent illness (Fotso 2006, Yang *et al.* 2018) are also associated with childhood stunting.

The educational levels of mother's have significant effect on child being undernutrition. Children with illiterate mothers were 2 times higher likelihood to be underweighted than children with secondary and above educated mothers. The number of living children of mother and household monthly income are important predictor on the child being underweighted (Giashuddin *et al.* 2003). There is still a rich-poor gap in stunting and underweight of the rural under-five children. The gap was almost two times higher among the poorest than that of the richest children (Giashuddin *et al.* 2005). The important contributing factors for under-five children being malnourished were child's age, mother's education, father's education, father's occupation, household income, currently breastfeeding, place of delivery and geographical division. Community level factors were also effect on child nutrition status (Alom *et al.* 2012).

Bangladesh has reached the targets of decreasing the prevalence of underweight children below the age of 5 years from 66 per cent in 1990 to 32.6 per cent in 2014. As one of the top-performing countries of MDGs, Bangladesh is equally confident to embrace the new targets of SDGs and the government has expressed deep commitment to achieving the SDGs' targets before the time frame of 2030. Exactly 12 of the 17 Sustainable Development Goals (SDGs) are highly relevant for nutrition and contain nutrition-related indicators (GNR 2016), so improving nutritional status is essential for achieving the SDGs. The aim of this study is to examine the effect of socioeconomic and demographic factors on child nutritional status, using multivariate analysis. This study also examined how much has the inequality of child malnutrition changed with the socio-economic change.

2. Data and Methods

The data used for this study come from the four rounds of the Bangladesh Demographic and Health Survey (BDHS) conducted during the years 1999–2000, 2004, 2011 and 2017–18. It is a nationally representative, cross-sectional household survey conducted by the National Institute of Population Research and Training (NIPORT) under the guidance of the Ministry of Health and Family Welfare (MOHFW), Government of Bangladesh. The survey covers a representative sample of women in the age group 15–49 years and provides reliable estimates of fertility, family planning practices, reproductive health, maternal and child health care, utilization and quality of health and family planning services and other related indicators across all the administrative divisions and Bangladesh as a whole. The number of women interviewed was 10,544 in BDHS 1999-2000, 11,440 in BDHS 2004, 17,842 in BDHS 2011 and 20,127 in BDHS 2017-18 respectively (NIPORT *et al.* 2001, NIPORT *et al.* 2005, NIPORT *et al.* 2013, NIPORT *et al.* 2020). The survey measures the nutritional status of children compared with the World Health Organization (WHO) Child Growth Standards, which are based on an international sample of ethnically, culturally, and genetically diverse healthy children living under optimum conditions that are conducive to achieve a child's full genetic growth potential (WHO 2006). The study used two indicators to measure the nutritional status among under-five children: Height-for-age (stunting) and Weight-for-age (underweight). All the outcome indicators were measured with binary responses (Whether stunting or underweight=1; otherwise = 0).

To explain the changes in demographic and socioeconomic characteristics among under-five children descriptive statistics were used. The trends in nutritional status were analyzed using frequency and percentage, by background characteristics. The trend was examined separately for the survey periods (1999–2004), (2004-2011), (2011–18), and (1999–2018) to observe the changes over time. This study used a proxy measure of the economic status of each household in terms of wealth rather than in terms of income or consumption (Gwatkin *et al.* 2000, Kakwani *et al.* 1997). The numerical Inequalities by wealth in child nutrition are measured by

using a concentration index (Gwatkin *et al.* 2000). The inequality of nutritional status is shown in a concentration curve, by plotting the cumulative proportion of stunted and underweight children against the cumulative proportion of total children ranked by wealth.

This study used pooled datasets from four rounds of BDHS to find the changes in undernutrition rate among children who were born in 5 years preceding the survey. To identify the determinants of stunting among under five children, both bivariate and multivariate analyses are done. The study focused on nutritional status of under-five children; whether they are undernourished or not. Since the interest is to identify the child at the risk of undernutrition, the dependent variables are coded as 1 if the child is undernourished and coded as 0 if not. The chi-square test was used to see the association between independent variables under study and the nutritional status of children as measured by stunting or underweight. Once the bivariate analysis was significant, then logistic regression analysis is applied to see the net effects of each independent variable controlling other factors. The model is given below:

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right)=\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots \ldots \ldots + \beta_p X_{ip}$$

Where, π_i range between 0 and 1 (π_i be the probability if i^{th} child is undernourished); and X_{i1}, X_{i2},…,X_{ip} are independent variables; i=1,2,…,n; β_0 is the intercept. The parameter β_j (j=1,2,3,….,p) are called the regression coefficient.

Results

Table 1 presents the percentage distribution of the subjects for each survey round by selected background characteristics. It shows considerable changes in socio-demographic characteristics of women over the past 20 years. The percentage of urban children increased from 17% in 1999-2000 to 27% in 2017-2018. The percentage of mothers with no education decreased significantly from 49% in 1999-2000 to 7% in 2017-2018. On the other hand, the proportion of women with secondary or higher education rose from 25% in 1999-2000 to 64% in 2017-18. Exposure to any type of mass media among women increased from 42% in 1999-2000 to 65% in 2017-18. The percentage of employed women has increased from 18% in 1999-2000 to 40% in 2017-18.

Table 1. Percentage distribution of children under age 5 of different surveys, by background characteristics, Bangladesh, 1999-2018

Background characteristics	BDHS 1999-2000 n = 5419	BDHS 2004 n = 5977	BDHS 2011 n = 7722	BDHS 2017-18 n = 8047
Residence				
Urban	16.5	19.6	22.2	26.6
Rural	83.5	80.4	77.8	73.4
Mother's Education				
No education	46.6	37.4	20.0	7.1
Primary	29.0	31.4	30.7	28.6
Secondary	20.6	26.2	42.3	48.8
Higher	3.8	5.0	7.0	15.5
Wealth index				
Poorest	22.0	25.1	23.5	21.6
Poorer	17.1	20.6	20.4	20.4
Middle	24.1	19.7	19.4	19.2
Richer	19.0	18.1	19.2	20.0
Richest	17.8	16.6	17.5	18.8
Mother's Exposure to any form of mass media				
Exposed	44.0	67.3	63.0	65.1
Not exposed	56.0	32.7	37.0	34.9
Mother's Employment				
Employed	17.6	17.7	9.1	40.3
Not employed	82.4	82.3	90.9	59.7
Total	100.0	100.0	100.0	100.0

3.1 Trends in stunting

The average height-for-age z-score (HAZ) increased from −1·8 (SE 0·018) in 1999 to −1·64 (SE 0·008) in 2018 (Table 2). The prevalence of stunting decreased from 45% to 31% over the same period (P < 0·05). Figure 1 shows slow drop in stunting between 1999 and 2011. A 10-percentage-point reduction was covered in the BDHS between 2011 and 2018.

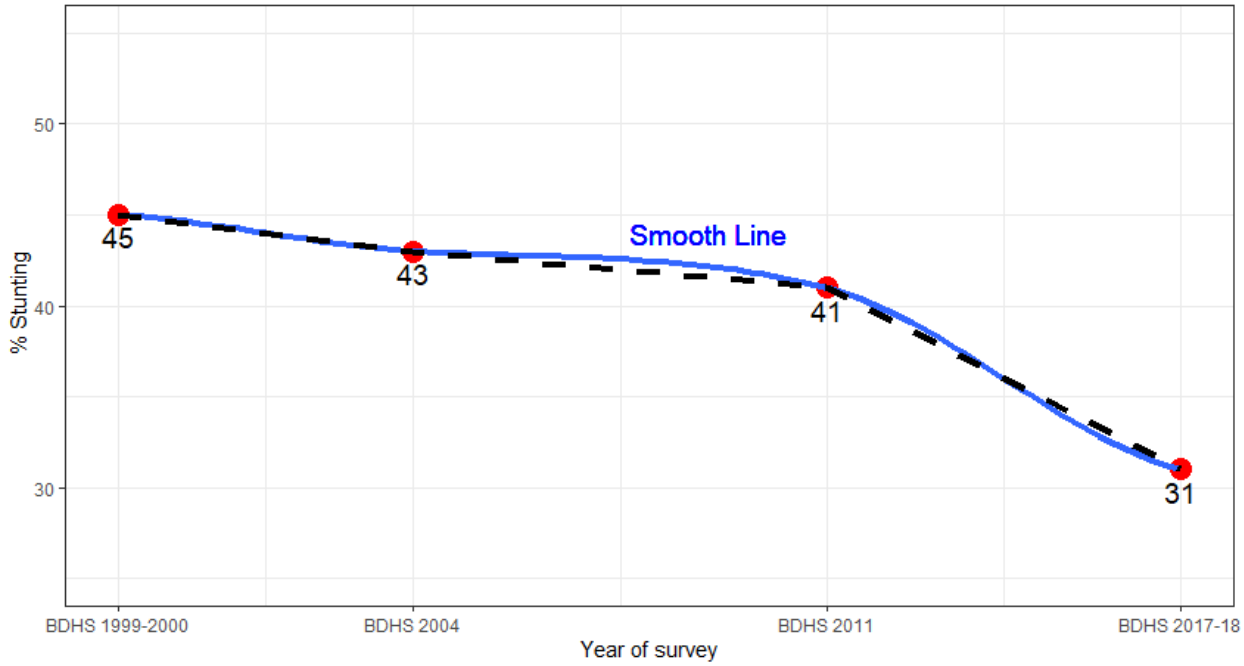

Figure 1. Trends in stunting among children age 0-59 months from 1999 to 2018

The analysis indicates that the children under 2 years were the more stunted than infant 2017-18 (39% and 20% respectively) but the reduction of stunting is highest (22%) among older (48-59 months) children. The prevalence of stunting was significantly higher among children with higher birth order than among those with lower birth order. During the study period, stunting with lower-order birth decreased by 15 percentage points compared with a 6-percentage-point decreased among higher-order birth child (Table 2).

In Eastern (Chottagram, Sylhet) Bangladesh, the prevalence of stunting declined steadily, consistent with the trend at the national level. Stunting in Central Bangladesh stagnated from 1999 to 2011, while the prevalence in Western Bangladesh decreased by 8 percentage points in 2011. Between 2011 and 2018, Central and Western Bangladesh experienced a sharp drop of 18% and 12% respectively (Table 2). In all the suveys, it is found that the rate of stunting was higher in rural areas than in urban areas, but only in the year, 2004 prevalence of stunting increase by 3%. Between 1999 and 2018, in urban and rural areas the percentage of stunting reduced by 10% and 14% respectively. When the children are grouped into wealth status, the richest quintile had the lowest percentage of stunting children. The rate of stunting among the poorest children stagnated from 1999 to 2011, while the percentage of stunting in the other four groups declined slowly.

It is observed from each BDHS, women had more access to education than in previous surveys. The stunting rate among children with no educated mothers decreased from 47% in 1999 to 7% in 2018 (Table 1). The proportion of childhood stunting decreased as the mother's educational level increased. Throughout all four surveys, the proportion of stunting of younger mothers was about two-thirds between 1999 and 2018, the proportion of childhood stunting decreased in all maternal age groups, but the reduction was lowest for children with middle age group mothers.

Table 2: Percentage of stunted children under age 5 by socio-demographic characteristics, Bangladesh, 1993–2018

Characteristics	% of stunted children under age 5					Percentage change	% underweight children under age five					Percentage change
	BDHS 1999-2000	BDHS 2004	BDHS 2011	BDHS 2017-18	Total (pooled data)	1999 to 2018	BDHS 1999-2000	BDHS 2004	BDHS 2011	BDHS 2017-18	Total (pooled data)	1999 to 2018
Overall HAZ												
Mean	-1.84	-1.78	-1.67	-1.37	-1.64		-0.94	-1.00	-0.93	-0.53	-0.83	
SE	0.018	0.017	0.016	0.015	0.008		0.01	0.01	0.01	0.01	0.01	
Age of child (months)												
0-11	18.9	17.3	20.1	20.1	19.3	-1.2	21.7	20.5	20.1	15.0	25.9	-6.7
12-23	52.3	50.9	49.2	33.4	45.6	-18.9	59.8	58.5	35.9	18.3	40.6	-41.5
24-35	49.6	44.7	47.3	38.8	44.7	-10.8	55.6	54.5	39.4	24.2	41.4	-31.4
36-47	53.1	49.3	46.8	33.5	44.9	-19.6	52.2	51.3	42.9	26.1	41.8	-26.1
48-59	50.3	51.5	41.2	28.7	41.9	-21.6	49.6	51.4	41.3	25.8	40.9	-23.8
Gender of child												
Male	43.6	42.5	40.1	30.8	38.6	-12.8	45.8	46.4	34.2	21.7	35.4	-24.1
Female	45.7	43.5	41.8	30.7	39.8	-15.0	49.6	48.6	38.2	21.9	38.1	-27.7
Birth order												
1	43.6	40.1	37.5	28.7	36.1	-14.9	47.4	44.8	32.5	19.9	33.1	-27.5
2-3	41.2	40.2	40.0	29.7	37.1	-11.5	44.1	45.8	34.7	21.0	34.4	-23.1
4-5	50.1	48.9	47.0	40.2	46.8	-9.9	51.9	52.0	44.5	29.6	45.1	-22.3
6+	51.4	53.7	57.4	45.4	53.0	-6.0	54.5	55.0	52.2	37.0	52.5	-17.5
Religion												
Muslim	44.9	43.6	41.5	30.9	39.5	-14.0	48.0	47.7	36.7	21.9	37.0	-26.1
Non-Muslim	42.6	36.3	35.3	28.8	35.5	-13.8	44.5	44.8	30.4	20.5	33.9	-24.0
Residence												
Urban	35.0	37.7	36.2	25.3	32.4	-9.7	39.8	42.1	27.8	19.1	29.3	-20.7
Rural	46.6	44.3	42.3	32.7	41.1	-13.9	49.2	48.8	38.5	22.8	38.7	-26.4
Division												
Barisal	46.0	49.0	44.0	32.8	42.4	-13.2	50.7	45.9	39.3	22.5	38.4	-28.2
Chattogram	45.1	46.2	40.9	32.5	40.7	-12.6	46.1	50.1	37.2	20.9	37.3	-25.2
Dhaka	45.4	44.6	43.2	25.5	39.6	-19.9	47.3	47.5	36.3	18.4	36.7	-28.9
Khulna	37.8	32.0	33.4	25.6	31.8	-12.2	41.8	40.3	28.8	19.0	31.5	-22.8
Mymensingh	0.0	0.0	0.0	35.0	35.0	35.0	0.0	0.0	0.0	25.9	25.9	25.9
Rajshahi	42.0	40.2	33.6	31.0	37.4	-11.0	48.6	48.1	34.1	23.1	39.9	-25.5
Rangpur	0.0	0.0	42.2	30.1	36.1	30.1	0.0	0.0	34.4	20.3	27.2	20.3
Sylhet	56.8	46.2	49.5	42.4	47.9	-14.4	56.8	49.8	45.3	32.7	44.6	-24.1

Characteristics	% of stunted children under age 5					Percentage change	% underweight children under age five					Percentage change
	BDHS 1999-2000	BDHS 2004	BDHS 2011	BDHS 2017-18	Total (pooled data)	1999 to 2018	BDHS 1999-2000	BDHS 2004	BDHS 2011	BDHS 2017-18	Total (pooled data)	1999 to 2018
Mother's age at birth												
<20	49.2	44.9	42.9	31.8	41.5	-17.4	51.0	49.0	37.8	22.6	38.7	-28.4
20-34	41.7	41.4	39.7	30.1	37.6	-11.6	45.3	46.6	34.6	21.1	35.1	-24.2
35-49	52.2	49.9	45.8	33.0	45.7	-19.2	55.3	49.1	46.8	28.4	45.3	-26.9
Maternal Education												
No education	52.4	50.4	50.8	42.9	50.6	-9.5	55.4	55.3	48.8	35.9	52.3	-19.5
Primary	45.8	45.6	46.6	38.7	44.0	-7.1	48.3	48.7	42.2	26.7	40.5	-21.6
Secondary	31.0	34.7	35.3	29.1	32.3	-1.9	34.6	40.3	29.0	20.4	28.0	-14.2
Higher	15.3	15.3	21.8	15.2	16.8	-0.1	18.6	19.5	17.3	10.7	14.1	-7.9
Mother's BMI												
<18.5 kg/m^2	49.5	50.4	51.2	40.8	49.0	-8.7	39.6	40.7	30.8	20.2	30.3	-19.4
≥18.5 kg/m^2	40.6	38.5	37.1	29.0	35.1	-11.6	58.1	58.9	50.0	31.7	52.3	-26.4
Mother's height												
<145 cm	41.0	39.3	38.0	27.2	35.7	-13.8	61.6	63.6	52.7	36.8	53.1	-24.8
≥145 cm	63.7	62.2	61.7	54.1	60.3	-9.6	45.0	44.5	33.8	19.5	34.0	-25.5
Wealth index												
Poorest	54.2	54.4	53.3	40.3	50.2	-13.9	58.0	59.3	50.3	28.9	48.0	-29.1
Poorer	51.0	47.0	45.7	37.3	44.4	-13.7	53.9	53.3	41.8	25.6	41.5	-28.3
Middle	48.2	42.5	40.0	30.1	39.8	-18.1	51.1	44.9	35.4	20.2	36.9	-30.9
Richer	39.6	39.8	35.8	26.7	34.6	-12.9	41.4	43.3	27.7	20.7	31.5	-20.7
Richest	27.3	25.1	25.6	17.2	23.3	-10.1	30.9	30.0	20.6	12.4	22.0	-18.5
Exposure to mass media												
Exposed	36.9	38.7	36.2	27.1	34.1	-9.8	40.3	43.4	30.3	19.4	31.5	-20.9
Not exposed	50.8	51.9	49.0	37.4	47.0	-13.4	53.4	55.9	46.2	26.2	44.8	-27.2
Employment												
Employed	48.2	44.8	41.3	34.0	39.1	-14.2	51.9	48.1	34.1	23.8	33.8	-28.1
Not employed	43.9	42.6	40.9	28.5	39.2	-15.4	46.7	47.4	36.4	20.4	37.5	-26.3
Total	44.6	43.0	41.0	30.7	39.2	-13.9	47.6	47.5	36.2	21.8	36.7	-25.8

During the study period, stunting of children with mothers who were not exposed to any media were significantly declined than children with exposed mothers (13% points versus 10% points). When children are categorized by maternal BMI, the prevalence of stunting decreased most among children with thin mothers (BMI <18.5 and height <145 cm). Mothers with a BMI of <18.5, their children had a 9% reduction in stunting, and those with a height of <145 cm had a 14% reduction in stunting. The prevalence of stunting was significantly higher among children whose mothers had no mass media exposure in all the surveys. Children with employed mothers had a higher prevalence of stunting (34% versus 29%) and the reduction rate was also lowest (14%) among them compared to non-employed mothers (15%).

3.2 Trends in underweight

The mean WAZ increased from −0·94 (SE 0·01) in 1999 to −0·53 (SE 0·01) in 2018 (Table 2). The prevalence of underweight increased from 48% to 36% over 1999 to

2011 and a sharp decline to 22% in 2018 (Figure 2). The trend shows the prevalence of underweight indicates the significantly ($p<0.001$) drop in underweight between 1999 and 2011. A 14 percentage-point reduction was covered in the BDHS between 2011 and 2018.

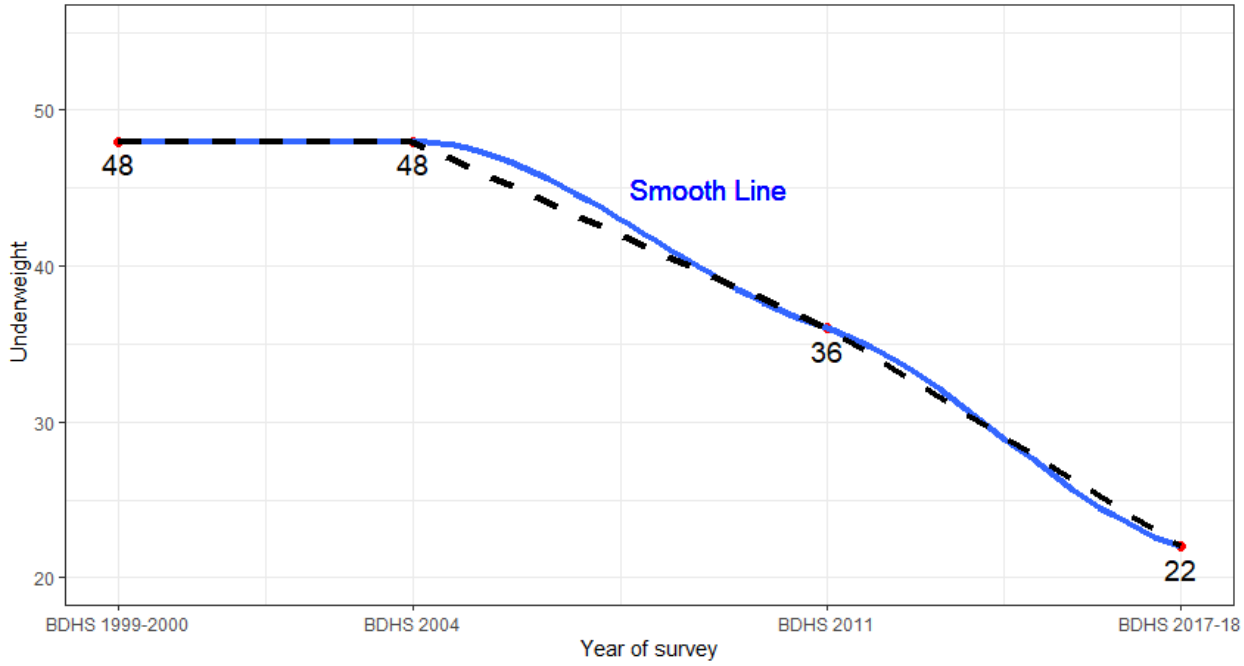

Figure 2. Trends in underweight among children age 0-59 months from 1999 to 2018

Overall, children of 2 years were the most underweighted, while children less than 1 year were least underweighted (41% and 26 respectively) but the reduction of underweight is highest (42%) among 12-23 months children. Prevalence of underweight was significantly higher among children with higher birth order than among those with lower birth order in all the surveys. Over the study periods, childhood underweight with lower-order birth decreased more by 28% points compared with children with higher-order birth at a 17% points (Table 2). Although the prevalence of underweight is almost similar between male and female children in all the surveys reduction rate is higher among female children (24% versus 28%).

The proportion of underweight was higher in rural areas than in urban areas in all surveys. In rural areas, the prevalence of underweight reduced by 16% between 2011 and 2018. Between 1999 and 2018, in urban and rural areas the prevalence of underweight reduced by 21% and 26% respectively. The highest decline (28%) of the prevalence of underweight declined to appear in the central (Dhaka and Barisal) region from 1999 to 2011, while the prevalence in lowest declined in the western (Khulna) region (23%). In 2011, the highest reduction in the proportion of underweight in the poorest quintile is at about 21%. The highest reduction of underweight is observed in the middle quintile (31%) from 1999-2018. The reduction rate is slightly high in Muslim children compared to non-Muslim (26% versus 24%).

The analysis revealed that the percentage of underweight children decreased as the mother's educational level increased. Throughout 1999-2018, childhood underweight demonstrated highest decrease for children with younger mothers (28%). For children with maternal BMI, the prevalence of underweight decreased the most among children with thin mothers (BMI <18.5). Mothers with a BMI of <18.5, their children had a 26% reduction in underweight, and those with a height <145 cm had a 26% reduction in underweight. Prevalence of underweight was higher among children whose mothers had no mass media exposure in all the surveys. During the study period, underweight children with no mass media exposed mothers decreased by 27 percentage points compared with a 21-percentage-point decreased among children with exposed mothers. Children with employed mothers had a higher reduction in the prevalence of underweight (28%) compared to non-employed mothers (26%).

3.3 Inequality for Child Nutrition

The relationship of child's nutritional status and income inequality were measured in terms of wealth quintiles. The difference in proportion of stunting of the poorest children was expressed as a ratio of the richest quintile. The inequality in stunted children was described using

concentration curve. The propostion of stunting children declines with standards of living. It is indicated proportion of the poor children suffer from chronic malnutrition than the rich children. For example, in 1999 rate of stunting among the lowest quintile was about 54% as opposed to about 48% and 27% in the third and fifth quintile respectively. For example, a poor-rich ratio of 1999 children implies that the stunting rate in the poorest quintile is about twice the rate of the richest.

Figure 3 presents the concentration curve for percentage of stunting of the under five children. The curve lies above the diagonal line. So, it is indicated that stunting favoured among the poor children. Table 3 reveals concentration indices along with 95% CI for stunting among the children by wealth score. The negative value of the concentration index indicated that there was a higher stunting rate among the poor. In 2017-18, the concentration index for stunting children was -.153 which implied that better-off children had a tendency to be better nourished than poorest and poorer children. The 95% confidence interval (CI) demonstrated that inequalities in stunting in all the surveys were significant differ from zero. The trend shows that inequality in stunting increased in 2017-18.

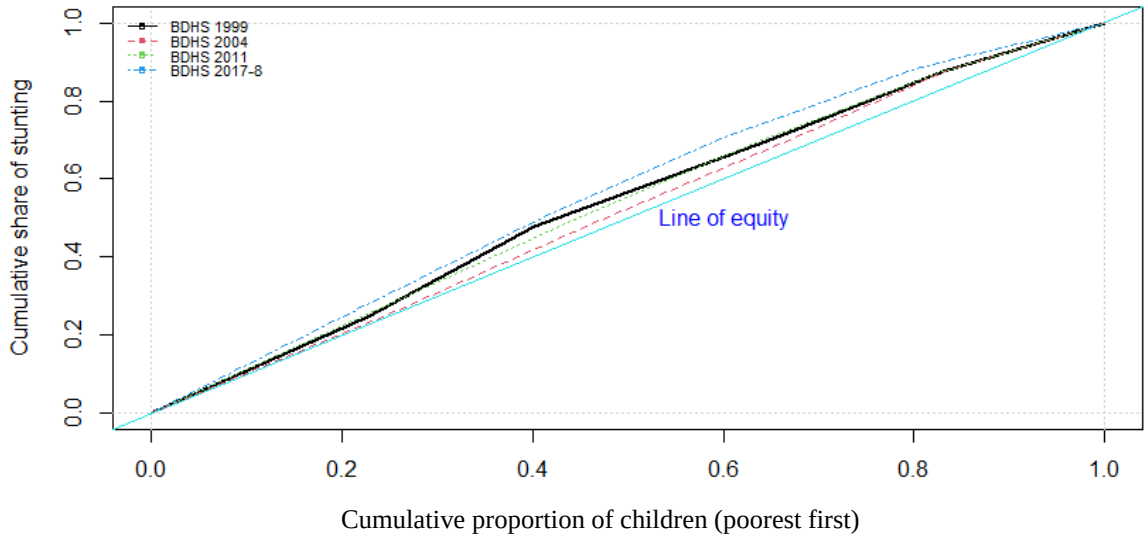

Figure 3. Concentration curves for Stunting

The rising trend of inequality in underweight was also explained with the help of the concentration curve (Table 4). In Figure 4 the curve of BHDS 2017-18 indicates a more degree of inequality than the concentration curve of BDHS 1999-2000. The absolute value of CI for underweight in these periods are -0.113 (-0.133,-0.093) in 1999 and -0.143 (-0.163,-0.123) in 2017-18. Both are significantly different from zero ($p<0.01$). This result is consistent with the concentration curve.

Table 3. Trends in inequity for nutrition status (Stunting) of children

	BDHS 1999-2000	BDHS 2004	BDHS 2011	BDHS 2017-18
	n=5419	n=5977	n=7723	n=7819
Wealth Quintile				
Poorest	54.2	54.4	53.3	40.3
Poor	51.0	47.0	45.7	37.3
Middle	48.2	42.5	40.0	30.1
Richer	39.6	39.8	35.8	26.7
Richest	27.3	25.1	25.6	17.2
Richest: Poorest ratio	2.0	2.2	2.1	2.3
Richest-Poorest difference	-26.9	-29.3	-27.7	-23.1
Concentration index (95% CI)	-0.119 (-0.139,-0.099)	-0.126 (-0.146,-0.106)	0.133 (0.113, -0.153)	-0.153 (-0.173,-0.133)

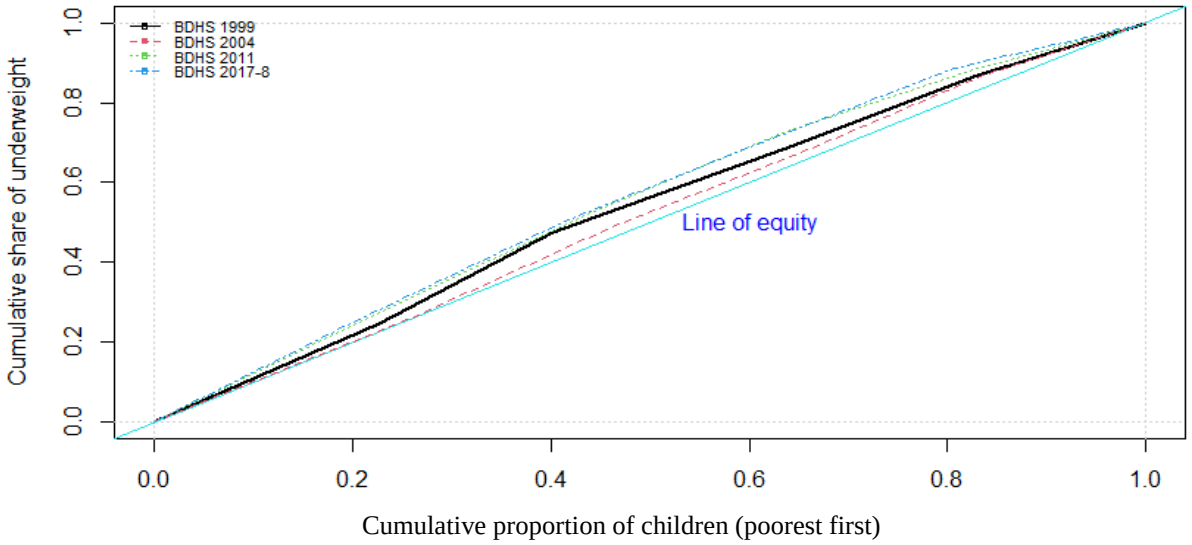

Figure 4. Concentration curves for underweight

Table 4. Trends in inequity for nutrition status (Underweight) of children

Wealth Quintile	BDHS 1999-2000 N=5419	BDHS 2004 N=5977	BDHS 2011 N=7723	BDHS 2017-18 N=7819
Poorest	58.0	59.3	50.3	28.9
Poor	53.9	53.3	41.8	25.6
Middle	51.1	44.9	35.4	20.2
Richer	41.4	43.3	27.7	20.7
Richest	30.9	30.0	20.6	12.4
Richest: Poorest ratio	1.9	2.0	2.4	2.3
Richest-Poorest difference	-27.1	-29.3	-29.7	-16.5
Concentration index (95% CI)	-0.113 (-0.133,-0.093)	-0.118 (-0.138,-0.098)	-0.172 (-0.192,-0.152)	-0.143 (-0.163,-0.123)

3.4. Determinants of nutritional status among children aged 0-59 months

Table 5 presents the results of pooled logistic regression for the nutritional status of children of stunting and underweight. The analysis shows that female children are more likely to be stunted and underweight than male children, the pooled adjusted odds ratio (AOR) are 1·04 (95% CI 1·00, 1·09) and 1·12 (95% CI 1·07, 1·18) respectively. Children's birth order had found a significant effect on stunting and underweight. Higher-order births are more likely to be stunted and underweighted than first-order births AOR was 1·34 (95% CI 1·17, 1·53) and 2·24 (95% CI 2·02, 2·48) respectively.

Compared with children from the central region, the rate of malnutrition is higher in eastern region. The pooled AOR for stunting was 1·24 (95% CI 1·08, 1·43) and for underweight 1·29

Table 5. Socio-demographic determinants of nutrition of children in Bangladesh, 1996-2018

Characteristics	Stunted children under age five		Underweight children under age five	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender of child				
Male	1.00	1.00	1.00	1.00
Female	1.05 (1.00-1.11)	1.04 (0.99-1.09)	1.12 (1.07-1.18)	1.12 (1.07-1.18)
Birth order				
1	1.00	1.00	1.00	1.00
2-3	1.04 (0.99-1.10)	1.03 (0.96-1.11)	1.06 (1.00-1.12)	1.02 (0.94-1.09)
4-5	1.56 (1.44-1.68)	1.23 (1.12-1.37)	1.66 (1.54-1.80)	1.17 (1.06-1.30)
6+	1.99 (1.80-2.21)	1.34 (1.17-1.53)	2.24 (2.02-2.48)	1.19 (1.04-1.37)
Religion				
Muslim	1.00	1.00	1.00	1.00
Non-Muslim	0.84 (0.77-0.92)	0.87 (0.80-0.96)	0.87 (0.80-0.96)	0.90 (0.82-0.99)
Residence				
Urban	1.00	1.00	1.00	1.00
Rural	1.45 (1.36-1.54)	0.98 (0.80-1.18)	1.53 (1.43-1.62)	0.96 (0.79-1.18)
Division				
Barisal	1.00	1.00	1.00	1.00
Chattogram	0.93 (0.83-1.04)	1.02 (0.91-1.15)	0.96 (0.85-1.07)	1.05 (0.93-1.19)
Dhaka	0.89 (0.80-1.00)	0.96 (0.86-1.08)	0.93 (0.83-1.04)	0.97 (0.86-1.09)
Khulna	0.64 (0.56-0.72)	0.73 (0.64-0.84)	0.74 (0.65-0.84)	0.86 (0.74-0.98)
Mymensingh	0.73 (0.61-0.88)	0.97 (0.79-1.18)	0.56 (0.46-0.69)	1.04 (0.84-1.29)
Rajshahi	0.81 (0.72-0.91)	0.75 (0.66-0.84)	1.07 (0.95-1.20)	0.94 (0.82-1.06)
Rangpur	0.77 (0.67-0.89)	0.84 (0.72-0.98)	0.60 (0.52-0.70)	0.80 (0.68-0.94)
Sylhet	1.25 (1.10-1.43)	1.24 (1.08-1.43)	1.29 (1.13-1.47)	1.26 (1.09-1.46)
Mother's age				
<20	1.00	1.00	1.00	1.00
20-34	0.85 (0.80-0.89)	0.78 (0.72-0.83)	0.86 (0.81-0.91)	0.82 (0.76-0.89)
35-49	1.18 (1.05-1.33)	0.75 (0.64-0.87)	1.32 (1.17-1.48)	0.85 (0.73-1.00)
Mother's Education				
No education	1.00	1.00	1.00	1.00
Primary	0.77 (0.72-0.82)	0.92 (0.86-0.99)	0.62 (0.58-0.66)	0.85 (0.79-0.91)
Secondary	0.47 (0.44-0.50)	0.72 (0.66-0.78)	0.36 (0.33-0.38)	0.67 (0.61-0.72)
Higher	0.20 (0.18-0.22)	0.42 (0.37-0.49)	0.15 (0.13-0.17)	0.41 (0.35-0.48)
Mother's BMI				
<18.5 kg/m^2	1.00	1.00	1.00	1.00
≥18.5 kg/m^2	0.56 (0.53-0.59)	0.76 (0.71-0.80)	0.40 (0.38-0.42)	0.57 (0.54-0.61)
Wealth index				
Poorest	1.00	1.00	1.00	1.00
Poorer	0.79 (0.74-0.85)	0.90 (0.83-0.97)	0.77 (0.72-0.83)	0.89 (0.82-0.96)
Middle	0.66 (0.61-0.71)	0.78 (0.72-0.84)	0.64 (0.59-0.68)	0.75 (0.69-0.82)
Richer	0.53 (0.49-0.57)	0.69 (0.63-0.75)	0.50 (0.46-0.54)	0.68 (0.62-0.75)
Richest	0.30 (0.28-0.33)	0.46 (0.42-0.52)	0.31 (0.28-0.33)	0.50 (0.44-0.56)
Exposure to mass media				
Not exposed	1.00	1.00	1.00	1.00
Exposed	0.58 (0.55-0.61)	0.89 (0.84-0.95)	0.57 (0.54-0.60)	0.89 (0.84-0.95)
Employment				
Not employed	1.00	1.00	1.00	1.00
Employed	1.00 (0.94-1.06)	1.00 (0.94-1.06)	0.85 (0.80-0.91)	1.04 (0.97-1.11)
BDHS				
1999	1.00	1.00	1.00	1.00
2004	0.94 (0.87-1.01)	0.98 (0.91-1.06)	0.99 (0.92-1.07)	1.07 (0.99-1.16)
2011	0.86 (0.80-0.92)	1.02 (0.94-1.10)	0.62 (0.58-0.67)	0.77 (0.71-0.83)
2017-18	0.55 (0.51-0.59)	0.71 (0.65-0.77)	0.31 (0.28-0.33)	0.44 (0.40-0.48)

(95% CI 1·13, 1·47) in the Sylhet region. The analysis revealed that children from the Western -region had lower odds of stunting compared to the central region (AOR=0.84; 95% CI 0.72, 0.98; $P<0·05$). The odd ratio shows that there is no significant impact on nutritional status among rural and urban children.

Using the poorest quintile as a reference, children in the richest and richer quintiles had significantly lower odds of stunting [AOR 0.69 95% CI (0.63-0.75); AOR 0.46 95% CI (0.42-0.52), respectively], underweight [AOR 0.68 95% CI (0.62-0.75); AOR 0.50 95% CI (0.44-0.56)].

There was a decreased likelihood of childhood stunting and underweight if the mother was older [AOR=0·75; 95% CI (0·64, 0·87) and AOR =0.85; 95% CI (0.73, 1.00)]. Using mothers with no education as the reference group, children of secondary and higher educated mothers were significantly less likely to be stunted and underweighted in the pooled model [AOR=0.42 95% CI (0.37-0.49); AOR=0.41 95% CI (0.35-0.48)]. The relationship between a mother's education and the nutritional status of the children is probably due to the fact that more educated women feel greater control over their lives and become more responsible for their children's survival. Overweight or obese mothers were significantly less likely to have stunted children in the surveys compared with mothers of normal BMI [AOR=0·76; 95 % CI 0·71, 0.57 (0.54-0.61)]. There was no significant association between maternal employment status and underweight after adjusting for other variables.

Using year 1999 as a reference year, the adjusted OR (AOR) of stunting in years 2004, 2011 and 2018 was 0.98 (0.91-1.06); 1.02 (0.94-1.10); 0.71 (0.65-0.77) respectively. This was a 29% reduction in the odds of stunting over 18 years. Similarly, the adjusted OR (AOR) of underweight in years 2004, 2011 and 2018 was 1.07 (0.99-1.16); 0.77 (0.71-0.83); 0.44 (0.40-0.48) respectively. This was a 56% reduction in the odds of being underweight over 18 years

4. Discussion

This study investigated the trends of nutritional status among Bangladeshi children between 1999 and 2018 by different socio-economic and demographic characteristics. Stunting and underweight among children under 5 deceased significantly in Bangladesh. Hosehold wealth, maternal age, maternal education and child age, gender and birth order were associated with child stunting and underweight. Similar results of childhood stunting have been found in other developing countries (Masibo & Makoka 2012, Barankanira *et al.* 2017).

Children of the poorest quintile were more likely to be stunted than the richest quintiles. This results were found consistent to the findings from other Asian and African countries (Hoffman *et al.* 2017, Akombi *et al.* 2017, Chirande *et al.* 2015), where children from poorer households were more likely to be stunted. It is expected that children from richer households would have adequate nutritional intake compared with poorer households. In most recent surveys this poor-rich gap increased. It is not very clear why this gap increased to stunting over time.

The higher maternal education was associated with a lower likelihood of childhood stunting and underweight. Higher the mother education level a lower likelihood of child being stunted. This result is consistent with other studies. The study explained higher education is associated with employment and higher household income (Giashuddin *et al.* 2003).

Female children were more likely to be underweighted during the surveys. Older children were more malnourished than younger children. This result is also consistent with studies in Nepal and Burundi (Tiwari *et al.* 2014, Nkurunziza *et al.* 2017). The results of concentration index indicated that there was significant inequalities across the socioeconomic categories. The results confirmed the gap existed in child nutritional status between the poorest and the richest. For instance, the stunting of the poor children was almost double of the richest group. An earlier study showed that children living in lower family income were more malnourished than the children of higher-income families (Giashuddin *et al.* 2003).

5. Conclusions

The study confirm significant declined in under-5 childhood stunting and underweight in Bangladesh in last 18 years. It also idenfied the significant determinants who are responsible for childhood malnutrition. But not all groups of children benefited equally from the decline. The regional differences in the prevalence of undernutrition and its associated factors are significant. As of 2018, living in poor households and with no education or less educated mothers were the most vulnerable to stunting and underweight. This paper provides comparative data that can be used for policymaking, program planning, and monitoring the nutritional status of children. Social determinants must prioritize to implement the National policy and plan to address this level of stunting and underweight.

References

Ahmed, T., Mahfuz, M., Ireen, S., Ahmed, A. M. S., Rahman, S., Islam, M. M. Cravioto, A. (2012). Nutrition of children and women in Bangladesh: Trends and directions for the future. *Journal of Health, Population and Nutrition, 30*, 1-11.

Alom, J., Quddus, M., & Islam, M. (2012). Nutritional Status Of Under-Five Children In Bangladesh: A Multilevel Analysis. Journal Of Biosocial Science, 44(5), 525-535. Doi:10.1017/S0021932012000181

Akombi BJ, Agho KE, Hall JJ *et al.* (2017) Stunting and severe stunting among children under-5 years in Nigeria: a multilevel analysis. BMC Pediatr 17, 15.

Barankanira E, Molinari N, Msellati P *et al.* (2017) Stunting among children under 3 years of age in Côte d'Ivoire: spatial and temporal variations between 1994 and 2011. Public Health Nutr 20,1627–1639.

Das, S., Hossain, M. Z., & Islam, M. A. (2008). Predictors of child chronic malnutrition in Bangladesh. *Proc. Pakistan Acad. Sci., 45*(3), 137-155.

Chirande L, Charwe D, Mbwana H *et al.* (2015) Determinants of stunting and severe stunting among under-fives in Tanzania: evidence from the 2010 cross-sectional household survey. BMC Pediatr 15, 165.

Fotso J-C (2006) Child health inequities in developing countries: differences across urban and rural areas. Int J Equity Health 5, 9.

Gandhi, S. J., Godara, N., Modi, A., & Kantharia, S. L. (2014). Impact of feeding practices on nutritional status of children in rural area of Navsari district. *International Journal of Medical Science and Public Health 3*(11)

Giashuddin M. S., M. Kabir, A. Rahman and M. A. Hannan (2003) Exclusive breastfeeding and nutritional status in Bangladesh; The Indian Journal of Pediatrics, 70, 471–475.

Giashuddin M. S., M. Kabir, and M. Hasan (2005) Economic Disparity and Child nutrition in Bangladesh; The Indian Journal of Pediatrics, 72(6), 481–487.

Global Nutrition Report (2016). From Promise to Impact: Ending Malnutrition by 2030. Retrieved from: https://www.compassion.com/multimedia/global-nutrition-report-2016.pdf

Gwatkin DR., Ruston S, Johnson K, Paned RP, Wagstaff A. (2000). Socioeconomic differences in health, nutrition and population in Bangladesh. Washington DC: The World Bank, www.worldbank.org/hnp.

Hoffman D, Cacciola T, Barrios P *et al.* (2017) Temporal changes and determinants of childhood nutritional status in Kenya and Zambia. J Health Popul Nutr 36, 27.

Kakwani, N.C., A. Wagstaff, and E. Van Doorslaer (1997). Socioeconomic inequalities in health: Measurement, computation and statistical inference. Journal of Econometrics, 77(1): p. 87-104.

Masibo PK & Makoka D (2012) Trends and determinants of undernutrition among young Kenyan children: Kenya Demographic and Health Survey; 1993, 1998, 2003 and 2008–2009. Public Health Nutr 15, 1715–1727.

Messelu, Y., & Trueha, K. (2016). Determining risk factors of malnutrition among under-five children in Sheka Zone, South West Ethiopia Using Ordinal Logistic Regression Analysis. *Public Health Research, 6*(6), 161-167.

Nkurunziza S, Meessen B, Van Geertruyden JP *et al.* (2017) Determinants of stunting and severe stunting among Burundian children aged 6–23 months: evidence from a national cross-sectional household survey, 2014. BMC Pediatr 17, 176.

National Institute of Population Research and Training (NIPORT), Mitra and Associates (MA), and ORC Macro (ORCM). (2001). Bangladesh Demographic and Health Survey 1999-2000. Dhaka, Bangladesh and Calverton Maryland [USA]: National Institute of Population Research and Training, Mitra and Associates, and ORC Macro.

National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ORC Macro, (2005). Bangladesh Demographic and Health Survey 2004. Dhaka, Bangladesh, and Calverton, Maryland, USA: NIPORT, Mitra and Associates, and ORC Macro.

National Institute of Population Research and Training, Mitra and Associates, and ORC Macro. National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ICF International. 2013. Bangladesh Demographic and Health Survey 2011. Dhaka, Bangladesh and Calverton, Maryland, USA: NIPORT, Mitra and Associates, and ICF International.

National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ICF International, (2016). Bangladesh Demographic and Health Survey 2014. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT, Mitra and Associates, and ICF International.

National Institute of Population Research and Training (NIPORT), and ICF. (2020). Bangladesh Demographic and Health Survey 2017-18. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT and ICF.

Rahman, M. (2015). Is unwanted birth associated with child malnutrition in Bangladesh? *International Perspectives on Sexual and Reproductive Health, 41*(2), 80-88.

Tiwari R, Ausman LM & Agho KE (2014) Determinants of stunting and severe stunting among under-fives: evidence from the 2011 Nepal Demographic and Health Survey. BMC Pediatr 14, 239.

United Nations Children's Fund (UNICEF), WHO and World Bank, Levels & Trends in Child Malnutrition, New York: UNICEF; Geneva: WHO; and Washington, DC: World Bank, 2017.

World Health Organization (WHO) Multicentre Growth Reference Study Group. (2006). 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.

Yang YY, Gabriella K, David N, Hope B, Darcy F, Yovani AM L, Ezekiel M and Paul M B (2018) Trends and determinants of stunting among under-5s: evidence from the 1995, 2001, 2006 and 2011 Bangladesh Demographic and Health Surveys; Public Health Nutrition: 21(16), 2915–2928.