

RESEARCH REPORT

Trends and Inequalities of Childhood Underweight in Bangladesh: A Decomposition Approach

Abdur Razzaque Sarker
Kashfi Rayan



Bangladesh Institute of Development Studies (BIDS)

RESEARCH REPORT

TRENDS AND INEQUALITIES OF CHILDHOOD UNDERWEIGHT IN BANGLADESH: A DECOMPOSITION APPROACH

**Abdur Razzaque Sarker
Kashfi Rayan**

September 2024

**BANGLADESH INSTITUTE OF
DEVELOPMENT STUDIES**

Research Report No. 205

DOI: <https://doi.org/10.57138/EZZY1359>

Abdur Razzaque Sarker

Research Fellow
Bangladesh Institute of Development Studies (BIDS)
Dhaka, Bangladesh

Kashfi Rayan

Research Associate
Bangladesh Institute of Development Studies (BIDS)
Dhaka, Bangladesh

Published by

Bangladesh Institute of Development Studies
E-17, Agargaon, Sher-e-Bangla Nagar
G.P.O. Box No. 3854, Dhaka-1207, Bangladesh
Phone: 880-2-58160430-37
FAX: 880-2-58160410
Website: www.bids.org.bd
E-mail: publication@bids.org.bd

© Copyright BIDS, September 2024

Price: Inland	Foreign
Tk. 150.00	US\$ 10.00

CONTENTS

List of Tables	ii
List of Figure.....	ii
Abbreviations	iii
Executive Summary.....	iv
CHAPTER 1	1
INTRODUCTION.....	1
1.1 Background of the Study	1
1.2 Objectives of the Study.....	2
CHAPTER 2	3
METHODOLOGY	3
2.1 Study Design and Sample	3
2.2 Variables	3
2.3 Measurement and Analysis	4
2.4 Concentration Curve.....	4
2.5 Concentration Index	5
2.6 Decomposition of Socio-economic Inequalities	5
2.7 Percentage Changes in Undernutrition	6
2.8 Ethical Approval	6
CHAPTER 3	7
RESULTS	7
3.1 Background Characteristics	7
3.2 Trends in Childhood Undernutrition	9
3.3 Trends in Socio-economic Inequalities in Childhood Undernutrition	12
3.4 Decomposition of Childhood Underweight Inequality in 2017-18.....	12
CHAPTER 4	15
DISCUSSION AND POLICY RECOMMENDATIONS	15
4.1 Discussion	15
4.2 Limitations of the Study	17
4.3 Conclusion and Policy Recommendations	18
REFERENCES.....	19

List of Tables

Table 3.1: Distribution of Socio-demographic, Maternal, and Household Characteristics among Under-Five Children in Bangladesh (N=38,294).....	7
Table 3.2: Prevalence of Childhood Underweight across Background Characteristics from 2004 to 2017- 2018.....	10
Table 3.3: Concentration Index of Childhood Underweight from 2004 to 2017-18.....	12
Table 3.4: Decomposition Analysis Socio-demographic Characteristics for Underweight Children, 2017-18.....	13

List of Figure

Figure 3.1: Concentration Curve Showing Inequality for Underweight in 2017-18	12
---	----

Abbreviations

BBS	Bangladesh Bureau of Statistics
BDHS	Bangladesh Demography and Health Survey
BMI	Body Mass Index
CI	Concentration Index
GoB	Government of Bangladesh
OR	Odds Ratio
PCA	Principal Component Analysis
SDGs	Sustainable Development Goals
SEA	Southeast Asia
8 FYP	Eighth Five-Year Plan
VIF	Variance Inflation Factor
WHO	World Health Organization

Executive Summary

Childhood underweight is a consistent public health problem globally. About 12.6 per cent of the total under-five children (85.4 million) were underweight in 2020, while half of the underweight burden (42 million) belonged to the Southeast Asian Region. Being underweight is one of the major risk factors for early neonatal mortality and morbidity in many developing countries. Although the global trend of underweight children has decreased over time, such progress is not uniformly distributed among resource-poor settings. This study investigates the nationwide trend of the prevalence of childhood underweight, inequalities and associated factors utilising data from the latest five rounds of the Bangladesh Demographic and Health Survey (BDHS).

Data were extracted from the Bangladesh Demographic and Health Survey (BDHS) across five rounds conducted in 2004, 2007, 2011, 2014, and 2017-18. The BDHS is a nationally representative cross-sectional survey that includes the entire population residing in non-institutional dwelling units in Bangladesh. Conducted by the National Institute of Population Research and Training (NIPORT), the survey employs a two-stage stratified sampling method based on the Population and Housing Census framework provided by the Bangladesh Bureau of Statistics (BBS) to obtain a nationally representative sample of households. The study population consists of women aged 15 to 49 years with at least one child. The number of women interviewed in the BDHS for the survey years was 6,912 in 2004, 5,997 in 2007, 8,716 in 2011, 8,034 in 2014, and 8,634 in 2017-18.

An analysis of the concentration indices across the five survey periods spanning from 2004 to 2017-18 exhibits negative values, indicating that childhood underweight is concentrated within economically disadvantaged households. For instance, in the 2017-18 survey period, the value of the Concentration Index (CI) was -0.176, the lowest among all survey periods, suggesting an improvement in inequality. However, the concentration curve still lies above the equity line. In summary, we observed that despite a decline in underweight rates over time, significant socio-economic disparities persist, indicating the necessity for targeted interventions aimed at low-income households. Employing concentration indices and decomposition analysis, household wealth status and maternal education were identified as pivotal determinants. Other notable contributors to childhood inequality were maternal body mass index, birth order of children, childhood illness and access to hygienic toilet facilities. Our empirical findings provide robust evidence of socio-economic inequalities in childhood underweight, informing policy interventions to reduce disparities and enhance child nutrition outcomes in Bangladesh.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Childhood underweight is a consistent global health issue. In 2020, approximately 12.6 per cent of children under five (85.4 million) were underweight, with half of this burden (42 million) concentrated in the Southeast Asian Region (WHO, 2023). Being underweight is one of the major risk factors for early neonatal mortality and morbidity in many developing countries (Mahumud, Sultan, & Sarker, 2017; Rezende Chrisman et al., 2016). In fact, mortality incidence from underweight children caused a larger loss of healthy years in countries with higher child mortality rates (Ezzati, Lopez, Rodgers, Vander Hoorn, & Murray, 2002). Although the global trend of underweight children has decreased over time, this progress is not uniformly distributed among resource-poor settings (Walker, Grantham-McGregor, Powell, & Chang, 2000).

Bangladesh has successfully reduced undernutrition among under-five children in the last two decades (Headey, Hoddinott, Ali, Tesfaye, & Dereje, 2015; Khanam, Shimul, & Sarker, 2019; Nisbett, Davis, Yosef, & Akhtar, 2017). Although the progress in tackling childhood underweight is a pioneer among the ASEAN countries, it is still behind the prevalence of the global average (12.9%) of underweight children (World Bank, 2023b). It is well evident that even mild degrees of underweight are associated with potentially significant increases in health risks (Bhagowalia, Chen, & Masters, 2011). Being underweight has both short- and long-term effects that are unfavourable to the physical and intellectual growth of under-five children (Kalbacher et al., 2020; Walker et al., 2000). A study indicated that underweight children are 8.4 times more likely to die before the age of five compared to well-nourished children (Pelletier, Frongillo, Schroeder, & Habicht, 1994). Various studies observed that there is a positive link among contagious diseases such as diarrhoea and pneumonia and underweight children (Caulfield, Onis Blössner, & Black, 2004; Pelletier, 1994). Underweight status reduces children's immune systems, making them more susceptible to infections and thus increases the risk of child morbidity and mortality (GED, 2020; Islam et al., 2020; MoFW, 2017).

In order to attain the Sustainability Development Goals (SDGs) to improve equity, quality and efficiency of health services, Bangladesh has set an SDG target to reduce the proportion of under-five underweight children to 15% by the year 2025. To achieve this target, the Bangladesh Government designed a Plan of Action for Nutrition 2016-25, addressing the slow

declining rate of malnutrition indicators and rising inequality in the prevalence of child undernutrition (Chowdhury, Chakrabarty, Rakib, Saltmarsh, & Davis, 2018a; GED, 2020; MoFW, 2017). Thus, considerable interest has developed in the literature on health equality addressing socio-economic inequities in childhood undernutrition to cater to the inquiries of researchers and policymakers regarding this matter. Studies indicated that childhood underweight is highly prevalent among poorer households with lower parental education and mothers' engaged in physical labour jobs in the Bangladeshi context (Chowdhury et al., 2018a; Das & Gulshan, 2017). Also, the rate of underweight reduction varied across regions, by urbanity and even the demographic structure of Bangladeshi households (Chowdhury et al., 2018a; Das & Gulshan, 2017; Nguyen et al., 2021). Although a number of studies are available addressing risk factors associated with childhood underweight, equity analysis of underweight has received less attention in the context of Bangladesh (Chowdhury et al., 2018a; GED, 2020; MoHFW, 2017). Furthermore, socio-economic inequities in childhood undernutrition are increasingly attracting the attention of researchers and policymakers in line with SDGs target to reduce inequality for all.

1.2 Objectives of the Study

The objective of the study is to assess the prevalence and inequities of childhood underweight situation in Bangladesh using the latest five rounds of the Bangladesh Demographic and Health Survey (BDHS) dataset. Moreover, we have decomposed a set of potential factors that are potentially contributing to socio-economic inequalities of underweight in Bangladesh to adopt the appropriate strategies targeting the vulnerable groups of utmost need. The specific objectives of this study are:

- i. to assess the trend of childhood undernutrition status among the Bangladeshi children,
- ii. to examine the inequality of childhood undernutrition status, and
- iii. to sort out the contributing factors of childhood undernutrition using decomposition analysis.

CHAPTER 2

METHODOLOGY

2.1 Study Design and Sample

Data were extracted from the Bangladesh Demographic and Health Survey (BDHS) for the five rounds from 2004, 2007, 2011, 2014 and 2017-18 for measuring child underweight, trends in socio-economic inequalities and conducting decomposition analysis. BDHS survey is a nationally representative cross-sectional survey and covers the entire population residing in non-institutional dwelling units in the country (Indicators, 2019). The surveys were conducted by the National Institute of Population Research and Training (NIPORT) under the Ministry of Health and Family Welfare in Bangladesh. A two-stage stratified sampling method, based on the Population and Housing Census framework provided by the Bangladesh Bureau of Statistics (BBS), was used to obtain a nationally representative sample of households. The women aged 15 to 49 years with at least one child were included as the study population. The number of such women interviewed in the BDHS 2004, 2007, 2011, 2014 and 2017-18 were 6912, 5997, 8716, 8034 and 8634, respectively.

2.2 Variables

Data concerning the weight were obtained from children under five. Childhood underweight is measured by weight-for-age z-score according to World Health Organization (WHO) guidelines (Chowdhury et al., 2018a; Shetty, 2003), where a child is considered underweight if their weight-for-age score is below two standard deviations (-2 SD) from the median of the reference population (Chowdhury et al., 2018a; Das & Gulshan, 2017; Rahman, Chowdhury, Karim, & Ahmed, 2008). Based on the published literature and this dataset, a number of explanatory variables, such as age, sex and birth order and illness status of the children, mother's BMI, age at first birth, educational and working status, household size, source of drinking water, access to toilet facility, place of residence, exposure to mass media, divisions and wealth index were included in and the decomposition analysis (Chowdhury et al., 2018a, 2018b; Huda, Hayes, El Arifeen, & Dibley, 2018; Islam et al., 2020; Khanam, Shimul, & Sarker, 2019; Nguyen et al., 2021; Rahman, Chowdhury, Karim, & Ahmed, 2008; Sarker et al., 2020; Win, Wallenborn, Probst-Hensch, & Fink, 2021). Maternal education was categorised into four levels: no education, primary level of education, secondary education and higher education. The other categorical variables used in this study are birth order, BMI, household size, and wealth index. Childhood Illness, mothers' working status, source of drinking water, toilet facility, place of residence and mass media exposure were dichotomous variables and defined as 'Yes' if child, mother and household had experienced or access to

these variables and 'No' if the experience or service was not availed. Since information on household income or expenditure is unavailable in BDHS, a household asset-based wealth index was utilised as a proxy to assess households' economic status (Sarker et al., 2020). Using principal component analysis (PCA), a wealth index was generated by using durable household assets (e.g., radio, television, mobile phone, refrigerator, almirah, water pump, and computer) and household characteristics (e.g., drinking water sources, toilet types, cooking fuel types, floor, wall, and roof materials) that are related to wealth; and categorised into five quintiles: poorest, poorer, middle, richer, and richest.

2.3 Measurement and Analysis

The analysis of inequality was conducted in three steps: first, plotting the concentration curve; second, calculating the concentration index for the five survey rounds; and finally, decomposing the concentration index on different socio-economic variables. Furthermore, to explore the socio-economic factors contributing to the inequity trend in underweight children, elasticity and the absolute and percentage contribution were calculated to understand their respective impacts on the observed inequity.

2.4 Concentration Curve

Concentration Curve and Index are widely regarded as the optimal measure of health inequality, as they satisfy three essential criteria: i) capturing the socio-economic dimension of health disparities, ii) incorporating the experiences of the entire population, and iii) finally being sensitive in the distribution of the population across socio-economic groups (Wagstaff, Paci, & van Doorslaer, 1991). The concentration curve displays the relationship between the cumulative percentage of health variable (y-axis) and the cumulative percentage of the population ranked by wealth index (x-axis) (O'Donnell, van Doorslaer, Wagstaf, & Lindelow, 2008; Sarker et al., 2020; Wagstaff et al., 1991; World Bank, 2023a; Zere & McIntyre, 2003). In this study, the concentration curve plotted the cumulative percentage of the children underweight status (y axis) against the cumulative percentage of the population, ranked by wealth status, beginning with the poorest and ending with the richest (x-axis). The diagonal line at a 45° angle means that there is perfect equity in childhood underweight with respect to the wealth index (O'Donnell et al., 2008; Sarker et al., 2020). Deviation of the curve from this line indicates the level of health inequality. When the curve is below the line, the outcome is concentrated among individuals with higher wealth or socio-economic status, while being above the line indicates a concentration among individuals with poor wealth and lower socio-economic status (Sarker et al., 2020; Zere & McIntyre, 2003; Zhang & Wang, 2007).

2.5 Concentration Index

The Concentration Index (CI) is derived from the concentration curve and the area between the concentration curve and the line of perfect equality and is defined as twice the area between concentration curves and equity line (Huda et al., 2018; Sarker et al., 2020). A simple formula for concentration index

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

Where **CI** is the concentration index, **h** is the childhood underweight, **r** is the fractional rank of the individual in the distribution of wealth index, μ is the mean of the child underweight variables, and **cov** is the covariance. This index measures the severity of socio-economic inequality ranging from values -1 to +1, where -1 refers to the case where malnutrition is fully concentrated among the poorest quintile, and +1 refers to the case where malnutrition is fully concentrated among the richest quintile (Islam et al., 2020; Sarker et al., 2020; Zere & McIntyre, 2003; Zhang & Wang, 2007). When the concentration index (CI) takes the value zero, the concentration curve aligns with the diagonal line, it means there is no socio-economic inequality (Huda et al., 2018; Sarker et al., 2020; Zhang & Wang, 2007). A negative CI suggests that the curve lies above the equity line (45-degree line) and outcome variable (underweight children in this case) is disproportionately concentrated among the lower socio-economic strata or the poor, while a positive CI indicates that the curves lie below the equity line and burden of underweight children is disproportionately concentrated among the wealthier population (Huda et al., 2018; Sarker et al., 2020; Zere & McIntyre, 2003; Zhang & Wang, 2007).

2.6 Decomposition of Socio-economic Inequalities

The Concentration Indexes (CI) were decomposed to realise the contribution of individual and socio-economic factors on childhood underweight (Kien et al., 2016; O'Donnell et al., 2008; Sarker et al., 2020; Wagstaff, Van Doorslaer, & Watanabe, 2003). The regression model that relates the health outcome (y) to a set of k determinants (x_k) can be expressed as follows:

$$y = \alpha + \sum_k \beta_k x_k + \varepsilon \quad (2)$$

In the above equation, β_k is the coefficient of x_k , and ε is the error term. The concentration index of the health outcome or, in this study, the underweight status of children (y) is denoted as C , and can be written as follows:

$$C = \sum_k (\beta_k \bar{x}_k / \mu) C_k + GC_\varepsilon / \mu \quad (3)$$

Here, μ is the mean of health outcome variable (y); \bar{x}_k is the mean of x_k (k^{th} determinant variable); the concentration index of x_k is denoted by C_k and GC_ε is the generalised

concentration for the error term (ϵ). $\frac{\beta_k \bar{x}_k}{\mu}$ denotes the elasticity of the underweight with respect to the explanatory variables (i.e., mothers' educational status, wealth index, etc.). To be specific, this quantity indicates the amount of change in dependent variables (i.e., weight-for-age) related to the one-unit change in the explanatory variables. Decomposition analyses were done for all of the underweight children under five years of age for the year 2017-18. Multivariable analyses were conducted, and results were presented in terms of the estimated elasticity, concentration index, absolute contributions (in the same unit as the concentration index) and percentage contributions (i.e., adjusted percentage contributions to inequality) for each of the explanatory variables.

2.7 Percentage Changes in Undernutrition

Percentage changes in prevalence of underweight from 2004 to 2017-18 were calculated using the below formula:

$$\text{Percentage change} = \frac{(\text{Prevalence at the current year} - \text{Prevalence at the base year})}{\text{Prevalence at the base year}} \times 100$$

The base year for this calculation is 2004, and the current year is 2017-18.

On the other hand, the annual percentage change in the prevalence of undernutrition was calculated based on the following formula:

$$\text{Annual percentage change} = \left(\left(\frac{\text{Prevalence at the current year}}{\text{Prevalence at the base year}} \right)^{\frac{1}{\text{No. of years}}} - 1 \right) \times 100$$

The statistical analyses were performed using Stata SE-13 software (Stata Corp LP, College Station, United States of America). The analysis was adjusted based on the recommended sampling weights provided by Bangladesh Demographic Health Survey (BDHS) guidelines.

2.8 Ethical Approval

The BDHS dataset is publicly available, yet access to it requires approval from the Measure Demographic and Health Survey (DHS) program office. Moreover, the DHS ensures that written informed consent was obtained from all participants involved in their survey.

CHAPTER 3

RESULTS

3.1 Background Characteristics

The socio-demographic, maternal, and household characteristics of the study participants from five different time periods are outlined in Table 3.1. This study analysed nutritional data from a total of 38,294 children under the age of five. The distribution of male and female children was fairly equal in each survey round. Significantly, a noticeable decrease in the prevalence of childhood illness was observed from 2004 to 2017-18, with rates decreasing from 43.39% to 34.52%. Over the same period, various maternal-related indicators displayed positive trends. The proportion of mothers giving birth before the age of 18 of their first child significantly decreased (60.19% in 2004 to 43.49% in 2017-18), and maternal educational attainment at the secondary and higher levels also saw a substantial growth (30.56% in 2004 to 63.8% in 2017-18). Moreover, maternal educational attainment at the secondary and higher levels also saw a substantial growth (30.56% in 2004 to 63.8% in 2017-18), and the percentage of working mothers experienced a significant increase (17.97% in 2004 to 40.73% in 2017-18) in these fourteen years. Access to safe drinking water from improved sources, such as tube wells and deep wells, was nearly universal in households. In 2017-18, approximately 60.47 per cent of households reported improved toilet facilities. Although the majority of the population resided in rural areas, the percentage of urban inhabitants steadily increased with each successive survey year, as indicated in Table 3.1. However, the growth in the percentage of people with mass media exposure was relatively slow, with only a 3.17 per cent increase over the course of the five survey rounds.

Table 3.1: Distribution of Socio-demographic, Maternal, and Household Characteristics among Under-Five Children in Bangladesh (N=38,294)

Characteristics	2004		2007		2011		2014		2017-18	
	N	%	N	%	N	%	N	%	N	%
Children's age in month										
<6 months	707	10.22	495	8.25	827	9.49	665	8.28	917	10.63
6-12 months	724	10.47	692	11.55	1033	11.85	1027	12.78	978	11.32
13-23 months	1220	17.64	1123	18.72	1441	16.53	1522	18.94	1563	18.11
24-35 months	1401	20.26	1229	20.48	1598	18.34	1640	20.41	1745	20.21
36-47 months	1459	21.10	1218	20.32	1958	22.46	1600	19.91	1704	19.73
48-59 months	1403	20.29	1241	20.68	1859	21.33	1582	19.68	1727	20.00
Sex of Child										
Male	3507	50.74	2982	49.73	4448	51.03	4185	52.10	4511	52.25
Female	3405	49.26	3015	50.27	4268	48.97	3849	47.90	4123	47.75

(Contd. Table 3.1)

Characteristics	2004		2007		2011		2014		2017-18	
	N	%	N	%	N	%	N	%	N	%
Birth order										
First	1966	28.44	1997	33.30	3052	35.02	3080	38.33	3305	38.28
Second	1757	25.41	1562	26.05	2536	29.10	2423	30.16	2771	32.10
Third	1257	18.18	1008	16.80	1518	17.42	1301	16.19	1462	16.94
Fourth or more	1933	27.97	1430	23.85	1609	18.46	1231	15.32	1095	12.68
Childhood illness										
No	3913	56.61	3531	58.87	5410	62.07	4899	60.97	5654	65.48
Yes	2999	43.39	2467	41.13	3306	37.93	3135	39.03	2980	34.52
Mothers' educational status										
No education	2660	38.49	1649	27.49	1770	20.31	1323	16.47	638	7.38
Primary education	2140	30.95	1892	31.55	2691	30.87	2244	27.93	2488	28.82
Secondary education	1778	25.73	2094	34.92	3649	41.87	3716	46.26	4182	48.43
Higher education	334	4.83	363	6.05	606	6.95	751	9.34	1327	15.37
Mothers age at first birth										
Less than 18 years	4160	60.19	3195	53.28	4429	50.82	3663	45.59	3755	43.49
18-24 years	2559	37.02	2604	43.42	3919	44.96	3989	49.65	4454	51.59
25 years or above	193	2.80	198	3.30	368	4.22	383	4.76	424	4.91
Mothers working status										
No	5670	82.03	4404	73.43	7877	90.38	5908	73.54	5117	59.27
Yes	1242	17.97	1593	26.57	839	9.62	2126	26.46	3516	40.73
Mothers Body Mass Index (BMI)										
Underweight	2570	37.18	1922	32.05	2356	27.03	1754	21.83	1177	13.63
Normal Weight	3892	56.30	3556	59.29	5177	59.40	4750	59.12	5123	59.33
Overweight	307	4.45	406	6.77	847	9.72	1230	15.31	1742	20.18
Obese	143	2.07	114	1.90	336	3.86	301	3.74	592	6.86
Household size										
Small (<4 members)	673	9.74	610	10.17	916	10.51	965	12.02	1135	13.15
Medium (4-6 members)	3565	51.57	3241	54.03	4876	55.94	4576	56.95	4813	55.75
Large (>6 members)	2675	38.69	2147	35.79	2924	33.55	2493	31.03	2685	31.10
Source of drinking water										
Improved water sources	6753	97.79	5204	96.68	7718	98.55	7160	97.57	7491	98.36
Non-improved water sources	152	2.21	178	3.32	113	1.45	178	2.43	125	1.64
Toilet facility										
Hygienic toilet facility	3883	56.18	2218	36.98	4180	47.95	5058	62.96	5221	60.47
Unhygienic toilet facility	3029	43.82	3780	63.02	4536	52.05	2976	37.04	3413	39.53
Place of residence										
Urban	1373	19.86	1236	20.61	1938	22.23	2039	25.37	2361	27.34
Rural	5540	80.14	4761	79.39	6778	77.77	5996	74.63	6273	72.66
Division										
Dhaka	2144	31.02	1888	31.48	2699	30.97	2814	35.03	2230	25.83
Chattogram	1519	21.97	1318	21.97	2011	23.07	1735	21.60	1797	20.81
Rajshahi	1531	22.15	1295	21.59	1142	13.10	824	10.26	718	8.31
Rangpur	-	-	-	-	674	7.74	808	10.05	905	10.48
Khulna	723	10.46	574	9.57	785	9.00	605	7.53	791	9.16

(Contd. Table 3.1)

Characteristics	2004		2007		2011		2014		2017-18	
	N	%	N	%	N	%	N	%	N	%
Mymensingh	-	-	-	-	-	-	-	-	709	8.21
Sylhet	589	8.52	544	9.07	923	10.59	794	9.88	1004	11.63
Barishal	407	5.88	379	6.32	482	5.53	455	5.66	481	5.57
Mass media exposure										
Have access	2712	39.23	2529	42.17	3237	37.14	3205	39.89	3661	42.40
No access	4201	60.77	3468	57.83	5479	62.86	4829	60.11	4973	57.60
Wealth index										
Poorest	1778	25.72	1351	22.52	2055	23.57	1825	22.71	1860	21.54
Poorer	1424	20.60	1302	21.71	1781	20.43	1536	19.12	1753	20.30
Middle	1351	19.54	1165	19.42	1685	19.34	1556	19.37	1620	18.77
Richer	1229	17.77	1135	18.93	1670	19.16	1591	19.80	1734	20.08
Richest	1132	16.37	1045	17.42	1526	17.50	1526	18.99	1667	19.30
Total	6,912	18.05	5,997	15.66	8,716	22.76	8,034	20.98	8,634	22.55

3.2 Trends in Childhood Undernutrition

The prevalence of childhood underweight over the five survey years has been illustrated in Table 3.2. We observed a substantial reduction in underweight children, plummeting from 42.44 per cent in 2004 to 21.74 per cent in 2017-18 in Bangladesh. The overall change in underweight prevalence amounts to 48.77 per cent %, with an annual decline rate of 4.38%. The annual decline percentage was notably higher for children aged 6 to 12 months (5.60%), those between 13 to 23 months (5.79%), and male children (4.43%). The annual declining rate was lowest among the fourth and more birth order children (2.99%). The annual percentage change in the reduction of child underweight is lower for small households (2.98%), households with non-improved drinking water sources (2.89%) and households with mothers having no education (2.31%). In fact, the declining percentages are highest among the under-five children for the wealthiest households (4.75%) and lowest among poorer households (3.97%). The study also reveals significant regional disparities in the prevalence of childhood underweight. Specifically, children residing in the Mymensingh, Rajshahi, and Barishal divisions exhibit higher rates of underweight compared to those in the Dhaka, Chattogram, and Khulna divisions. The elevated underweight rates in these regions can be attributed to challenging socio-economic conditions, a limited skilled workforce, and prevalent maternal health issues, all of which contribute to an increased risk of being underweight among children under five in these areas.

Table 3.2: Prevalence of Childhood Underweight across Background Characteristics from 2004 to 2017- 2018

Characteristics	Underweight							
	2004	2007	2011	2014	2017-18	Percentage change	Annual Percentage Change	P-value (Base year vs. Current year)
Children's age in month								
<6 months	27.40	28.50	15.92	19.14	15.51	43.39	-3.74	0.006
6-12 months	33.27	28.28	25.65	22.05	14.07	57.71	-5.60	0.000
13-23 months	45.85	39.32	35.77	32.03	18.82	58.95	-5.79	0.000
24-35 months	45.84	44.47	39.43	36.63	24.24	47.12	-4.18	0.000
36-47 months	44.70	46.82	42.94	37.12	26.09	41.63	-3.54	0.000
48-59 months	46.33	46.01	41.31	37.68	25.85	44.20	-3.83	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Sex of Child								
Male	42.55	39.59	34.17	32.14	21.65	49.12	-4.43	0.000
Female	42.33	42.08	38.25	33.18	21.83	48.43	-4.34	0.000
<i>P-value</i>	<i>0.807</i>	<i>0.101</i>	<i>0.004</i>	<i>0.482</i>	<i>0.700</i>			
Birth order								
First	40.03	37.60	32.52	28.76	19.97	50.11	-4.55	0.000
Second	38.49	40.40	33.41	32.84	20.61	46.45	-4.10	0.000
Third	43.07	40.42	36.90	33.95	21.28	50.59	-4.61	0.000
Fourth or more	48.33	46.20	46.57	40.65	30.70	36.48	-2.99	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Childhood illness								
No	39.99	38.38	33.56	30.94	20.36	49.09	-4.42	0.000
Yes	45.24	44.04	40.12	35.10	24.15	46.62	-4.12	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Mothers' educational status								
No education	50.72	46.86	48.81	41.89	35.78	29.46	-2.31	0.000
Primary education	43.09	46.37	42.18	39.04	26.55	38.38	-3.19	0.000
Secondary education	34.93	35.03	28.96	28.48	20.36	41.71	-3.55	0.000
Higher education	15.92	20.36	17.27	17.97	10.68	32.91	-2.64	0.170
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Mothers age at first birth								
Less than 18 years	44.37	43.88	40.18	36.48	24.21	45.44	-3.98	0.000
18-24 years	39.74	37.45	32.70	30.24	20.24	49.07	-4.42	0.000
25 years or above	36.15	37.08	24.97	20.52	15.85	56.15	-5.37	0.006
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Mothers working status								
No	42.03	39.67	36.38	30.46	20.44	51.37	-4.72	0.000
Yes	44.36	44.06	34.14	38.76	23.66	46.66	-4.12	0.000
<i>P-value</i>	<i>0.029</i>	<i>0.009</i>	<i>0.870</i>	<i>0.000</i>	<i>0.003</i>			
Mothers BMI (Body Mass Index)								
Underweight	53.32	51.37	50.02	45.47	31.39	41.13	-3.49	0.000
Normal Weight	37.85	38.35	32.98	31.92	22.02	41.82	-3.56	0.000

(Contd. Table 3.2)

Characteristics	Underweight							
	2004	2007	2011	2014	2017-18	Percentage change	Annual Percentage Change	P-value (Base year vs. Current year)
Overweight	16.98	17.14	19.83	19.93	16.65	1.94	-0.13	0.478
Obese	21.22	18.74	22.54	19.09	12.99	38.78	-3.23	0.206
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Household size								
Small (<4 members)	34.97	40.64	37.53	29.62	22.26	36.35	-2.98	0.002
Medium (4-6 members)	44.46	41.60	37.32	33.24	22.18	50.11	-4.55	0.000
Large (>6 members)	41.52	39.74	33.89	32.64	20.73	50.07	-4.55	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.537</i>	<i>0.010</i>	<i>0.401</i>	<i>0.609</i>			
Source of drinking water								
Improved water sources	42.42	41.09	36.78	32.63	22.15	47.78	-4.26	0.000
Non-improved water sources	43.90	44.23	51.42	40.25	28.34	35.44	-2.89	0.071
<i>P-value</i>	<i>0.411</i>	<i>0.236</i>	<i>0.002</i>	<i>0.026</i>	<i>0.116</i>			
Toilet facility								
Hygienic toilet facility	36.52	35.69	30.82	29.37	19.65	46.19	-4.07	0.000
Unhygienic toilet facility	50.18	43.96	41.16	38.34	24.92	50.34	-4.58	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Place of residence								
Urban	37.32	33.32	27.84	26.25	19.03	49.01	-4.41	0.000
Rural	43.69	42.85	38.54	34.79	22.71	48.02	-4.29	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Division								
Dhaka	41.98	39.82	36.30	28.42	18.43	56.10	-5.37	0.000
Chattogram	45.44	41.25	37.24	35.79	21.04	53.70	-5.03	0.000
Rajshahi	42.70	43.10	34.11	32.28	25.64	39.95	-3.36	0.000
Rangpur			45.25	39.99	20.08	55.62	-5.30	0.000
Khulna	35.02	34.27	28.79	25.56	18.95	45.89	-4.03	0.001
Mymensingh					32.61			
Sylhet	46.65	41.59	34.40	37.13	22.98	50.74	-4.63	0.000
Barishal	40.49	45.67	39.28	36.51	22.45	44.55	-3.87	0.002
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Mass media exposure								
Have access	33.73	33.84	27.70	23.99	18.73	44.47	-3.86	0.000
No access	48.18	46.06	41.25	38.51	23.95	50.29	-4.58	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Wealth index								
Poorest	55.66	50.31	50.30	45.45	28.76	48.33	-4.33	0.000
Poorer	46.82	45.85	41.77	38.64	25.56	45.41	-3.97	0.000
Middle	38.46	41.19	35.45	31.97	19.99	48.02	-4.29	0.000
Richer	38.62	37.73	27.75	27.34	20.64	46.56	-4.11	0.000
Richest	25.74	25.80	20.61	17.44	12.44	51.67	-4.75	0.000
<i>P-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>			
Overall	42.44	40.84	36.17	32.64	21.74	48.77	-4.38	0.000

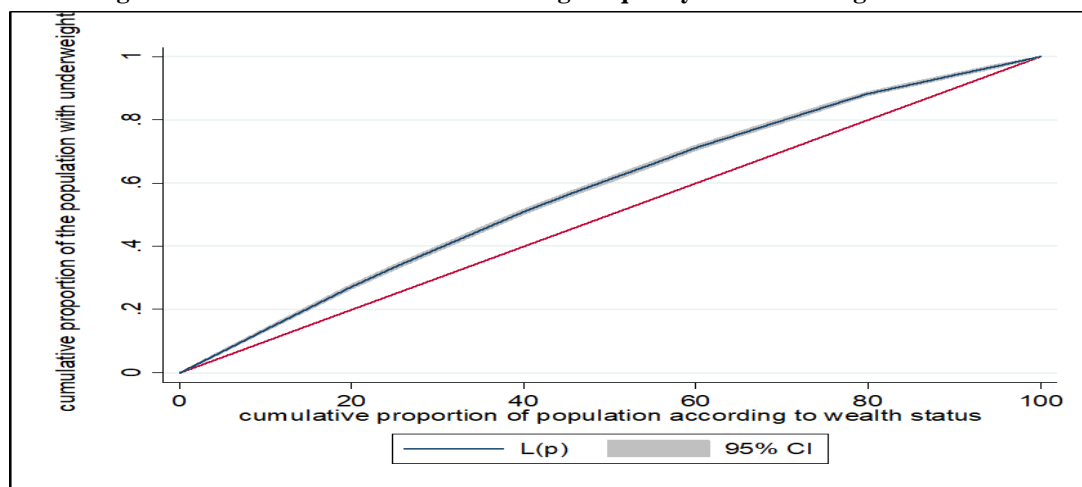
3.3 Trends in Socio-economic Inequalities in Childhood Undernutrition

Socio-economic disparities in underweight prevalence, as measured by concentration indices (CI) with robust standard errors, are detailed in Table 3.3. An analysis of the concentration indices across the five survey periods spanning from 2004 to 2017-18 exhibits negative values indicating that childhood underweight is concentrated within economically disadvantaged households. For instance, in the 2017-18 survey period, the value of CI was -0.176, the lowest among all survey periods, suggesting an improvement in the scenario of inequality. However, the concentration curve still lies above the equity line (Figure 3.1).

Table 3.3: Concentration Index of Childhood Underweight from 2004 to 2017-18

2004		2007		2011		2014		2017-18	
CI	Robust standard error	CI	Robust standard error	CI	Robust standard error	CI	Robust standard error	CI	Robust standard error
-0.224	0.015	-0.185	0.016	-0.256	0.013	-0.247	0.014	-0.176	0.015

Figure 3.1: Concentration Curve Showing Inequality for Underweight in 2017-18



3.4 Decomposition of Childhood Underweight Inequality in 2017-18

Table 3.4 explores the contributions of various socio-economic and demographic variables on the prevalence of childhood underweight inequity during 2017-18. The tables present the results of elasticity analysis, the concentration index of the regressors (CI), absolute, and the percentage contribution of regressors to the inequality of undernutrition. The column ‘Elasticity’ indicates the change in the dependent variable associated with a one-unit change in the outcome variables. A positive or negative sign in elasticity indicates an increasing or decreasing change in childhood undernutrition in association with a positive change in the determinant.

Table 3.4: Decomposition Analysis Socio-demographic Characteristics for Underweight Children, 2017-18

Background Characteristics	Elasticity	Concentration Index (CI)	Absolute contribution	Percentage contribution
Children's age in month				
<6 months (ref.)				
6-12 months	-0.003	-0.006	0.0001	-0.059
13-23 months	0.003	0.004	0.0001	-0.034
24-35 months	0.016	0.002	0.0001	-0.085
36-47 months	0.018	0.004	0.0003	-0.203
48-59 months	0.019	0	0.0001	0.001
Total			0.0007	-0.38
Birth order				
First (ref.)				
Second	0.001	0.051	0.0001	-0.223
Third	0.001	-0.043	0.0001	0.131
Fourth or more	0.006	-0.121	-0.003	2.266
Total			-0.0028	2.174
Childhood illness				
Yes (ref.)				
Total	-0.029	0.04	-0.005	3.692
Mothers' educational status				
Higher education (ref.)				
No education	0.011	-0.099	-0.004	3.473
Primary education	0.027	-0.299	-0.032	24.783
Secondary education	0.028	0.082	0.009	-7.225
Total			-0.027	21.031
Mothers' age at first birth				
18-24 years (ref.)				
Less than 18 years	0	-0.245	0.0001	-0.121
25 years or above	0.001	0.089	0.0002	-0.242
Total			0.0003	-0.363
Mothers working status				
Yes	-0.001	-0.256	0.001	-0.798
No (ref.)				
Mothers' BMI				
Normal Weight (ref.)				
Underweight	0.012	-0.146	-0.007	5.639
Overweight	-0.008	0.198	-0.006	4.948
Obese	-0.004	0.11	-0.002	1.375
Total			-0.015	11.962
Toilet facility				
Hygienic toilet facility (ref.)				
Unhygienic toilet facility	0.006	-0.516	-0.013	9.759
Place of residence				
Urban (ref.)				
Rural	-0.005	-0.457	0.008	-6.616
Division				
Dhaka (ref.)				
Chattogram	0.004	0.07	0.001	-0.797

(Contd. Table 3.4)

Background Characteristics	Elasticity	Concentration Index (CI)	Absolute contribution	Percentage contribution
Rajshahi	0.004	-0.086	-0.001	1.008
Rangpur	-0.002	-0.092	0.001	-0.459
Khulna	-0.001	0.039	0.0001	0.101
Mymensingh	0.011	-0.016	-0.001	0.548
Sylhet	0.002	-0.019	0.0001	0.106
Barishal	0.002	-0.078	0.0002	0.365
Total			0.0003	0.872
Mass media exposure				
No (ref.)				
Yes	0.007	0.637	0.018	-14.092
Wealth index				
Poorest	0.019	-0.695	-0.053	41.094
Poorer	0.017	-0.296	-0.02	15.861
Middle	0.009	0.015	0.001	-0.412
Richer	0.01	0.325	0.013	-10.284
Richest (ref.)				
Total			-0.059	46.259

We observed the major contributors to childhood inequality in terms of underweight include wealth index of the households, the mother's educational status and body mass index (BMI), the availability of hygienic toilet facilities, the childhood illness status and the birth order of the children. We observed that household wealth status was responsible for 46% of the total childhood underweight inequality, whereas mothers' education explained 21% of the total inequality in 2017-18. Mothers' BMI level and access to hygienic toilet facilities also had a significant contribution to the underweight inequality and accounted for 12% and 10% of the total inequality in 2017-18.

CHAPTER 4

DISCUSSION AND POLICY RECOMMENDATIONS

4.1 Discussion

Bangladesh is fervently committed to reducing childhood malnutrition, reflected in its national policies aligned with the Sustainable Development Goals (SDGs). The Health, Population, and Nutrition Targets of the Eighth Five-Year Plan (8 FYP) and the Second National Plan of Action for Nutrition 2016-2025 exemplify this dedication, aiming to lower childhood underweight to 15 per cent by 2025 (GED, 2020; MoHFW, 2017). While progress has been made in addressing malnutrition indicators, childhood undernutrition remains a crucial public health challenge (Akhtar, 2016). The current study addresses the trend of childhood undernutrition using the latest BDHS dataset, sorts out the degree of socio-economic inequality, and decomposes a set of potential factors to prioritise various interventions targeting the most vulnerable groups of utmost need.

This study revealed a consistent decline in childhood underweight prevalence, decreasing by 4.38 per cent annually from 2004 to 2017-18. This decline is evident, starting at 42.44 per cent in 2004, then 40.84 per cent in 2007, followed by 36.17 per cent in 2011, 32.64 per cent in 2014, and a significant drop to 21.74 per cent in 2017-18. However, the diminishing trend of undernutrition does not guarantee an improvement in nutritional equity for all (Khan, Krämer, Khandoker, Prüfer-Krämer, & Islam, 2011). We observed that the improvement in childhood nutrition is still more concentrated among the richer communities. In the latest 2017-18 survey, we found a negative value of the concentration index (-0.176), which indicates that children from resource-poor households were more prone to childhood undernutrition. Similar inequity scenarios were often observed in South Asian countries (UNICEF, 2015).

Higher socio-economic status further contributes to improved living conditions, potentially fostering better childcare and feeding practices, subsequently reducing the prevalence of childhood undernutrition (Wu, Yang, Yin, Zhu, & Gao, 2015). On the contrary, resource-poor households suffer from a lack of quality living standards, unfavourable environmental conditions, unaffordability and even lower utilisation of essential medical care (Kumar, Kumari, & Singh, 2015; Tette et al., 2016).

Our study showed that household wealth status accounted for almost half (46%) of the total inequality in the prevalence of childhood undernutrition. In contrast, maternal education was ranked as the second highest contributor (21%). Previous studies also indicated similar

findings, suggesting that resource-poor households and children of uneducated mothers were vulnerable to childhood undernutrition (Chen, Wu, & Coyte, 2014; Kumar et al., 2015). Affluent households often live in areas with advanced healthcare facilities, select better living conditions, and invest in nutritious food. Moreover, these households exhibit better housing arrangements, improved water and sanitation facilities, better feeding practices, and efficient transportation options--all of which correspond to increased healthcare accessibility and overall better health outcomes for children living in those households (Hong, Banta, & Betancourt, 2006; Mohsena, Mascie-Taylor, & Goto, 2010; Sarker et al., 2020; Sarma et al., 2017). Therefore, policies should address unequal wealth distribution by implementing measures such as financial protection and social safety net programs, as well as creating income-generating opportunities to tackle wealth-related inequalities across all societal segments.

Our study, much like others, emphasises the crucial role of a mother's educational status in impacting childhood undernutrition (Rabbani, Khan, & Adams, 2016). This aligns with numerous previous studies indicating a persistent negative association between higher maternal education levels and child malnutrition (Bhutta et al., 2008; Chowdhury et al., 2018b; Islam et al., 2020; Khanam et al., 2019; Oyekale, 2012; Sarker et al., 2020). Maternal education can impact childhood undernutrition through improved knowledge of healthy behaviours and sanitation practices during childcare (Das & Gulshan, 2017; Mohsena et al., 2010; Ntenda & Chuang, 2018). Higher maternal education empowers women and enhances their participation in household decision-making, ultimately resulting in reduced malnutrition indices in Bangladesh (Islam et al., 2020; Khanam et al., 2019). Therefore, it is crucial to introduce various community-based educational programs, including behaviour change messages, aiming to lessen education disparities, particularly for rural and unprivileged mothers within the community.

Other notable contributors to childhood inequality were maternal body mass index, birth order of children, childhood illness status, and access to hygienic toilet facilities. Previous research has shown that multiple births by a mother correlate with a range of health challenges, including premature deliveries, low birth weight, cerebral palsy, and inadequate breastfeeding (Kabubo-Mariara, 2009; Ntenda, 2018). These collective factors impede proper child growth, emphasising the linkage between multiple births and a higher incidence of underweight in children with increasing birth order (Khanam et al., 2019; Sarker et al., 2020).

It is a well-known fact that basic sanitation and proper personal hygiene practices can completely prevent various infectious diseases, including diarrhoeal infections (Valley, 2018). It was observed that people who used hygienic toilet facilities washed their hands with

antimicrobial soap more frequently (KG et al., 2016). In this analysis, we documented that childhood illnesses wield a significant influence on underweight outcomes. Diseases such as diarrhoea, fever, and various infections trigger reduced food intake, nutrient losses, vomiting, compromised digestion, and disruptions in metabolic equilibrium (Khanam et al., 2019; UNICEF, 2019). Furthermore, providing minimum acceptable diets (MAD) in the early stages of child growth is essential for tackling childhood undernutrition (Nguyen et al., 2013; Sheikh et al., 2019).

The study revealed that children born to mothers with underweight status faced a greater risk of undernutrition. This can be exemplified by understanding that a mother's nutritional status directly impacts her ability to breastfeed effectively (Olagnero et al., 2018). A mother lacking adequate nutrition may struggle to provide her child with sufficient nourishment, which can contribute to undernutrition in the child (Hasan, Magalhaes, Williams, & Mamun, 2016; Islam et al., 2020; Khanam et al., 2019). These study findings should be taken into account when formulating current and proposed nutritional policies to prevent inequalities in childhood undernutrition across all social strata

4.2 Limitations of the Study

The study has several limitations that need to be considered. Firstly, the data across all five survey rounds are cross-sectional, capturing a snapshot in time without tracking changes within the same households and children over time. This limitation may lead to debates about causation and correlation between outcomes and explanatory variables. Another limitation arises from the unavailability of data related to various factors that can influence childhood undernutrition inequality, such as diet, food security, childcare practices, physical exercise, and smoking behaviour of parents. These factors could potentially play a role in the observed inequalities but were not included in the analysis due to data constraints.

Lastly, the measurement of household wealth status relied on a wealth index due to the absence of data on household income and expenditures. While this index provides valuable insights, it has its limitations. Additionally, the decomposition analysis specifically focused on the 2017-18 survey, providing insights into the determinants contributing to underweight inequality during that period but not over time.

Despite these limitations, it is important to note that the study's data were drawn from a nationally representative demographic and health survey with a large randomised sample, providing robust evidence of the relationship between household socio-economic status and underweight prevalence in children. Therefore, the findings can be representative of the entire country.

4.3 Conclusion and Policy Recommendations

The study revealed a substantial reduction in childhood underweight from 42.44% in 2004 to 21.74% in 2017-18 in Bangladesh. Although the overall childhood undernutrition situation is improving, socio-economic inequalities are still prevalent in Bangladesh. The current trend of inequalities in childhood undernutrition indicates that there is a long way to go to eradicate this problem. Although we did not decompose the factors associated with childhood undernutrition, numerous factors are responsible for childhood malnutrition, and there is a lot of literature available on this topic. Economic conditions and consumption patterns are crucial for the improvement of a child's nutrition level.

Several studies have shown that socio-economic determinants such as income, ethnicity, geographical location, and intra-household parental and child-level factors play a crucial role in childhood undernutrition. We observed persistent inequities of underweight children within the Mymensingh, Rajshahi, and Barishal divisions among the poorest quintiles. The study underscores that belonging to the upper-income quintile not only provides advantages in terms of food and nutrition knowledge but is also closely associated with secondary or higher maternal education, a healthy body mass index (BMI), access to employment, and delayed childbirth. Therefore, introducing division-specific nutritional strategies and targets within the national nutrition program would assist in declining the regional child nutritional disparities. Hence, the government's target of reducing underweight among under-5 children to 15% by 2025 may be unattainable without effectively addressing the persistent inequities among divisions and quintile groups.

Although the overall childhood undernutrition situation is improving, socio-economic inequalities are still prevalent in Bangladesh. To enhance children's health and reduce disparities, investments in economic well-being and maternal education are essential. Prioritising nutrition-specific interventions, as in micronutrient supplementation and improving food and nutrient intake during pregnancy for low-income households, can play a pivotal role in achieving this goal. Additionally, the promotion of education, the expansion of employment opportunities, and nutritional awareness programs could be potential strategies for eliminating such inequality on a broader scale.

REFERENCES

- Akhtar, S. (2016). Malnutrition in South Asia—A critical reappraisal. *Critical Reviews in Food Science and Nutrition*, 56(14), 2320–2330. <https://doi.org/10.1080/10408398.2013.832143>
- Bhagowalia, P., Chen, S. E., & Masters, W. A. (2011). Effects and determinants of mild underweight among preschool children across countries and over time. *Economics and Human Biology*, 9(1), 66–77. <https://doi.org/10.1016/j.ehb.2010.05.002>
- Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E., ... & Shekar, M. (2008). What works? Interventions for maternal and child undernutrition and survival. *The Lancet*, 371(9610), 417-440.
- Caulfield, L. E., de Onis, M., Blössner, M., & Black, R. E. (2004). Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles. *The American Journal of Clinical Nutrition*, 80(1). <https://doi.org/10.1093/ajcn/80.1.193>
- Chen, L., Wu, Y., & Coyte, P. C. (2014). Income-related children's health inequality and health achievement in China. *International Journal for Equity in Health*, 13(1), 1–11. <https://doi.org/10.1186/s12939-014-0102-6>
- Chowdhury, T. R., Chakrabarty, S., Rakib, M., Saltmarsh, S., & Davis, K. A. (2018a). Socio-economic risk factors for early childhood underweight in Bangladesh. *Globalization and Health*, 14(1). <https://doi.org/10.1186/s12992-018-0372-7>
- Das, S., & Gulshan, J. (2017). Different forms of malnutrition among under five children in Bangladesh: A cross sectional study on prevalence and determinants. *BMC Nutrition*, 3(1). <https://doi.org/10.1186/s40795-016-0122-2>
- Ezzati, M., Lopez, A. D., Rodgers, A., Vander Hoorn, S., & Murray, C. J. (2002). Selected major risk factors and global and regional burden of disease. *The Lancet*, 360(9343), 1347-1360. <https://www.thelancet.com/pb-assets/Lancet/extras/02art9066web.pdf>
- General Economics Division (GED), BPC. (2020). 8th Five Year Plan July 2020- June 2025.
- Hasan, M. T., Magalhaes, R. J. S., Williams, G. M., & Mamun, A. A. (2016). Long-term changes in childhood malnutrition are associated with long-term changes in maternal BMI: Evidence from Bangladesh, 1996–2011. *The American Journal of Clinical Nutrition*, 104(4), 1121-1127.
- Headey, D., Hoddinott, J., Ali, D., Tesfaye, R., & Dereje, M. (2015). The other Asian enigma: explaining the rapid reduction of undernutrition in Bangladesh. *World Development*, 66, 749-761. <https://doi.org/10.1016/j.worlddev.2014.09.022>
- Hong, R., Banta, J. E., & Betancourt, J. A. (2006). Relationship between household wealth inequality and chronic childhood under-nutrition in Bangladesh. *International Journal for Equity in Health*, 5, 1-10. <https://doi.org/10.1186/1475-9276-5-15>
- Huda, T. M., Hayes, A., El Arifeen, S., & Dibley, M. J. (2018). Social determinants of inequalities in child undernutrition in Bangladesh: A decomposition analysis. *Maternal & Child Nutrition*, 14(1), e12440. <https://doi.org/10.1111/mcn.12440>
- Bangladesh Demographic and Health Survey 2017-18. (2019). <http://www.niport.gov.bd>

- Islam, M. R., Rahman, M. S., Rahman, M. M., Nomura, S., De Silva, A., Lanerolle, P., ... & Rahman, M. M. (2020). Reducing childhood malnutrition in Bangladesh: The importance of addressing socio-economic inequalities. *Public Health Nutrition*, 23(1), 72-82. <https://doi.org/10.1017/S136898001900140X>
- Kabubo-Mariara, J., Ndenge, G. K., & Mwabu, D. K. (2009). Determinants of children's nutritional status in Kenya: evidence from demographic and health surveys. *Journal of African Economies*, 18(3), 363-387.
- Kalbacher, D., Tigges, E., Boekstegers, P., Puls, M., Plicht, B., Eggebrecht, H., ... & Lubos, E. (2020). Underweight is associated with inferior short and long-term outcomes after MitraClip implantation: Results from the German TRAns catheter mitral valve interventions (TRAMI) registry. *American Heart Journal*, 222, 73-82. <https://doi.org/10.1016/j.ahj.2019.12.022>
- Khan, M. M. H., Krämer, A., Khandoker, A., Prüfer-Krämer, L., & Islam, A. (2011). Trends in sociodemographic and health-related indicators in Bangladesh, 1993-2007: Will inequities persist?. *Bulletin of the World Health Organization*, 89, 583-593. <https://doi.org/10.2471/blt.11.087429>
- Khanam, M., Shimul, S. N., & Sarker, A. R. (2019). Individual-, household-, and community-level determinants of childhood undernutrition in Bangladesh. *Health Services Research and Managerial Epidemiology*, 6. <https://doi.org/10.1177/2333392819876555>
- Kumar, A., Kumari, D., & Singh, A. (2015). Increasing socioeconomic inequality in childhood undernutrition in urban India: trends between 1992–93, 1998–99 and 2005–06. *Health Policy and Planning*, 30(8), 1003-1016. <https://doi.org/10.1093/heapol/czu104>
- Mahumud, R. A., Sultana, M., & Sarker, A. R. (2017). Distribution and determinants of low birth weight in developing countries. *Journal of Preventive Medicine and Public Health*, 50(1), 18. <https://doi.org/10.3961/jpmph.16.087>
- Ministry of Health and Family Welfare. (2017). Second National Plan of Action for Nutrition (2016-2025). https://bnnc.portal.gov.bd/sites/default/files/files/bnnc.portal.gov.bd/download/ddabde0d_3bfc_4e05_92fe_8ef33a73a235/2019-12-15-13-55_3e877e2d446e08834d7e1353cd4b86ffb.pdf
- Mohsena, M., Mascie-Taylor, C. N., & Goto, R. (2010). Association between socio-economic status and childhood undernutrition in Bangladesh; a comparison of possession score and poverty index. *Public Health Nutrition*, 13(10), 1498-1504.
- Nguyen, P. H., Avula, R., Ruel, M. T., Saha, K. K., Ali, D., Tran, L. M., ... & Rawat, R. (2013). Maternal and child dietary diversity are associated in Bangladesh, Vietnam, and Ethiopia¹. *The Journal of Nutrition*, 143(7), 1176-1183. <https://doi.org/10.3945/jn.112.172247>
- Nguyen, P. H., Scott, S., Khuong, L. Q., Pramanik, P., Ahmed, A., Rashid, S. F., ... & Menon, P. (2021). Adolescent birth and child undernutrition: an analysis of demographic and health surveys in Bangladesh, 1996–2017. *Annals of the New York Academy of Sciences*, 1500(1), 69-81. <https://doi.org/10.1111/nyas.14608>
- Nisbett, N., Davis, P., Yosef, S., & Akhtar, N. (2017). Bangladesh's story of change in nutrition: Strong improvements in basic and underlying determinants with an unfinished agenda for direct community level support. *Global Food Security*, 13, 21-29. <https://doi.org/10.1016/j.gfs.2017.01.005>

- Ntenda, P. A. M., & Chuang, Y. C. (2018). Analysis of individual-level and community-level effects on childhood undernutrition in Malawi. *Pediatrics & Neonatology*, *59*(4), 380-389.
- O'Donnell O, van D. E. W. A. L. M. (2008). Analysing Health Equity Using Household Survey Data. A Guide to Techniques and Their Implementation. World Bank. <https://openknowledge.worldbank.org/entities/publication/8c581d2b-ea86-56f4-8e9d-fbde5419bc2a>
- Olagnero, G., Barretto, L., Wiedemann, A., Terraza, R., Poy, M. S., & López, L. (2018). Maternal understanding regarding women nutrition during breastfeeding. *Health*, *10*(12), 1661-1672.
- Oyekale, A. S. (2012). Factors explaining acute malnutrition among under-five children in Sub-Sahara Africa (SSA). *Life Sci J*, *9*(4), 2101-7.
- Pelletier, D. L. (1994). The relationship between child anthropometry and mortality in developing countries: implications for policy, programs and future research. *The Journal of Nutrition*, *124*, 2047S-2081S.
- Pelletier, D. L., Schroeder, D. G., & Habicht, J.-P. (1994). A Methodology for Estimating the Contributions of Malnutrition to Child Mortality in Developing Countries Integration of Nutrition into BRAC Programs (INBP) View project Strategic capacity and adaptive management of multisectoral policy and programs in Africa View project. In Article in Journal of Nutrition. <https://www.researchgate.net/publication/15266955>
- Rabbani, A., Khan, A., Yusuf, S., & Adams, A. (2016). Trends and determinants of inequities in childhood stunting in Bangladesh from 1996/7 to 2014. *International Journal for Equity in Health*, *15*(1), 1-14. <https://doi.org/10.1186/s12939-016-0477-7>
- Rahman, A., Chowdhury, S., Karim, A., & Ahmed, S. (2008). Factors associated with nutritional status of children in Bangladesh: A multivariate analysis. *Demography India*, *37*(1), 95-109.
- Rezende Chrisman, J., Mattos, I. E., Koifman, R. J., Koifman, S., Moraes Mello Boccolini, P., & Meyer, A. (2016). Prevalence of very low birthweight, malformation, and low Apgar score among newborns in Brazil according to maternal urban or rural residence at birth. *Journal of Obstetrics and Gynecology Research*, *42*(5), 496-504. <https://doi.org/10.1111/jog.12946>
- Sarker, A. R., Sultana, M., Sheikh, N., Akram, R., Ali, N., Mahumud, R. A., ... & Morton, A. (2020). Inequality of childhood undernutrition in Bangladesh: A decomposition approach. *The International Journal of Health Planning and Management*, *35*(2), 441-468. <https://doi.org/10.1002/hpm.2918>
- Sarma, H., Khan, J. R., Asaduzzaman, M., Uddin, F., Tarannum, S., Hasan, M. M., ... & Ahmed, T. (2017). Factors influencing the prevalence of stunting among children aged below five years in Bangladesh. *Food and Nutrition Bulletin*, *38*(3), 291-301.
- Sheikh, N., Akram, R., Ali, N., Haque, S. R., Tisha, S., Mahumud, R. A., ... & Sultana, M. (2019). Infant and young child feeding practice, dietary diversity, associated predictors, and child health outcomes in Bangladesh. *Journal of Child Health Care*, *24*(2), 260-273. <https://doi.org/10.1177/1367493519852486>
- Shetty, P. (2003). Malnutrition and undernutrition. *Medicine*, *31*(4), 18-22.
- Tette, E. M., Sifah, E. K., Nartey, E. T., Nuro-Ameyaw, P., Tete-Donkor, P., & Biritwum, R. B. (2016). Maternal profiles and social determinants of malnutrition and the MDGs: What have we learnt?. *BMC Public Health*, *16*, 1-11. <https://doi.org/10.1186/s12889-016-2853-z>

- Unicef. (2015). Stop Stunting in South Asia: A Common Narrative on Maternal and Child Nutrition. In UNICEF South Asia Strategy 2014-2017. <https://www.unicef.org/rosa/reports/stop-stunting-south-asia-common-narrative-maternal-and-child-nutrition>
- Unicef. (2019). The state of the World's children 2019. Children. Food and Nutrition: Growing well in a changing world.
- Valley, I. N. K. (2018). Factors associated with hand washing practices among adolescents Yemeni students in Klang Valley, Malaysia. *International Journal of Public Health and Clinical Sciences*, 5(6), 164–177. <https://doi.org/10.32827/ijphcs.5.6.164>
- Wagstaff, A., Paci, P., & Van Doorslaer, E. (1991). On the measurement of inequalities in health. *Social Science & Medicine*, 33(5), 545-557. [https://doi.org/10.1016/0277-9536\(91\)90212-U](https://doi.org/10.1016/0277-9536(91)90212-U)
- Wagstaff, A., Van Doorslaer, E., & Watanabe, N. (2003). On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. *Journal of Econometrics*, 112(1), 207-223. [https://doi.org/10.1016/S0304-4076\(02\)00161-6](https://doi.org/10.1016/S0304-4076(02)00161-6)
- Walker, S. P., Grantham-McGregor, S. M., Powell, C. A., & Chang, S. M. (2000). Effects of growth restriction in early childhood on growth, IQ, and cognition at age 11 to 12 years and the benefits of nutritional supplementation and psychosocial stimulation. *The Journal of Pediatrics*, 137(1), 36-41. <https://doi.org/10.1067/mpd.2000.106227>
- WHO. (2023, April). Underweight among children under 5 years of age. THE GLOBAL HEALTH OBSERVATORY. <https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/gho-jme-global-and-regional-trends-underweight-jme-unicef-who-wb>
- Win, H., Wallenborn, J., Probst-Hensch, N., & Fink, G. (2021). Understanding urban inequalities in children's linear growth outcomes: a trend and decomposition analysis of 39,049 children in Bangladesh (2000-2018). *BMC Public Health*, 21(1), 1-18. <https://doi.org/10.1186/s12889-021-12181-x>
- World Bank. (2023a). Analyzing Health Equity: Concentration Curves. World Bank. <https://www.worldbank.org/content/dam/Worldbank/document/HDN/Health/HealthEquityCh7.pdf>
- World Bank. (2023b, May). Joint child malnutrition estimates. Prevalence of Underweight Children. <https://data.unicef.org/resources/jme-report-2023/>
- Wu, L., Yang, Z., Yin, S. A., Zhu, M., & Gao, H. (2015). The relationship between socioeconomic development and malnutrition in children younger than 5 years in China during the period 1990 to 2010. *Asia Pacific Journal of Clinical Nutrition*, 24(4), 665-673.
- Zere, E., & McIntyre, D. (2003). Inequities in under-five child malnutrition in South Africa. *International Journal for Equity in Health*, 2, 1-10. <http://www.equityhealthj.com/content/2/1/7> <http://www.equityhealthj.com/content/2/1/7>
- Zhang, Q., & Wang, Y. (2007). Using concentration index to study changes in socio-economic inequality of overweight among US adolescents between 1971 and 2002. *International Journal of Epidemiology*, 36(4), 916-925. <https://doi.org/10.1093/ije/dym064>



Bangladesh Institute of Development Studies
E-17, Agargaon, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh
Tel: 88 02 58160430-37, Email: info@bids.org.bd, Web: www.bids.org.bd